California Department of
Community Services & Development

# Assembly Bill 1232 Report & Action Plan

Cap and Trade Dollars at Work

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# Section 1 - Introduction

Traditional federal, state, and local weatherization programs have been in existence since the early to mid-1970s as a governmental response to higher energy costs associated with the energy crisis. Weatherization programs have typically provided low-income households with simple energy conservation measures such as caulking, weatherstripping, ceiling, wall, and floor insulation, and heating and cooling repairs and improvements at no cost. These improvements are designed to help reduce household energy usage and utility costs, which allows occupants to stretch limited financial resources to pay for other necessities such as food and medicine. These services also include basic health and safety checks and preventative measures and have served to improve the energy efficiency, health, safety, comfort, and quality of living in low-income households for almost 50 years.

As weatherization programs have matured, services have expanded to include more advanced energy efficiency measures as well as solar renewable photovoltaic installations. These comprehensive program offerings further the original programmatic goals of reducing energy usage and cost. In addition to these energy-related direct benefits, these services have also been found to provide significant additional health-related benefits. Referred to as “co-benefits,” weatherization programs improve indoor air quality and contribute to positive health outcomes for residents through the reduction of asthma triggers, respiratory issues, stress, and other health concerns. Additionally, these services help to improve climate resiliency by allowing vulnerable individuals to stay cool, comfortable, and safe during increasingly frequent high-heat events.

The recognition of the health benefits related to home energy performance retrofits has come to be referred to as a “Healthy Homes” approach to service delivery. The Healthy Homes approach applies when enhanced energy efficiency measures are combined with an integrated and coordinated approach to services between public health professionals and energy program implementers. These enhanced measures may include the installation of other non-energy measures such as improved air filtration, pest control, safety measures to prevent slips, trips, and falls, and other home safety improvements. At its heart, the Healthy Homes initiative is a coordinated, comprehensive, and holistic approach to preventing disease and injury that can often result from housing-related hazards and deficiencies.

With the enactment of California Assembly Bill (AB) 1232 (Gloria) in 2019, the state identified the need to explore how to bring the benefits of energy and healthy home improvements to the Department of Community Services and Development’s (CSD’s) Low-Income Weatherization Program (LIWP), and in turn, the residents of low-income multi-family housing located in disadvantaged communities across the state.

AB 1232 charges CSD, the California Energy Commission (CEC) and the California Department of Public Health’s (CDPH’s) Office of Health Equity with collaborating to identify best practices from model programs and funding mechanisms and to provide a recommended action plan to deliver comprehensive energy and healthy home improvements to multi-family housing (among other requirements). CSD is submitting this report and recommended action plan in fulfillment of that requirement.

To develop this action plan, CSD and its partner agencies undertook a review of the existing LIWP Multi-Family Energy Efficiency and Renewables (LIWP Multi-Family) program component to identify how the program currently addresses occupant health, comfort, and indoor air quality as a co-benefit of its regular program offerings. Funded through the Greenhouse Gas Reduction Fund (GGRF) and targeted towards the multi-family housing segment of focus under AB 1232, LIWP Multi-Family concentrates its efforts almost exclusively on providing deep energy efficiency and solar renewable retrofits to reduce greenhouse gas (GHG) emissions and energy usage at low-income multi-family properties. While reducing GHG emissions is a primary goal of LIWP Multi-Family, the energy efficiency and renewable energy improvements supported by the program have significant health co-benefits as currently designed.

The action plan development process also involved the evaluation of relevant studies, program strategies, and models for the delivery of energy efficiency improvements that have shown to positively benefit occupant health outcomes in a variety of housing types, including multi-family. This literature review encompassed two noted Healthy Homes meta-analysis evaluations that when combined identified more than three million potentially eligible publications for consideration, reviewed over 300 articles in detail, and then thoroughly analyzed more than 50 studies to evaluate Healthy Homes approaches and the positive effects of energy efficiency and renewable energy work on occupant health outcomes. Several well-designed energy and health guidelines documents, intended as tools to help launch Healthy Homes efforts, are also reviewed and summarized within this report. After evaluating different Healthy Homes models, the collaborating agencies recommend one model, the Vermont Economic Investment Corporation Energy-Plus-Health Playbook (VEIC), that offers a scalable approach for building upon LIWP Multi-Family to advance AB 1232's goals for Healthy Homes implementation.

The Recommended Action Plan section of this report proposes a Healthy Homes model for LIWP Multi-Family that emphasizes critical principles and details the elements of the LIWP Multi-Family program approach that currently incorporate Healthy Homes practices.

The Recommended Action Plan identifies a strategic path forward to achieve a fully engaged cross-sector referral approach to services between public health professionals and CSD's LIWP Multi-Family program implementers by documenting a number of "moderate" and "substantial" enhancements for consideration. The substantial program enhancements required to achieve full cross-sector referral status involve specific actions that will be needed from other state entities to assist the program in meeting the goals of AB 1232.

Lastly, this report offers a Summary / Next Steps section that outlines the recommended actions identified in this report to move the LIWP Multi-Family program component towards a more fully-realized Healthy Homes program that features an engaged cross-sector referral process between the health and energy sectors.

# Section 2 - Assembly Bill 1232

AB 1232 (Gloria, Chapter 752, Statutes of 2019) requires CSD to coordinate with the CEC and CDPH's Office of Health Equity to identify best practices from model programs and funding mechanisms, and provide a recommended action plan by January 1, 2021, among other requirements. The purpose of this report is to meet the requirements outlined in Section 2. The text of the bill relevant to this report is as follows.

**SEC. 2. Section 12087.9 is added to the Government Code, to read:**

12087.9. By January 1, 2021, the Department of Community Services and Development shall coordinate with the California Energy Commission and the State Department of Public Health's Office of Health Equity to identify best practices from model programs and funding mechanisms, and provide a recommended action plan to do all of the following:

(a) Ensure greater cross-referral between public health agencies, the State Department of Public Health's Office of Health Equity, and the Low-Income Weatherization Program for comprehensive energy and healthy home improvements for low-income multifamily residents in disadvantaged communities.

(b) Promote projects that include energy improvements that do all of the following:

(1) Provide net financial benefits, inclusive of rent and utility costs.

(2) Provide health benefits to tenants in low-income multifamily properties.

(3) Provide increased indoor air quality and address asthma or respiratory issues triggered by mold and moisture.

(c) Create mechanisms for enforcing state energy upgrade program requirements to maintain the affordability of benefiting units to low-income tenants.

## Section 3 - Project Partners / Roles

Department of Community Services and Development

The Department of Community Services and Development (CSD) administers local community services and energy programs through a network of local service providers and regional administrators to deliver services to low-income families, individuals, and communities with the goal of helping them achieve self-sufficiency and a higher quality of life. The services and programs administered by CSD help low-income individuals and families achieve and maintain economic security, meet their home energy needs, and reduce their utility costs through energy efficiency upgrades and access to clean renewable energy.

CSD's programs include the U.S. Department of Health and Human Services Low Income Home Energy Assistance Program (LIHEAP), U.S. Department of Energy Weatherization Assistance Program (WAP), and U.S. Department of Health and Human Services Community Services Block Grant (CSBG). CSD also administers California's Low-Income Weatherization Program, one of California's Climate Investments funded by Cap-and-Trade auction proceeds.

CSD's weatherization and energy efficiency programs include LIHEAP, WAP, and LIWP. Collectively, they provide improvements to low-income housing that reduce energy use and lower energy costs for low-income individuals and families. Energy efficiency measures installed under these programs include, but are not limited to, weather-stripping, insulation, caulking, water heater blankets, fixing or replacing windows, refrigerator replacement, water heater repair/replacement, and heating and cooling system repair/replacement. The energy efficiency retrofits installed through these programs may also include the provision of renewable energy systems such as rooftop photovoltaic systems, at no cost to the low-income households served.

Energy efficient weatherization is a long-term solution to reduce the high energy burdens faced by low-income families, who pay a significantly higher percentage of their income to meet the energy needs of their homes than higher income households. Reducing energy costs for these families means that they can live more comfortably in their homes while making more of their income available for other critical expenses such as food or medicine. Additional benefits of weatherization programs include reducing pollution and GHG emissions, improving health and safety conditions, and supporting the preservation of affordable housing properties. These programs also create economic co-benefits, such as encouraging job training and workforce development opportunities oriented towards disadvantaged individuals and communities.

In 2012, California established the Greenhouse Gas Reduction Fund (GGRF), funded by Cap-and-Trade auction proceeds, and mandated that a portion of the funds be invested to benefit disadvantaged communities. The State Fiscal Year 2014-15 Budget appropriated $75 million in GGRF proceeds to CSD for the development and implementation of LIWP, an energy efficiency program administered by CSD that installs energy efficiency measures and renewable energy systems in low-income single-family and multi-family housing. Since its inception, LIWP has been appropriated a total of $212 million from the GGRF.

One of the first program components developed by CSD when LIWP was created was the LIWP Multi-Family Energy Efficiency and Renewables (LIWP Multi-Family) program component. LIWP Multi-Family is one of several LIWP program components that have evolved since the program began, including Single-Family Energy Efficiency and Solar PV, Community Solar, and Energy Efficiency and Solar PV for Farmworker Housing.

LIWP Multi-Family serves multi-family affordable housing properties occupied by low-income households throughout California. The program conducts energy audits and modeling to identify feasible energy efficiency and solar PV upgrades for installation at qualifying multi-family buildings, with assistance and incentive payments available to property owners for agreed-upon scopes of work. The low-income residents that participate in this program benefit from lower energy costs and improved living conditions. The program also helps preserve affordable housing by reducing owner operating costs, limiting the need for owners to raise rents to fund capital improvements. LIWP financial incentives for property owners are based on estimated GHG reductions and if LIWP improvements directly benefit tenants by reducing their utility costs.

LIWP Multi-Family was one of the first programs of its kind to address the “split incentive” for property owners that have been disincentivized to invest in energy efficiency improvements when the benefits – such as lower energy costs for tenants – do not accrue to the property owner. LIWP addresses this split-incentive by increasing financial incentives for property owners who fund improvements that directly benefit tenants. In master-metered properties, where one or several meters may measure the energy usage for an entire property, the property owner is billed directly by the utility company for the property’s energy consumption. Utility costs for tenants of mastered-metered rental properties is generally included in their rent, and not billed separately. As a result, the financial benefits of LIWP investments made for energy efficiency at this type of property will directly accrue to the property owner, and not necessarily the tenants, in the form of lower utility bills. These master-metered properties receive a lower level of financial incentives through LIWP Multi-Family, and while the tenants may not receive a direct financial benefit from these improvements, they still benefit from quality of life enhancements to their living conditions such as new appliances, health and safety benefits, and other non-energy efficiency property improvements that are typically made alongside a LIWP investment.

For multi-family properties in which units are individually metered for utilities, and energy bills are directly paid by the tenants, property owners receive a higher co-investment from LIWP because these investments in energy efficiency and solar PV directly benefit the low-income tenants at the property by reducing their energy costs. Through this dual approach to property owner and tenant incentives provided in LIWP Multi-Family, the benefits of these program investments are more likely to reach low-income tenants. LIWP Multi-Family has been recognized for its progressive, flexible design and has spurred efforts to emulate its approach by other low-income energy programs, including those overseen by the California Public Utilities Commission.

To learn more about programs and services offered by CSD, visit www.csd.ca.gov.

California Department of Public Health, Office of Health Equity

The California Department of Public Health's (CDPH) Office of Health Equity (OHE) was established, as authorized by Section 131019.5 of the California Health and Safety Code, to provide a key leadership role to reduce health and mental health disparities to vulnerable communities.

A priority of OHE is the building of cross-sectoral partnerships. The office works with community-based organizations and local governmental agencies to ensure that community perspectives and input help to shape a health equity lens in policies and strategic plans, recommendations, and implementation activities. OHE is organized into operational units whose focus is to strengthen the Department of Public Health's ability to advise and assist other state departments, provide data that facilitates action, and to engage partners who share our commitment to eliminate inequities in health and mental health across the state.

One of the OHE units is the Climate Change and Health Equity Unit (CCHEU), which works across agencies and departments to embed health and equity into California climate change programs and policies. CCHEU guides state investment and resource distribution to prioritize health equity and climate resilience; provides data, research, and tools to identify and reduce health effects of climate change and maximize the health equity benefits of climate action; increases the capacity of public health departments and partner agencies to work on climate change and health equity; and engages with stakeholders to increase communities' power in decision-making. CCHEU collaborated with local health departments and nonprofit partners to develop the Energy Efficiency and Health[1] guidance document for health care professionals to connect medically vulnerable residents with energy efficiency and weatherization services. CCHEU provided health equity and epidemiology expertise to this report. This document is reviewed in detail in the Literature Review section of this report.

To learn more about programs and services offered by the CDPH Office of Health Equity, visit www.cdph.ca.gov/.

California Energy Commission

The California Energy Commission (CEC) is the state's primary energy policy and planning agency. It plays a key role in crafting and implementing policies and programs related to energy efficiency, energy infrastructure planning, renewable energy, energy research, and clean transportation to create a clean energy future for California. The CEC develops both Building Energy Efficiency Standards and Appliance Efficiency Standards, assists local governments in developing energy standards beyond state standards, funds research and studies on efficient

[1] http://www.rampasthma.org/D:Web%20Siteswww.rampasthma.orgwp-contentuploads/2018/12/Energy-Efficiency-and-Health-Guide-for-Public-Health-and-Health-Care-Professionals.pdf

and carbon-free technologies in buildings, implements the state's building energy benchmarking program, and is currently assessing the potential to reduce GHG emissions 40 percent by 2030.

The CEC recognizes that disadvantaged communities, low-income households, and rural areas need more assistance than they are receiving to realize the benefits of a clean energy future. To better address barriers, the CEC attempts to view all existing and proposed energy policies and programs through an equity lens.

To learn more about the California Energy Commission, visit www.energy.ca.gov.

**Collaboration Overview**

Following the enactment of AB 1232 in October 2019, CSD convened a working group with representatives of CDPH's Office of Health Equity and the CEC to begin the process of implementing the requirements of this bill. Through regular meetings and information exchanges, CSD and its state partners identified research on energy efficiency and health, data sources, best practices, and other resources relevant to the goals of this report.

In addition, CSD consulted with subject matter experts in a variety of areas including representatives from the California Department of Fair Employment and Housing, CDPH's Indoor Air Quality Section, Three[3] (a research non-profit that conducts innovative and interdisciplinary social science research), and the LIWP Multi-Family program administrator, the Association for Energy Affordability. CSD also provided updates on the progress of the development of this report to representatives of the California Environmental Justice Alliance and the Asian Pacific Environmental Network.

CSD's ongoing partnerships with its network of local energy services providers, the California Public Utilities Commission (CPUC), the CPUC's Low-Income Oversight Board, the Energy Efficiency for All coalition, Health in All Policies (HiAP), Regional Asthma Management and Prevention (RAMP), and federal partners at the U.S. Department of Health and Human Services and U.S. Department of Energy also informed the recommendations enclosed in this report.

Finally, CSD would like to acknowledge the leadership of former Assemblymember Todd Gloria and the coalition of advocates for environmental justice and low-income tenants that supported AB 1232 and recognized the potential of LIWP to address equity issues and provide health benefits to Californians in disadvantaged communities.

# Section 4 - Low-Income Weatherization Program (LIWP) - Overview

## 4.1 Introduction

The California Department of Community Services and Development (CSD) administers the Low-Income Weatherization Program (LIWP) to provide low-income households with energy efficiency upgrades and rooftop and community solar to reduce greenhouse gas emissions. LIWP has received appropriations totaling $212 million from the GGRF since 2014. Supported by advocates for environmental justice, sustainable communities, and healthy homes, among others, LIWP plays an important role so that all Californians have the opportunity to benefit from the state's climate investments.

LIWP funds energy efficiency upgrades and solar renewable investments for both low-income single-family households and multi-family affordable housing. Complementing the primary goal of greenhouse gas emission reduction, LIWP also provides important co-benefits, such as reducing household energy bills, improving public health, creating jobs and job training opportunities, and stimulating economic activity in low-income communities.

LIWP improves household living conditions while simultaneously reducing living expenses for residents to strengthen their economic security and contributes to the health of communities through improved air quality. LIWP also helps lower operating costs for multi-family affordable housing properties, helping to preserve valuable below-market housing for low-income families.

LIWP helps make vulnerable communities more resilient to the effects of climate change by providing services that include energy efficient air conditioning or improved insulation. These services make it more affordable for low-income households to keep their homes cool and comfortable at a lower cost while protecting children and seniors from the health impacts of higher temperatures. With many low-income Californians already struggling to make ends meet and spending more of their income on housing expenses than ever before, LIWP can help by reducing energy usage and related costs to free up limited disposable income for other critical expenses. The LIWP services described above are all provided at no cost to the low-income households assisted by the program.

## 4.2 LIWP Program Components

Currently, CSD administers three distinct LIWP components that are designed to target and serve various low-income populations around the state. Each currently operating program component is described below, and links have been provided that can offer more granular program detail as needed. Two additional LIWP program components, the Single-Family Energy Efficiency and Solar PV Program (funded at $70 million) and a separate Single-Family Solar PV Program (funded at $51 million) have fully expended their allocations and have been closed out.

Since the purpose of AB 1232 is to advance best practices and a recommended action plan for a Healthy Homes approach and to increase cross-referrals between public health officials and the LIWP Multi-Family program for the benefit of low-income populations, the section describing the LIWP Multi-Family program component provides a greater level of detail on the program's objectives, goals and service impacts.

### 4.2.1 LIWP Farmworker Housing Component: Single-Family Energy Efficiency & Solar PV Program

Beginning in mid-2019, CSD launched a new LIWP program component designed to serve residents of single-family farmworker housing, one of the most vulnerable groups in the state due to the seasonal nature of their employment and low wages. Farmworker families often pay a larger share of their annual income on home energy costs and as a result often reduce spending on other critical needs to pay their energy bills. This program is focused on a 12-county area of California that houses the highest proportions of farmworker families.

LIWP's Farmworker Housing Component is designed to provide agricultural worker households with energy efficiency upgrades such as efficient heating and cooling systems, improved insulation, and climate resiliency measures such as efficient windows, appliances, lighting, solar PV, and other innovative efficiency approaches to resiliency and energy cost reduction such as fuel substitution. This program component is the only low-income single-family energy efficiency program operating in California that integrates both energy efficiency with solar renewables which can substantially impact and reduce energy costs for low-income households.

It is estimated that more than 750 households will be served with the $10.7M allocation. This program component is scheduled to sunset by the end of 2021.

To learn more about the LIWP Farmworker Housing Program Component, visit https://www.csd.ca.gov/Pages/Farmworker-Housing-Component.aspx

### 4.2.2 LIWP Community Solar Pilot

Many low-income households are unable to participate in existing solar photovoltaics (PV) programs that typically focus on placing solar systems on owner-occupied homes and multi-family buildings. Barriers include inadequate roof space, roof condition, or shading; living in a multi-family building where the property owner chooses not to install solar PV; and programs that restrict eligibility to homeowners.

Community solar offers the potential to increase access to clean renewable energy for low-income Californians who are unable to directly benefit from solar energy by sharing the production output of an off-site solar system, typically designed large enough to serve many households and other electricity users.

Through this pilot, CSD funded California's first low-income community solar project that broke ground earlier in 2020 and is scheduled for completion by the end of 2020. The project, funded by a $2.05M grant, is located in Riverside County on tribal lands donated by the Santa Rosa Band of Cahuilla Indians. This nearly 1-megawatt solar electric system is expected to generate enough electricity to power more than 200 homes, providing $5.4M in savings over 30 years through utility bill credits that benefit low-income residents on the reservation and within Anza Electric Cooperative's territory. The project will also offer solar installation training and meet specific local hiring and prevailing wage requirements.

The project is scheduled to be operational and delivering benefits by the first quarter of 2021. For more information, visit https://www.csd.ca.gov/Pages/Community-Solar-Pilot.aspx.

### 4.2.3 LIWP Multi-Family Energy Efficiency & Renewables

The LIWP Multi-Family Energy Efficiency and Renewables program component serves multi-family properties occupied by low-income households throughout California. It is the first low-income multi-family program to promote and directly incentivize building electrification and decarbonization, and the program has garnered strong support and reception by affordable housing property owners, policy makers, and notable environmental and housing advocates.

Under this effective and successful program model, CSD provides direct program oversight to the program implementer who serves as a single point of contact for marketing, outreach, and most importantly, as the provider of free technical assistance to qualifying properties. The Association for Energy Affordability (AEA) has served as the LIWP Multi-Family program implementer since the inception of the program component. The technical assistance provided is instrumental to help affordable housing property owners navigate complex deep energy efficiency retrofit projects, aid them to identify and gain access to other funds available for leveraging, and facilitate the delivery of energy efficiency and clean energy resources to historically underserved communities.

LIWP Multi-Family's approach centers around energy audits and the utilization of computer modeling to assess energy savings opportunities throughout the entire building and property as part of a scope development process. At its core, this multi-family holistic building approach uses building science and a whole building comprehensive approach to identify and recommend energy savings opportunities to address areas of energy loss that are often missed by other programs. By evaluating the whole building as a system, rather than compartmentalized unrelated areas, and by offering an incentive-based approach to improving the energy performance of entire buildings and properties, the program offers a flexibility in approach that is unique to the field of multi-family retrofits.

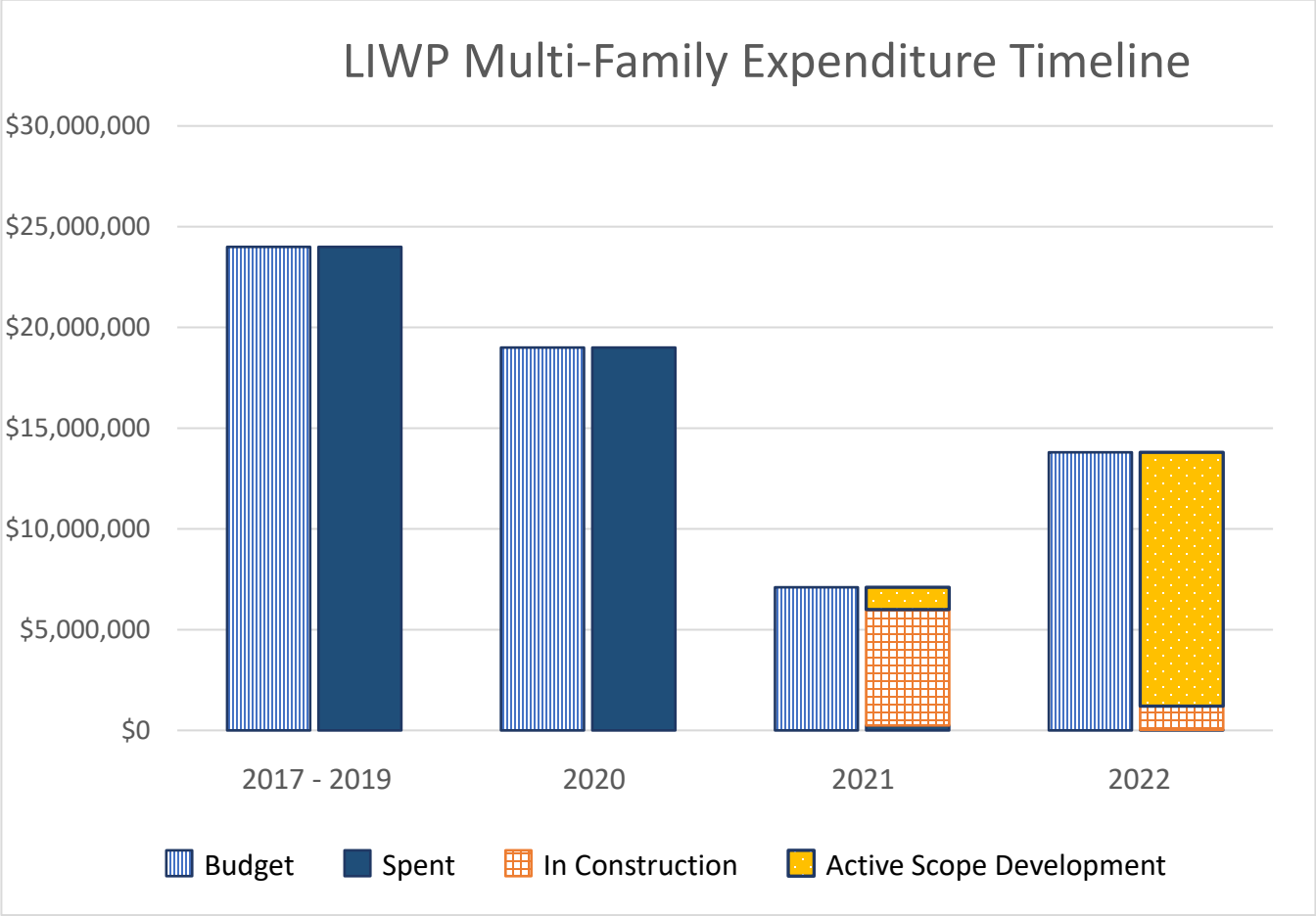
Another unique element of the LIWP Multi-Family program component is that it offers an integrated energy efficiency and solar renewable photovoltaics (PV) approach to building improvements that is the first of its kind in California. By using this integrated and interactive approach to a property's scope of work, the property owners and the program implementer are able to explore options for deeper scopes of work which reduce energy usage and greenhouse gas emissions at the property, and equally as important, reduce energy costs for the low-income residents that live there.

The flexible and comprehensive design of the program has produced remarkable results thus far with properties averaging 37 percent site energy savings from energy efficiency measures alone and 43 percent site energy savings when energy efficiency is integrated with solar PV. More than one-third of the projects completed to date are projected to save more than 45 percent

overall, including three projects that are projected to reach near net-zero energy performance (i.e., greater than 85% savings).[2]

CSD has committed $63.9M to LIWP Multi-Family over the course of the program's existence. It is expected that at least 105 properties comprising more than 12,000 units will receive technical assistance and incentives for upgrades before the program concludes in June 2022. More than 180 additional properties comprised of more than 14,000 housing units have been waitlisted and may only be served should additional funding be allocated to the program. Figure 1 below illustrates program expenditures to date and projected expenditures through 2022. Expenditure projections for waitlisted properties are dependent on the completion of a full project assessment and scope of work evaluation. In the event there is a new LIWP funding round, the investment need for waitlisted properties likely exceeds what LIWP Multi-Family has been allocated in the past, based on average property investments to date.

*Figure 1: LIWP-Multi-Family Expenditure Timeline*




[2] Equitable Electrification: Program Models that Work for Existing Low-Income Multifamily Buildings – American Council for an Energy-Efficient Economy - Summer Study on Energy Efficiency in Buildings 2020.

#### 4.2.3.1 How LIWP Multi-Family Currently Operates

LIWP Multi-Family utilizes a unique approach to incentivizing energy efficiency and solar PV improvements at affordable multi-family properties where property owners interested in the program are provided free technical assistance in the form of initial desktop project reviews, an energy audit, project scope development, and if a project qualifies for the program and is able to reserve funding, a full on-site assessment of their property.

Initial Property Qualification

Properties interested in participating in LIWP Multi-Family must meet several eligibility criteria to qualify for the program.

- Income Certification – At least 66 percent of the tenant units must qualify for the program by having incomes that do not exceed 80 percent of the Area Median Income (AMI).
- Multi-family Dwelling Type – Properties must contain buildings with 5 or more units per building.
- Project Location and AB 1550 Priority Populations – Geographic considerations are extended to priority areas such as disadvantaged communities (DACs) as identified by the California Environmental Protection Agency (CalEPA) and the Office of Environmental Health Hazard Assessment's (OEHHA) CalEnviroScreen 3.0 census tract ranking tool.
- Funding Set-Asides:
    - Priority Populations Targeting – AB 1550 requires that a percentage of LIWP Multi-Family funds be allocated to projects located within specific low-income communities, low-income households statewide and that a percentage of funds benefit low-income households located within a half mile of a DAC.
    - Five million dollars are dedicated to retrofit services for properties that house farmworkers.
    - Two million dollars are dedicated to properties that serve as homeless shelters or transitional housing.
- Modeled Savings – Properties must be able to demonstrate modeled energy savings equal to or greater than 15 percent.
    - If leveraging other major incentive programs, the project must demonstrate a minimum of 25 percent modeled energy savings.
- Affordability Covenant – Property owners must be willing to sign a covenant agreeing to maintain rent affordability to low-income occupants for at least 10 years following site improvements.
    - LIWP Multi-Family offers a path to affordability covenants for both deed-restricted properties (must have a minimum of 10 years remaining on regulatory agreements) and naturally occurring affordable housing (NOAH) properties.
    - Long-term rent affordability for low-income residents is of critical importance.

Initial Project Scoping

Once it has been determined that a property will meet the required eligibility criteria above, the program implementer initiates a remote desktop review whereby the they gather additional information about the property regarding the planned scope of the project, interest in advanced technologies and measures, information about the building's age and current energy systems, and estimated project timeline. Depending on availability of program funds and interest in proceeding, the program implementer will schedule a site visit to the property to gather additional information about the building(s) to aid in conducting a detailed energy, water, health and safety, and building durability analysis to inform the development of a full project scope.

After the site visit has been completed and energy-modeling conducted, the LIWP Multi-Family program implementer will engage the property owner in additional discussions about the building's current energy performance, and any observed structural or health and safety issues or hazards that will need to be remediated by the property owner before the project can advance to the next stage of negotiations where a potential scope of work that includes all feasible energy saving retrofit opportunities for the project is developed. Table 1 below shows a representative example of health and safety issues that may need to be addressed by property owners:

Example – Health and Safety Remediation Issues – Property Owner Responsibility

*Table 1: Health and Safety Remediation - Property Owner Responsibility*

| H&S / Indoor Air Quality (IAQ) Issues | Remediation |
|---|---|
| Mold in Ducts | Duct Cleaning or Replacement |
| Moisture and Ventilation Issues | Exhaust and Ventilation Repair or Replacement; Condensation Risk Mitigation (Moisture management strategies) |
| Gas Leaks | Repair or Replacement of Gas Lines |
| Pest (Evidence of rodents, termites, etc.) | Integrated Pest Management |
| Combustion Appliance Safety Issues (Backdrafting, spillage, etc.) | Fixing, Replacing, or Extending Flues, Appliance Replacement or Repair, Air Sealing and Pressure Balancing |

Energy Efficiency Incentive Estimation

The amount of LIWP Multi-Family incentives that a property can qualify for is determined by projected energy savings (and by extension GHG savings) as calculated through energy modeling software. Projects that achieve a minimum of 15 percent modeled energy savings improvement over the property's baseline usage qualify for LIWP Multi-Family incentives (25 percent savings required if leveraging other major incentive sources). These energy savings are then converted by formula to a metric tonnage total for GHG reductions and the LIWP incentive budget for the property is determined. Essentially, this flexible incentive methodology allows projects to target deep energy savings because any measure installed can earn incentives as long as it saves energy, and the greater the energy savings, the greater the incentive that is available to the project.

Further, incentives can be earned for energy efficiency improvements that reduce both resident utility bills as well as those paid by the property owner, however owner-benefitting improvements are incentivized at a lower rate than those targeted to low-income tenants.

Because LIWP Multi-Family can provide incentives for essentially any measures that save energy (and GHG) an exhaustive list of potential measures would be difficult to aggregate. For illustrative purposes, a list of typical measures found in the program are shown in Table 2 below and a more extensive LIWP Multi-Family List of Measures document is provided in Appendix 3 for reference.

*Table 2: Typical LIWP Multi-Family Energy Efficiency Measures*

| Example of Typical LIWP Multi-Family Energy Efficiency Measures | |
|---|---|
| Building Envelope Air Sealing | In-Unit and Common Area LED Lighting |
| Title 24 Compliant Windows | Heating and Cooling Replacement |
| Recirculation Pump Demand Controls | Tankless Gas Water Heaters |
| Heat Pump Heating, Ventilation, and Air Conditioning (HVAC) Systems | Solar Thermal Water Heaters |
| Cool Roofs | Energy Star Refrigerators |
| Attic Insulation | Duct Repairs and Sealing |
| Condensing Domestic Hot Water Heaters | Ductless Heat Pump HVACs |
| Smart Thermostats | Exterior Rigid Wall Insulation |

Solar PV Integration with Energy Efficiency

LIWP Multi-Family is the first multi-family program in California that combines comprehensive whole-building energy efficiency retrofits with renewable solar PV improvements in one program. This unique and creative approach has allowed property owners to consider deeper energy efficiency retrofit approaches that are made possible by the interactive energy savings offsets achieved by solar PV when evaluating the feasibility of long-term returns on investment. For example, LIWP Multi-Family has been able to provide opportunities to explore building electrification and fuel-substitution where gas-burning combustion appliances are converted to high-efficiency electric alternatives, and the additional electrical usage required is offset by clean, renewable solar PV generation. Not only has LIWP Multi-Family seen greater savings opportunities when using this strategy, but the indoor air quality is improved through the removal of combustion appliance particulate matter from the living spaces which makes homes safer for their occupants.

Solar PV incentives are calculated in a different manner than the energy efficiency retrofit incentives. Essentially, solar PV is incentivized at a cost per watt that is determined by the amount of other leveraged funding sources being utilized in the project and whether the solar PV will be offsetting consumption at either the tenant's meter or the common system meters that the property owner is responsible for paying. As in the energy efficiency incentive described above, owner-benefitting investments are incentivized at a lower rate than solar PV installations that benefit tenant meters.

As was mentioned in the overview section above, this integrated, flexible program design has shown impressive results and more recently has produced three properties that have demonstrated near net zero results, where the renewable electric energy generated by solar panels at the project almost completely meets the electrical energy needs of the property.

Final Project Scope of Work and Incentive Reservation Process

After the LIWP Multi-Family program implementer and property owner agree on a final scope of work the property owner is required to submit an “Incentive Reservation and Participation Agreement” form for review. This form is a critical step in this retrofit process and represents a commitment by the property owner to move forward with the installation of the agreed upon measures.

The form details all the following:

- Scope of Work – Includes all measures being installed with estimated measure incentives which depend on whether a measure is tenant or property owner benefitting (Example follows in Table 3, next page.)
- Sources Used to Fund Improvements (LIWP, Leveraged Rebates, Property Owner Payment, etc.).
- Projected dates of Completion.
- Details about documentation that will need to be submitted by the property owner once the job is completed to receive the incentive.

The Incentive Reservation form is reviewed by the program implementer and if approved it will initiate the work phase of the project.

The Scope of Work is a subsection of the incentive reservation document and for comprehensive projects can be lengthy, so for purposes of illustration CSD has provided a portion of an actual LIWP Multi-Family Energy Efficiency scope of work example below. For clarity, some of the measure detail information from the original form has been removed. A complete copy of this scope of work has been provided in Appendix 4 for reference purposes.

Of additional note, this project also included a robust solar PV installation as part of an additional project phase. More than 94 percent of the investment for the solar PV install went to fund panels that offset energy usage at tenant meters.

## Energy Efficiency Scope of Work Example

*Table 3: LIWP Multi-Family Energy Efficiency Scope of Work - Partial*

| LIWP Energy Efficiency Scope of Work | | | | | |
|---|---|---|---|---|---|
| **Measure Detail** (see measure performance requirements for full measure and installation requirements) | Energy Savings % | Annual GHG Savings ($MTCO_2$) | Owner or Tenant Savings | Incentive per **Annual** $MTCO_2$ | **Completion Date** |
| Low Flow Aerators and Showerheads | 0.3% | 0.75 | Tenant | $4,500 | 2/28/2020 |
| In-Unit LED Lighting | 1.7% | 6.37 | Tenant | $4,500 | 2/28/2020 |
| Common Area and Exterior LED Lighting | 2.0% | 6.28 | Owner | $3,000 | 2/28/2020 |
| High Efficiency Central Washing Machines | 1.6% | 3.26 | Owner | $3,000 | 2/28/2020 |
| Energy Star Rated Refrigerators | 0.1% | 0.48 | Tenant | $4,500 | 2/28/2020 |
| Attic Insulation – Triplex, Cottage, & Townhouse Units | 4.8% | 10.31 | Tenant | $4,500 | 2/28/2020 |
| Attic Insulation – Office | 0.10% | 0.13 | Owner | $3,000 | 2/28/2020 |
| Aeroseal and Professionally Clean Ductwork – Townhouse Units | 0.20% | 0.48 | Tenant | $4,500 | 2/28/2020 |
| Aeroseal and Professionally Clean Ductwork – Office | 0.00% | 0.02 | Owner | $3,000 | 2/28/2020 |
| High Efficiency Tankless Gas Water Heater – Laundry Rooms | 0.20% | 0.37 | Owner | $3,000 | 2/28/2020 |
| High Efficiency Tankless Gas Water Heater – Office | 0.40% | 0.73 | Owner | $3,000 | 2/28/2020 |
| T24 Window Replacement – Triplexes | 1.20% | 3.92 | Tenant | $4,500 | 2/28/2020 |
| Exterior Wall Insulation – Triplexes | 12.40% | 22.47 | Tenant | $4,500 | 2/28/2020 |

### Energy Efficiency and Solar PV Installation

Once the Incentive Reservation Form is approved, the property owner may commence with procuring subcontractors to bid on the work scope. It is the job of the property owner to oversee the bidding, construction timeline, to keep the LIWP Program Implementer apprised of progress, and to manage the project to avoid delays. Throughout the process, the LIWP Multi-Family program implementer is available to provide technical assistance to the property owner.

For example, as a program safeguard, the LIWP program implementer may review bids from all contractors performing work to identify and avoid excessively high project costs. Additionally, material specifications for equipment to be installed may be reviewed by the program implementer at any time to ensure consistency with the project's approved scope of work.

During the installation process, when the project is approximately 50 percent complete the property owner will contact the program implementer to schedule a Quality Assurance site visit to ensure that measures are being installed correctly. This is important because measures that are incorrectly installed may not deliver the anticipated energy savings that were estimated in the site energy audit modeling.

Post-Installation – Project Wrap-Up and Site Visit

Once a project has been reported as complete the property owner must submit a "Statement of Completion" that attests that all measures identified in the Incentive Reservation have been installed as specified, and submit additional documentation such as permits required for the project, invoices and receipts, source documentation for other funding applied to the project, and if necessitated, certain technical measures installed at the project or proof of specific diagnostic testing that is required for code compliance.

The program implementer's technical analyst will then schedule a post-inspection site visit to verify that all equipment and measures were installed correctly so that projected energy savings will be realized for the property. The technical analyst will also perform diagnostic testing where any combustion appliances were installed or were repaired as part of the project scope and verify that health & safety issues identified as part of the initial project scoping and site visit have been resolved.

Lastly, before incentives can be paid, the program implementer performs a "true-up" to adjust the LIWP incentives if there were change-orders or modifications to the scope of work during the site work. It is important to note that it is possible that incentives might be adjusted up or down depending on the specific change-orders processed during construction. For example, if a property owner opts to install a more energy efficient appliance in place of the one modeled during the energy audit stage, then the LIWP incentive for that measure will increase.

Once complete, the incentives can be paid either by check, or electronically if the property owner has selected that method. This can occur within one week to 30 days depending on the method chosen by the property owner.

#### 4.2.3.2 Program Design Strengths

The current LIWP Multi-Family program component has a number of built-in advantages that have been developed and implemented since the start of the program in early 2016. Details regarding specific advantages include:

- Whole Building Approach – Utilizing energy audit modeling is a best practice that aligns with understood building science – considering the building as a system of inter-related parts helps to design effective approaches to reducing energy usage and energy cost savings to low-income residents.
- Free Technical Assistance – Energy efficiency retrofits can be complex, and the program implementer provides a single point of contact for expert technical assistance that helps to overcome barriers to participation in the program and benefit the project throughout the entire process.
- Identification of Health & Safety Concerns – as part of the technical analyst's site visit, they will identify immediate health and safety concerns, including signs of moisture, pests, lead, asbestos, electrical hazards, or other general health and safety concerns – it is the property owners' responsibility to remediate these concerns to ensure the property is safe for its occupants before they can initiate work under LIWP Multi-Family.
- Leveraging – the program was designed to allow for ease of leveraging with other complimentary programs – this allows for layering of resources that encourage deep energy savings opportunities.
- Results Confirmation – LIWP Multi-Family is able to access and evaluate utility data to confirm retrofit results and to continually evolve and improve program approaches – known as benchmarking, this process helps to document the continued energy savings over time for the low-income residents served.

For additional information about LIWP Multi-Family, including program guidelines ,visit https://www.csd.ca.gov/Pages/Multi-Family-Energy-Efficiency-and-Renewables.aspx

# Section 5 - Literature Review

## 5.1 Introduction

Federal home weatherization programs have been in existence since the late 1970s when their creation was primarily driven as a direct response to rising energy costs due to the Organization of the Petroleum Exporting Countries (OPEC) oil embargo in 1973. While the effects of the embargo were widespread and painful for many Americans, in truth the initial warning signs of an emerging energy crisis were first experienced in the late 1960s as electricity demand in some parts of the United States began to exceed available energy resources.

Weatherization programs now often referred to as energy efficiency programs, have provided low-income residents with energy conservation measures and improvements at no cost for more than four decades. These improvements provide energy savings, create jobs, assist low-income households by freeing up scarce financial resources to help them pay for other vital necessities such as food, medicine and healthcare, and in more recent years, have been recognized as offering a way to reduce carbon emissions which lead to global climate change.

CSD has administered traditional weatherization programs like those described above for many years in the form of the federal Department of Energy Weatherization Assistance Program (DOE WAP) and the Low Income Home Energy Assistance Program (LIHEAP). The CPUC also oversees a ratepayer funded energy efficiency program that is administered by Investor Owned Utilities (IOUs) in their respective utility service areas around the state. These programs have become more technical since their inception, but the essential premise of the programs remain the same. Service implementers provide an assessment and essential diagnostic testing to identify any possible health hazards in the home and to determine a list of potential energy saving measures for installation. The services provided help to improve the health, safety, comfort, and quality of living in the homes of low-income recipients.

Examples of the types of measures that are installed as part of the health & safety and energy efficiency efforts are smoke detectors, carbon monoxide monitors, ceiling, wall and floor insulation, dual-paned efficient windows, heating and cooling repairs and replacements and infiltration reduction (e.g., caulking, weatherstripping, etc.).

In recent years, energy efficiency programs have begun to offer more comprehensive energy saving retrofits through the use of complex diagnostic testing, advanced energy audit software modeling that utilizes utility billing data and computer algorithms, and through the integration of solar renewable energy installations where feasible. An example of this type of holistic, whole-building, deep energy efficiency retrofit program is offered in Section 4.2.3 of this document where we describe the current Low-Income Weatherization Program's Multi-Family Program component.

While the energy savings of established weatherization programs has been well-documented, in recent decades there has been increasing recognition of the panoply of health benefits that can be achieved through the utilization of a "Healthy Homes" approach when providing energy efficiency and solar renewable energy improvements in homes.

In the subsections below CSD will first provide an overview of several comprehensive meta-studies that evaluate and analyze data on occupant health outcomes where households were

provided with energy efficiency or weatherization program services through a variety of approaches. In the second part of this section, CSD will offer summaries of three energy plus health program methodologies and approaches to providing Healthy Homes benefits. Lastly, a recent paper is included as part of the subsection on Integrated Healthy Homes Strategies (Section 5.4.1) that provides an analysis of current California Healthy Housing approaches and offers a series of recommendations that provide steps and long-term aspirational goals to strive for to create a comprehensive, interactive, coordinated and fully engaged Healthy Housing program that serves low-income residents of this state in a meaningful and equitable way.

## 5.2 Healthy Homes Studies - Overview

### 5.2.1 U.S. Department of Energy (DOE) and National Center for Healthy Housing (NCHH)

#### Home Rx: The Health Benefits of Home Performance – A Review of the Current Evidence (December 2016)

**Study Purpose:** This study was undertaken to summarize results from the extensive number of studies that have been conducted to evaluate the effects of residential energy efficiency and green renovation work on indoor environmental quality and occupant health. More than three million potentially eligible studies were considered for this meta-analysis, and 300 of those studies were selected for more detailed review. Additional analysis culminated in the selection of forty studies and forty-four reports that were fully explored in the review. The reports were further categorized into five specific treatment approaches and from these groupings the analysis drew conclusions as to effectiveness of approach on health outcomes.

The five general treatment regimens or groupings studied are listed below:

- **Base Energy Efficiency (BEE)** – This approach looked at energy efficiency programs that included at least two of the three core energy efficiency elements: Air sealing, insulation, and heating upgrades.
- **Enhanced Energy Efficiency (EEE)** – These studies analyzed energy efficiency programs that focused on measures such as air sealing, insulation, heating upgrades, and enhanced moisture remediation along with improved ventilation.
- **Green Renovation Construction (GRC)** – Nine studies were reviewed that evaluated programs utilizing core energy efficiency components plus enhanced ventilation, use of low-volatile organic compound (VOC) products, resilient flooring, pest management, and policies such as “No Smoking.” These programs offered more extensive remediation efforts than the two mentioned above.
- **Ventilation (VENT) –** Researchers reviewed nine studies that analyzed the effects of Enhanced Ventilation independent of other measures. In most of the studies the homes already met basic energy efficiency standards and the enhanced ventilation was applied to a subset of buildings and the results compared.
- **Potential Supplemental Home Performance Services (PSHPS)** – This study analysis looked specifically at three supplemental activities intended to improve indoor air quality through installation of in-room High-Efficiency Particulate Air (HEPA) filters, conversion of

gas stoves to electric, and replacement of standard wood stoves with more efficient, cleaner burning wood stoves.

**Study Conclusion:** The study undertook a seemingly exhaustive literature review that when summarized by the authors makes a strong argument that energy efficiency measures can improve the home living environment, which by extension improves the health of the home's occupants.

Of the treatment regimens evaluated it was determined that the Enhanced Energy Efficiency (EEE), Ventilation (VENT) and Potential Supplemental Home Performance Services (PSHPS) approaches offered the most promise with respect to showing positive health outcomes and indoor environment improvements for occupants. Health outcomes varied based on approach, but commonly observed improvements included reduced asthma symptoms (e.g., wheezing, runny nose and stuffiness), fewer unscheduled doctor visits for asthma, reductions in blood pressure, fewer coughs, throat irritation and general irritability. Improvements were likely driven by lower dust mite allergen levels in treated homes, a 50 percent decline in particulate matter for homes where HEPA filters were installed, and a measurable reduction in relative humidity and VOCs in study homes among other measured environmental conditions. Of note, each of these approaches included improved ventilation and thermal boundary performance that help to control air quality, temperature, and humidity and improve occupant comfort in the home.

### 5.2.2 E4 The Future, Inc.

#### Occupant Health Benefits of Residential Energy Efficiency – E4 The Future, Inc. (November 2016)

**Study Purpose:** Energy efficiency providers assert that the benefits of their programs extend far beyond their economic value to low-income clients, and there is growing interest in associated co-benefits including environmental sustainability, energy security, economic development and job growth, and reduced energy burden for low-income residents.

This meta-study is the product of energy efficiency experts brought together to review the currently available literature regarding programs that combine residential energy efficiency programs and health benefits for residents. According to the authors, the "*goal was to review existing research on residential energy efficiency measures and associated health impacts, discuss ways that programs monetize occupant health co-benefits, highlight innovative programs that combine energy efficiency and health-focused home repairs, and identify research gaps and strategies to help advance and leverage funding across such integrated efforts.*"

#### Potential Occupant Health Impacts from Residential Energy Efficiency

This meta-study evaluated results of 12 separate residential energy efficiency studies and two ventilation system studies and found that installation of energy efficiency measures improved occupant health, including asthma and respiratory problems, and improved the indoor environmental quality through the prevention of moisture issues and the accumulation of VOCs.

Health improvements in the energy efficiency studies included reduction in allergies, asthma, colds, sinusitis, throat irritation and wheezing. Additionally, the studies documented other health

improvements in headaches, hypertension, thermal stress and overall physical and mental health along with reduced emergency room and/or hospital visits for respiratory problems.

### Innovative Energy and Health Strategies

Energy efficiency programs are currently evaluating the potential for increased improvements in occupant health through partnerships with health professionals, including integrated energy efficiency and healthy home retrofits, energy efficiency programs that include health referrals, and through collaboration with health officials at the local level. Many programs focus on clients with pre-existing conditions and/or known housing related health risks.

Among key findings included in the report, researchers have laid out four basic activities to further promote innovative collaborations between energy efficiency programs and health professionals. These key findings called "A Road Map for Action" can be summarized as follows:

- Share Results - Distribute resident health research to energy and health professionals and encourage energy staff to include occupant health co-benefits when designing programs and in cost effectiveness considerations.
- Support innovative programs - Support energy efficiency programs that consider occupant health outcomes and engage with local health partners while promoting innovative funding, work practices, and energy plus health collaborations.
- Fill Research Gaps – Evaluate possible risks related to concentrations of radon and formaldehyde in thermally tight homes and expand research to study effects of energy efficiency in warmer climates and in a diversity of building structure types.
- Define and Share Best Practices -Promote U.S. Environmental Protection Agency (EPA) guidance on health benefits during energy efficiency upgrade visits and keep reference materials up to date regarding current research.

### Monetizing the Value of Energy Efficiency in Relation to Health Benefits

The study also documented the possible monetary value of energy efficiency non-energy impacts or non-energy benefits (NEBs) to households receiving services. One study was able to link the health benefits from energy efficiency retrofits to reduced financial outlays for low-income occupants as follows:[3]

- Reduced asthma symptoms (lower medical costs).
- Reduced cold- and heat-related thermal stress and reduced carbon monoxide (CO) poisoning (lower medical costs and fewer deaths).

[3] Massachusetts Special and Cross-Cutting Research Area: Low-Income Single-Family Health- and Safety-Related Non-Energy Impacts (NEIs) Study. August 5,2016. Accessed: 10/02/2020. https://nascsp.org/wp-content/uploads/2019/07/Mass-Low-Income-Single-Family-Health-and-Safety-Related-NonEnergy-Impacts-Study.pdf

- Reduced missed days at work (reduction in lost income).
- Reduced use of short-term, high interest loans (lower interest payments and loan fees).
- Increased home productivity due to improvements in sleep; and reduced home fires (fewer fire-related injuries, deaths, and property damage).

**Study Conclusion:** This white paper was initiated to better understand the effect of residential energy efficiency programs on occupant health and to further advance the idea that including a monetized (non-zero) value of health co-benefits resulting from energy efficiency provides a more accurate accounting of the true value of energy efficiency retrofits. Additionally, while not detailed here, the research team highlighted several programs that have undertaken innovative approaches to occupant health and energy efficiency service delivery, including common home assessment and referral tools that can be shared between the energy and health service partners to streamline service delivery and ensure that occupants receive the full measure of energy efficiency retrofits which ultimately help to improve patient health. Lastly, the paper also identified additional research opportunities that can aid in filling in "knowledge gaps" and will aid in further directing this emerging field of research.

### 5.3 Healthy Homes Strategies

At the outset of the AB 1232 project, CSD and its partners conducted research to identify possible Healthy Homes strategies that could be effectively utilized and that would complement CSD's comprehensive LIWP Multi-Family energy efficiency and solar PV integrated approach while also offering opportunities to develop a fully integrated energy plus health approach to service delivery.

With this in mind, CSD narrowed the analysis to three specific program models or strategies identified below to provide high-level overviews of each. CSD and its partners at CDPH and CEC have determined that the third model reviewed (VEIC's Energy-Plus-Health Playbook) offers an easy-to-evaluate ranking system that can determine where CSD's LIWP Multi-Family program is currently situated with respect to addressing housing-related health and safety hazards and offers straightforward recommendations and resources that will be helpful to strengthen the program's impact in this area, provided programmatic and funding challenges can be resolved.

#### 5.3.1 U.S. Department of Housing & Urban Development (HUD) Office of Healthy Homes & Lead Hazard Control

**The Healthy Homes Program Guidance Manual – HUD (July 2012)**

**Overview**: Born out of more than a decade-long effort by HUD, the U.S. Centers for Disease Control (CDC) and the EPA to reduce and eliminate lead poisoning in children, local implementers of lead hazard control efforts recognized the need to address other housing-related health and safety hazards which if properly addressed would lead to a reduction in incidences of poorly controlled asthma and allergies, unintentional injuries caused by falls and other household accidents, lead exposure, and illness or even death that can be the result of compromised air quality due to carbon monoxide, tobacco smoke, and VOCs among other

contaminants. This recognition eventually led to the "Healthy Homes" concept discussed in this study.

This extensive resource document is nicely organized across seven chapters that cover everything from establishing community involvement and buy-in and developing a well-thought-out program design, to evaluating and assessing the program, measuring success, and planning for program sustainability.

### Healthy Homes Concept

A 2009 Surgeon General's report, Call to Action to Promote Healthy Homes, describes a healthy home as "a home designed, constructed, maintained, or rehabilitated in a manner that supports the health of residents."[4] According to HUD's 2007 American Housing Survey, almost six million households live with moderate or severe physical housing-related problems, a group the Surgeon General's report identifies as likely benefitting from the Healthy Homes concept.[5]

This HUD Healthy Homes Program Guidance Manual further underscores what has been established in the meta-studies cited earlier in this document—that homes receiving energy efficiency services and proper attention to health and safety issues can enhance health outcomes for occupants of the home. When providing comprehensive retrofits to a home every effort should be made to correct structural defects, improve indoor air quality, minimize or remove exposure to contaminants, and to address identified safety hazards to improve occupant health, increase comfort, and to reduce stress for those residing in the home.

The HUD manual helps to simplify the steps and actions necessary to maintaining a Healthy Home by defining seven key actions known as the "Seven Principles of Healthy Homes." These principles were developed by the National Center for Healthy Housing's National Healthy Homes Training Center, with funding from HUD and the CDC.[6] The original "Seven Principles" are identified below and have been reproduced as they appeared in the HUD Healthy Homes Manual in Appendix 2 of this document for reference.

Please note that the original "Seven Principles of Healthy Homes" have been expanded to include an 8th principle (Keep it Thermally Controlled) and two additional principles since the HUD Manual was published in 2012.

### Principles of a Healthy Home

These principles are guided and informed by what is identified in a proper housing assessment. There is prioritization given to imminent hazards (e.g., Carbon monoxide leaks), hazards associated with chronic health issues (e.g., asthma triggers) and steps needed to prevent

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[4] U.S. Department of Health and Human Services, 2009. The Surgeon General's Call to Action to Promote Healthy Homes. Office of the Surgeon General. Available: https://www.ncbi.nlm.nih.gov/books/NBK44192/pdf/Bookshelf_NBK44192.pdf

[5] U.S. Department of Housing and Urban Development. 2008. 2007 American Housing Survey. Available: https://www.census.gov/prod/2008pubs/h150-07.pdf

[6] https://nchh.org/information-and-evidence/learn-about-healthy-housing/healthy-homes-principles/

further housing deterioration. While physical interventions are critical, changes in occupant behavior through educational outreach can be just as important.

1. **Keep it Dry** – Ventilation and moisture control are both related in this principle.
    - Structural interventions (preventing leaks and resolving drainage problems), mechanical ventilation, use of dehumidifier or air conditioning in some climates, and envelope sealing all reduce relative humidity and improve indoor air quality.
    - Health Impacts: Reduction in asthma triggers and respiratory irritants, reduced risk of injury.
2. **Keep it Ventilated –** Two component strategy - utilize low-emission products (carpet, low-VOC furnishings, regulated pressed wood, etc.) in conjunction with improved ventilation systems.
    - Local exhaust ventilation systems remove moisture and airborne contaminants with proper exhaust ventilation at the source (bathroom and cooking / stove exhaust fans).
    - General Ventilation - Introduces fresh air into the home to reduce contaminant concentrations and avoid hazardous contaminant levels.
    - Health Impacts: Reduced asthma triggers and respiratory irritants, reduced risk of lung cancer and chemical exposure.
3. **Keep it Pest-Free** – Pests are an important health issue in many homes, especially in multi-family housing where infestations and allergens can spread from one unit to the next.
    - An Integrated Pest Management approach is useful because it pairs structural interventions that eliminate conditions that are conducive to pests (e.g., crack sealing, copper mesh to seal holes and exclude pests, etc.) with resident education and other approaches that make the home less hospitable to pests (e.g., reducing moisture, eliminating food sources, etc.) which reduces the amount and toxicity of pesticides needed to address issues.
    - Health Impacts: Reduction in asthma triggers and respiratory irritants – reduces exposure of vulnerable populations (e.g., elderly, children, and the chemically sensitive) to harmful chemicals.
4. **Keep it Safe** – "Structural deficiencies in a home can account for falls, smoke inhalation from fires, burns and scalds, carbon monoxide and other forms of poisoning, drowning, and other injuries. Healthy homes programs should focus on populations at greatest risk, including children and older adults."[7]
    - Fall prevention through use of stair rails, non-slip bathmats, nightlights, grab bars in the bathroom and adequate lighting.

[7] U.S. Department of Housing and Urban Development Office of Health Homes and Lead Hazard Control. The Healthy Homes Program Guidance Manual (2012).

- Fire or Scalding danger – installation of smoke detectors, carbon monoxide alarms, fire extinguisher maintenance, avoiding circuit overloads and extension cords and maintaining water temperature below 120 degrees to avoid burns.
- Chemical Exposure and Poisoning – Storing chemicals and medicines appropriately and out of reach for children, medicine hazards - those at increased risk of fire-related injury or death include infants, young children, and the elderly. Certain racial/ethnic groups are also at risk as well as those living in mobile homes or substandard housing.
- Health Impacts: Reduced exposure to chemicals and poisoning, reduced risk of burns.

5. **Keep it Contaminant Free** – Risks linked to lead-based paint hazards, asbestos, combustion products, VOCs, Radon gas, particulate matter, and secondhand smoke all present risks to occupants.
    - Remediation for homes with lead-based paint and asbestos – reducing exposure can be accomplished several ways, including leaving the contaminant undisturbed, proper maintenance, controlling airflow, and in certain cases, removal of the contaminant by certified technicians.
    - Through education on home purchases, reducing introduction into the home of VOCs present in cleaners, adhesives, carpets, etc.
    - Particulate Matter and Secondhand Smoke – Proper exhaust ventilation for combustion sources helps reduce the risk, adopting “smoke-free” policies where possible.
    - Health Impacts: Reduced risk of lung cancer, respiratory irritation, and risk of childhood lead poisoning – reduced developmental hazards.
6. **Keep it Clean** – Cleaning and maintenance alone are usually not sufficient to create healthy housing because sources of hazards must also be addressed, however cleaning can be a short-term fix for many housing health hazards.
    - Cleanable surfaces - Difficult to clean surfaces on floors or windowsills may make re-accumulation of lead-contaminated dust exposure more likely.
    - Heating, ventilation, and air conditioning (HVAC) systems should be cleaned to prevent mold build-up from blocked coils and causing higher fuel costs. Include the change-out or cleaning of furnace filters to improve air movement.
    - Health Impacts: Reduction in asthma triggers and respiratory irritants, reduction in risk for childhood lead poisoning.
7. **Keep it maintained** – Simply correcting identified deficiencies in a home may momentarily resolve an unsafe condition, but a regular maintenance inspection protocol can improve safety and help identify new deficiencies to be addressed.

- In homes where lead paint is suspected - Control of lead dust with floor to ceiling cleaning and through the use of HEPA filter vacuums.
- Awareness of occupants that may be hoarding – this compulsion results in clutter and may lead to pest infestations and a host of other issues.
- Health Impacts: Reduced risk of lung cancer, protection of central nervous system, increased physical comfort, and energy efficiency.

8. **Keep it Thermally Controlled** – As mentioned above this action is not included in the HUD Manual, but has since been added in a number of other approaches and bears mentioning.
    - Homes that are not maintained at adequate temperatures pose a risk to residents from extreme cold or heat.
    - Ensuring efficient and adequately sized heating and cooling equipment are installed, caulking windows and door frames, sealing ducts, insulating walls, and properly programming thermostats to reduce energy use.
    - Health Impacts: Minimizes stress on residents and increases comfort in their home, increases climate resilience.

**Conclusion:** Utilizing a Healthy Homes approach can offer substantial savings in health care costs for low-income households, but it can also provide additional co-benefits, such as reduced energy costs, an improved quality of life and well-being for the occupants, and by extension, more comfort and enjoyment in their homes. This manual, with several case studies and real-life examples, offers excellent resource materials and direction for those interested in engaging their communities and fostering a Healthy Homes program in their area.

### 5.3.2 Regional Asthma Management & Prevention (RAMP) and Contra Costa Health Services

#### Energy Efficiency and Health: A Guide for Public Health and Health Care Professionals on Connecting Medically Vulnerable Residents with Energy Efficiency Services (December 2018)

**Overview:** This Energy Efficiency and Health guide was created with support from CDPH to help inform health professionals about the potential for improved patient health outcomes that can be generated when healthcare programs are combined with energy efficiency service delivery programs to comprehensively serve medically vulnerable clients.

Public health officials have long understood that there is a direct connection between the condition of a person's housing and their health. In America, since at least the 19th century, public health practitioners have undertaken efforts to improve health outcomes for their low-income patients by addressing substandard conditions in the often-run-down dwellings where they lived.

With the above in mind, public health officials have been working in collaboration with "non-traditional partners" such as energy efficiency program providers that assist low-income clients

to coordinate service delivery that will better address their client's needs. For example, lead poisoning prevention programs run by energy efficiency programs that can be coordinated with home visits by health professionals to address asthma and other health hazards in the home can help to create a symbiotic relationship benefitting all parties involved, but most importantly the client is more comprehensively served.

In addition to recognizing the healthcare needs of low-income patients and the health-related benefits that home energy efficiency services can provide, this guide highlights the importance of establishing a referral program between health and energy efficiency programs that will enable optimization of benefits and better health outcomes for clients and communities.

### Housing and Health Connection

As previously noted, health officials have been aware that some health risks associated with substandard housing conditions can be addressed through home improvements provided by energy efficiency programs. This includes respiratory illness, asthma, cardiovascular disease, cancer, communicable diseases, mental health, and more. A "Healthy Home" that is dry, clean, safe, well-ventilated, pest and contaminant free, well-maintained and thermally controlled[8] can help to address many of these health risks.

Energy efficiency programs can be especially beneficial to low-income communities and communities of color. This research and other similar studies point out that health benefits which occur as part of these programs provide the greatest benefit to people with pre-existing health conditions, whose respiratory ailments and cardiovascular disease, for example, are exacerbated due to housing deficiencies.

- For example, 65 percent of African Americans and 57 percent of Latinx households occupy rental homes, and rental housing is often substandard when contrasted with owner-occupied housing. Only 36 percent of whites live in rental housing.[9]
- Additionally, low-income communities and communities of color are frequently located in "urban heat islands" where temperatures may be as much as 22 degrees higher than surrounding neighborhoods.[10] Improving cooling systems through energy efficiency retrofits can mitigate death and illness from heat stroke, heat exhaustion, and other chronic illness.

### Energy and Health Program Pilots

The three small Energy Efficiency and Health programs mentioned below are described in this report, and they each share a similarity in approach.

- Contra Costa Pilot Project

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[8] U.S. Department of Housing and Urban Development Office of Lead Hazard Control and Healthy Homes. *Eight Tips for Keeping a Healthy Home*. https://portal.hud.gov/hudportal/documents/huddoc?id=HH8Tips.pdf.

[9] California Department of Housing and Community Development. California's Housing Future: Challenges and Opportunities; Public Draft-Statewide Housing Assessment 2025. January 2017.

[10] Gronlund, Carina J. Racial and socioeconomic disparities in heat-related health effects and their mechanisms: a review Curr Epidemiol Rep. 2014 Sep 1; 1(3): 165–173.

- Fresno County Department of Public Health
- Central California Asthma Collaborative

**Pilot Approaches**

- All three pilot programs involved a collaborative effort between community nursing and health workers, energy efficiency service providers, and the populations being served.
- The programs also included an educational training element:
    - Nurses learned about energy efficiency services and how to make program referrals.
    - The parties collaborated to develop a high-level home assessment tool for use by visiting nurses (Contra Costa and Fresno Pilots).
    - The Central California Asthma Collaborative Pilot approach included a comprehensive training that informed health officials about energy efficiency programs, including program goals and eligibility requirements.

**Lessons Learned / Identified Best Practices -** Additionally, the collaborative efforts mentioned above yielded a set of "best practices" for others interested in pursuing this approach.

1. **Develop Relationships** - Identify and reach out to energy efficiency organizations.
2. **Ask the weatherization service providers how they protect indoor air quality** – These helpful services must be accompanied by appropriate indoor air quality diagnostic testing to avoid any potential for unintended negative impacts.
3. **Identify the health professionals who will be asked to refer residents who might benefit from weatherization services** – Provide widespread dissemination of program information, availability, and goals to other healthcare providers, clinicians and staff that work with vulnerable populations.
4. **Train the health professionals** – Offer training to healthcare professionals regarding health benefits related to energy efficiency and how to make referrals.
5. **Systematize a way for the health professionals to identify the people who would benefit** – For example, healthcare staff should include energy efficiency questions to their intake forms.
6. **Establish a referral process** – Referrals should include a simple transfer of information from healthcare staff to energy efficiency provider but should also include checks and balances so that clients do not get lost or accidentally dropped in the process.
7. **In counties that have multiple weatherization service providers, work with them to establish a referral / cross-referral process** – Efforts should be made to minimize "touches" and to reduce confusion for the client while maximizing weatherization offerings.
8. **Establish a system for weatherization service providers to report back to health professionals** – Completing the loop ensures the client receives a full complement of services.

**Health and Energy Programs Outside California – Additional Best Practices**

The RAMP Energy Efficiency and Health Guide also provides brief overviews of other Healthy Homes style programs outside of California. Several notable takeaways from those programs can be summarized as follows:

- An electronic referral system such as *One Touch*® which was used by the Vermont Weatherization Program can help to connect energy efficiency providers and health professionals through one unified platform[11] helping to avoid duplication in effort.
- A single uniform application can help to minimize red tape and number of touches.
- Utilizing a comprehensively trained Healthy Homes Assessor to visit and triage homes, and to make connections between various service providers to address multiple concerns can ensure that clients receive a full complement of services.

**Conclusion:** The approach recommended in this guide has been shown to have promise when linking health professionals to energy efficiency service providers to improve housing conditions and by extension the health outcomes for low-income Californians. This paper provides a "best practices" guide to assist health and energy program workers to initiate and implement an integrated and effective Healthy Homes program.

Of additional note, the Contra Costa Pilot highlighted as part of this study recently received additional funding to further explore some of the lessons learned and best practices identified as part of the RAMP Energy and Health pilots.

Through a 3-year grant from California Department of Health Care Services, Contra Costa Health Services is furthering their efforts to connect high risk residents with weatherization and energy efficiency services. This grant will integrate weatherization and energy efficiency services with asthma preventative services provided to Medi-Cal patients with severe asthma. Remediations will be performed in approximately 38 single and multi-family homes and will include air filtration/dehumidification, electrification of heating/cooling, induction cooking appliances, electric panel upgrades, plumbing repairs, roof repairs, mold remediation, ventilation, pest management, and carpet removal or cleaning.

The program will also offer asthma mitigations such as providing less-toxic cleaning and pest management supplies, hypoallergenic bedding, and HEPA vacuum cleaners. Lastly, the program will include a component that establishes data management systems to share and track data while maintaining confidentiality. The project also includes a one-year Bay Area Air Quality Management District (BAAQMD) grant to augment the mitigations that can be provided.

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[11] One Touch.
Accessed: 09/30/2020
https://onetouchhousing.com/overview/

### 5.3.3 Vermont Energy Investment Corporation (VEIC)

#### Energy-Plus-Health Playbook (July 2019)

**Overview:** There is a growing body of evidence that points to the impact that energy efficiency work can have on health outcomes for occupants of healthy homes. In fact, according to the U.S. Department of Housing and Urban Development (HUD), the U.S. Environmental Protection Agency (EPA) and the Centers for Disease Control and Prevention (CDC) there are "eight core healthy home principles" that include keeping the home dry, well-ventilated, contaminate-free and thermally controlled among others, all of which can be achieved through energy efficiency retrofits and healthy homes programs.[12] The Energy-Plus-Health Playbook designed by VEIC, and organized into seven parts, offers an easy-to-use game plan for program administrators to develop and implement a Healthy Homes program.

This playbook provides a three-tier framework for energy efficiency program administrators that are interested in creating Energy-Plus-Health programs. While not every existing or planned Healthy Homes style program fits neatly into a specific tier, the framework is intended to help program administrators determine which program model is the best fit for their goals and resources. The three program tiers below represent a continuum in their level of complexity, collaboration, comprehensiveness, and impact:

- **Tier 1 – Basic Health & Safety Programs**: These programs are the simplest to design and deliver but achieve modest health impacts. These programs focus on doing no harm by offering basic health and safety checks and remediation through light engagement with community-based partners that may or may not combine efficiency measures with Healthy Homes principles.
- **Tier 2 – Cross-Sector Referrals**: These programs are more complex and provide greater benefits by creating strong cross-sector referral systems between energy efficiency, health, and housing partners to proactively address needs and deliver responsive services, particularly for low-and-moderate-income households.
- **Tier 3 – Integrated Energy-Plus-Health Services**: These approaches are the most resource-intensive to design and deliver but because of their comprehensiveness they offer the greatest potential for positive impact through fully integrated energy and health services. They can support improved health outcomes for households with chronic respiratory illness and potentially unlock new funding streams from the health sector.[13]

[12] U.S. Department of Housing and Urban Development (HUD) – Making Homes Healthier for Families. https://www.hud.gov/program_offices/healthy_homes/healthyhomes

[13] VEIC Energy-Plus-Health Playbook (July 2019)

Table 4 below describes elements of each approach and can aid interested energy and health care professionals as they evaluate the approach and level of complexity, collaboration and comprehensiveness that is the right fit for their programs.

*Table 4: Energy-Plus-Health Tier Approaches*

| Overview - Choosing the Right Energy-Plus-Health Approach[14] | | |
|---|---|---|
| **Tier 1** | **Tier 2** | **Tier 3** |
| **Basic Health and Safety** | **Cross-Sector Referrals** | **Integrated Energy-Plus-Health Services** |
| • Best option for program administrators who lack the time and resources to build external partnerships or develop new programs.<br>• Supports program administrator goals to "do no harm".<br>• Many existing residential retrofit and weatherization programs fit in Tier 1. | • Best option for program administrators who have healthy home resources available and are willing to invest in a referral network but are not ready to invest in learning about the needs of the health care sector and building a full partnership with them.<br>• Supports program administrator goals for community and low-income impact.<br>• Usually doesn't require major changes to existing efficiency programs. | • Best option for program administrators who are willing to make a significant investment to understand the needs of the health care sector and develop a mutually beneficial cross-sector partnership.<br>• Supports quantification of health-related non-energy impacts for inclusion in cost-effectiveness screening.<br>• Supports program administrator goals to develop new health-related funding streams.<br>• May require approval by regulators or other oversight bodies. |

Each of the approaches outlined in the overview table above are described in additional detail within the document and further guidance is offered regarding both required and optional elements of each approach, and elements that are not usually present within the specific level of program selected.

Additionally, the playbook specifies roles that key stakeholders will need to fill, such as the energy efficiency program administrators, community-based organizations (CBOs) and home energy contractors if those services are subcontracted out by the CBOs. Where the approach is more comprehensive and deeper services are possible, the playbook also discusses the role

[14] Ibid

that healthy homes evaluators who perform home visitation services may play in making referrals and coordinating services from multiple entities. These services can include health referrals, efficiency retrofits, well-being visits and housing repairs that are typically beyond the scope of energy efficiency programs. Essentially, the higher the tier of services, the more expansive the role of each partner or stakeholder may be.

Lastly, for each of the tiered approaches the document provides guidance on program start-up at each level and includes tips on marketing and outreach, training, service referrals, building a referral network, data sharing, program design, communication, and suggested tools and resources for further exploration.

As has been documented in the vast and growing field of research into the positive health impacts and outcomes related to energy efficiency work, there are several benefits for residents that live in homes that adhere to the eight core healthy homes principles. Table 5 provides a sampling of benefits that energy-plus-health programs may experience by utilizing approaches from the most basic to those that are fully integrated.

*Table 5: Programmatic Benefits Energy-Plus-Health Tiers*

| Programmatic Benefits Dependent on Energy-Plus-Health Approach | | |
|---|---|---|
| **Tier 1** | **Tier 2** | **Tier 3** |
| **Basic Health and Safety** | **Cross-Sector Referrals** | **Integrated Energy-Plus-Health Services** |
| • Linking energy efficiency to a "do no harm" standard prevents unintended adverse health effects.<br>• Promoting increased comfort and health benefits of energy efficiency can motivate customers to participate in program.<br>• Recognizing that health-related non-energy benefits of energy efficiency work can help to support spending on minor repairs and may reduce deferral rates. | • Enhanced partnerships between housing and health partners can identify new resources to address housing conditions beyond program scope and minimize deferrals.<br>• Leveraging referral networks can increase participation in energy efficiency programs by hard-to-reach populations through warm hand-offs.<br>• Partnering agencies can reduce duplicative administration costs of marketing and engagement. | • Collaboration between health and energy efficiency programs helps to support vulnerable low-income clients most in need of services.<br>• Significant reductions in urgent and emergency care which reduces statewide spending on housing-related health issues such as asthma, COPD and home injuries.<br>• Braiding of services may help uncover new sources of program funding in the health sector. |

**Study Conclusion**: VEIC's Energy-Plus-Health Playbook offers a well thought out guide for health and energy programs that are open to exploring collaborative opportunities in this emerging field. In addition to the basics of program planning and implementation, the guide provides case study examples for programs at each of the identified service tiers and a wealth of resource material and links that can be explored by interested parties.

Having evaluated the three Healthy Homes models above it was determined by the project partners that the three-tiered structure provided within the VEIC Energy-Plus-Health Playbook offers a scalable approach for building onto the existing LIWP Multi-Family program's approach to services, recognizing that the current program structure renders comprehensive services that both reduce energy consumption and improve the health and safety of occupants at the low-income affordable housing properties being served. The VEIC model also fully embraces the "Principles of Healthy Homes" as described in the HUD Healthy Homes Program Guidance Model.

In addition, the VEIC model offers clearly defined programmatic "stretches" within each tier ranking that can assist programs utilizing the model to broaden and enhance health impacts, to increase levels of collaboration between public health professionals and energy program implementers, and to advance programs further in the direction of a fully-integrated energy and health model.

## 5.4 Integrated Healthy Homes Strategies

### 5.4.1 Regional Asthma Management & Prevention (RAMP)

**Investing in Prevention and Equity: A Comprehensive Approach to Healthy Housing in California (October 2020)**

**Study Purpose:** This recent RAMP study funded by the Blue Shield of California Foundation represents a collaborative exploration into potential enhancements to existing California programs ranging from energy efficiency home repair and rehab programs to childhood lead poisoning prevention, fall prevention for seniors, and a variety of others that serve to improve health outcomes, decrease health costs, reduce ethnic and racial health disparities, preserve housing stock, and positively impact the lives of low-income residents around the state. While the plethora of benefits provided by these programs are easily recognized, the siloed nature of these healthy housing programs prevents potential synergies that a coordinated "comprehensive, equitable, and prevention-oriented strategy" might achieve.

The recommendations provided in this paper represent findings from extensive research, informational interviews, and meetings with key housing and health partners, and are presented by the paper's authors with the hope that they may foster greater collaboration across sectors and programs. The study proposes program enhancements that address improvements focused on low-income renters and homeowners; a targeted approach for existing housing stock; state-level, but locally implemented solutions based on aspirational goals with feasible short-term steps, and increased occupant equity and hazard protections.

The study provides healthy housing details that have already been covered in the literature reviewed within this report. Concisely stated, for housing to be considered healthy it must be dry, pest-free, contaminant-free, safe, ventilated, clean, maintained and thermally controlled.

**Challenges Within the Current System**

The paper identifies key programs that are currently invested in the provision of healthy housing benefits to residents in California, but as the study clearly indicates, the great majority of programs address particular aspects of healthy housing, however they do not provide for a more comprehensive, holistic, and collaborative approach.

Study authors gathered information on the following representative sample of programs:

- Lead poisoning prevention programs
- Federal and state-funded home repair programs
- Energy efficiency programs
- Older adults fall prevention programs
- Asthma home visiting programs
- Code enforcement
- Other public health programs that provide services in homes

A list of challenges identified by the RAMP study include:

1. Not enough funds – fund allocations are not typically determined by a true needs assessment, and in some cases, there is insufficient data to even define the actual need. Often funding is determined solely based on budget limitations.
2. Limited scope and reach – Most programs address only specific components of the home as a whole and as such additional opportunities to benefit the home and the occupants are routinely unaddressed.
3. Lack of coordination between healthy housing programs prevents potential synergies that a coordinated “comprehensive, equitable, and prevention-oriented strategy” might achieve.
4. Programs are reactive rather than preventative – For example unsafe housing conditions are often discovered only when conditions get so bad that a tenant files a complaint. Tenants may fear retaliation such as rent increases from their property owners which likely causes under-reporting of unhealthy housing situations.
5. Property owner challenges – Many property owners maintain their housing and provide safe rental units, but some small “Mom and Pop” property owners may not be in a position financially to do so, while other less scrupulous property owners may utilize a business model that is “based on renting substandard units to vulnerable residents.”
6. Lack of tenant protections – Often there are inadequate protections for tenants and without strong rent control, just cause evictions, and anti-harassment policies, tenants may forego program participation because they are reluctant to risk rent increases or possible eviction.
7. Lack of trust – Because there are a wide range of professionals involved in service provision, there can be distrust of some service providers. This may be driven by cultural and language barriers, and fear among immigrant populations to name a few reasons.

8. Systematic inefficiencies – Outreach is resource intensive and it can be difficult to reach all qualified clients. There are also competing / varied eligibility criteria among programs which makes leveraging multiple programs difficult, and each program may require a separate application and extensive documentation.
9. There are additional challenges that are unique to specific housing types such as rural and farmworker housing, mobile homes, and Accessory Dwelling Units.
10. Challenges meeting healthy housing needs for people with disabilities – For housing built prior to 1991, property owners must allow for reasonable accommodations such as grab bars and ramps. However, it is the responsibility of the tenant, not the owner to facilitate the work and pay for it. Even though property owners are required by law to reasonably accommodate disabled tenants, many are reluctant to do so and tenants may fear retaliation. While Community Development Block Grant funds which can be used to fund repairs, these funds are limited, and availability varies widely across the state.

Although the current siloed approach to healthy housing efforts does not sufficiently address complete health, safety and equity needs, the authors identified several areas where the current delivery system provides important benefits to the populations served as follows:

- Service providers have necessary expertise – specialized skillsets are utilized by community health workers and energy efficiency providers to assess and provide services to target populations, which provide critical benefits to their intended populations, even though the segregated services approach falls short of a holistic, comprehensive approach.
- Specific eligibility criteria help the programs target services to those who need them most – targeting the populations that need services most makes sense, but at the cost of a fully integrated approach.
- Funding addresses a significant healthy housing need – Advocates have helped to target funding to critical areas of need, however important issues (e.g., mold, pests, etc.) remain unaddressed.

Having taken stock of the current programmatic landscape, existing barriers and challenges to services, systemic inequities and what the current siloed system gets right, the paper recommends solutions that could help to bridge the disconnect between the energy and health sectors and achieve a more equitable system .

**RAMP Study Recommendations**

The recommendations that follow are drawn directly from CSD's literature review of the RAMP study and describe features, funding strategies and policy considerations that can move California closer to a comprehensive approach to healthy housing:

1. **What would an equitable system designed to prevent illness and injury by comprehensively promoting healthy housing look like?**

- Focus on prevention – Includes resident illness and injury as well as preventing the deterioration of existing housing stock – Preserving housing helps avoid further exacerbating the state's affordable housing crisis.
- Sufficient funding - Includes improved data collection and monitoring to ensure appropriate funding levels – funding should be allocated based on assessed need.
- Need and equity-based funding allocations - Ensure that resources reach historically underserved communities, communities of color, and rural communities.
- Holistic approach - A comprehensive assessment and referrals sufficient to ensure that all needs related to healthy housing are met.
- Hold property owners accountable for healthy and safe conditions
    - Effective code enforcement to protect tenants.
    - Enhanced code enforcement for property owners that fail to maintain properties.
- Public investments should be used for public good
    - Target resources to low-income renters and homeowners.
    - Loans or tax credits for improvements in rental housing would require property owners to maintain affordability for a designated length of time.
- Comprehensive program coordination and tracking
    - Establish a state level entity to collect, track, and maintain data on housing conditions.
        - Would ensure sufficient funds are properly directed based on need and equity.
        - Establish process for providing healthy housing services, enhanced code enforcement, and housing stock preservation.

**2. What changes would move the state's current system closer to a comprehensive, prevention-oriented approach to ensuring healthy housing for Californians?**

Recommendations in this section are focused on providing an equitable, evidence-based distribution of public and private investments to address current program deficiencies, including the siloed funding streams identified earlier. There will be a substantial need to recreate systems of investment and accountability. Recommendations follow:

- Systematic data collection on rental habitability
    - Document unsafe or unhealthy conditions in low-income and communities of color.
    - To be combined with health data for program and resource targeting.
- Regular proactive rental inspections – Transition from an ineffective, complaint-based system to a proactive rental inspection protocol with regularly scheduled inspections
    - Identify issues before they become hazards which reduces cost.

    - Remove tenant risk / fear of eviction or increased rent.
- Establish a state-run Rent Escrow Account Program
    - Allows tenants to use existing law to withhold rent until necessary repairs are completed.
    - Ensures proper maintenance of existing rental stock and addresses issues with low maintenance / high profit margin property owners.
- Establish rental housing licensing requirement
    - Ensures health and safety requirements are met before property is rented.
    - Best when linked with proactive inspections protocol.
- Preserve quality of housing for low-income residents
    - Encourage public and private investment in housing stock.
    - Shift emphasis to funding repair or rehab of existing rather than new housing.
- Coordinate healthy housing funding, programs, and policies across state-level healthy housing programs and local code enforcement agencies
    - Streamline application process and improve outreach.
    - Establish anti-displacement protocols and just cause eviction policies and tie them to resources and programs.
- Establish specific, minimum standards for repairs and provide expertise/workforce development for services
    - Ensure inspectors are trained and aware of any new standards or regulations.
    - Establish minimum standard for expertise required for specific repairs.
- Identify existing or create necessary funding mechanisms to move the current system closer to a comprehensive, prevention-oriented approach.

**3. What are near-term goals for the next 3-5 years to help bring California closer to a comprehensive approach to healthy housing?**

The last section of the RAMP paper essentially reiterates key approaches to healthy housing that can be accomplished in the near term. They are as follows:

- Scale proactive rental inspection programs
- Develop local Rent Escrow Account Programs – establish minimum state standards and elements while allowing room for innovation and adaptation.
- Dedicate public funds aimed at preserving the quality of housing for low-income residents.
    - Low-interest loans for property owners which are tied to requirements for long-term affordable housing.

    - Low-interest loans, grants, and tax-credits benefitting non-profit affordable housing developers designed to improve housing quality while augmenting the supply of affordable housing.
- Increase coordination of healthy housing funds and policies across state healthy housing programs.
- Build political will – The current landscape of healthy housing programs reflects a patchwork of policies and programs that were developed as specific interests "built political will around specific issues at specific times."
    - Ongoing engagement with healthy housing stakeholders can help to build the political will to create a "more comprehensive, prevention-oriented system" that is robust.
    - Identified need to expand the network of stakeholders to include other advocates within the health care, labor, education, faith-based organizations, and other non-traditional partners to develop a more comprehensive, equitable system.
    - Encourage resident leaders and other partners to build relationships with state and local representatives, delivering a consistent message that current systems are ineffective, and a more comprehensive prevention-based approach with improve health outcomes.

**Study Conclusion:**

Many state and federal programs designed to improve housing conditions, increase energy efficiency, and address occupant health issues currently operate in California; however, as noted in the RAMP study, insufficient funding and the siloed structure of these various programs along with very specific agency objectives often interferes with attempts to implement efficient, high-quality healthy housing programs.

This RAMP paper represents a cooperative effort by multiple healthy housing stakeholders (both energy efficiency and public health advocates) to develop and describe the features and policies necessary to operate comprehensive, prevention based, and equitable healthy housing programs. Key recommendations highlighted in the paper include an emphasis on landlord accountability, increased investment to improve living conditions in existing housing stock occupied by low-income households as well as the need to supplement the amount of affordable housing available to qualified populations. To facilitate these solutions, agencies will need to improve cross-program coordination and build the political will necessary to break down current programmatic and policy barriers which challenge the creation of comprehensive, equitable, proactive, and prevention based healthy homes programs.

# Section 6 - Recommended Action Plan

## 6.1 Overview

As mentioned in Section 4.2 (LIWP Program Components) of this document, this AB 1232 Recommended Action Plan is designed around the LIWP Multi-Family Energy Efficiency and Renewables program component, which targets services to affordable housing properties throughout much of California.

After considering several existing Healthy Homes models in Section 5 (Literature Review), it was determined that the three-tiered structure provided by the VEIC Energy-Plus-Health model is the most scalable model applicable to the current LIWP Multi-Family program design. This model recognizes the positive health benefits generated by the program's existing comprehensive deep energy retrofit approach to services. The VEIC model can also help identify opportunities for program enhancement, and "stretches" to help move the program further in the direction of a cross-referral program providing comprehensive energy and healthy home improvements for low-income multifamily residents in disadvantaged communities.

In Section 6.2 we assess LIWP Multi-Family's position within the established VEIC Energy-Plus-Health model and use next-steps suggestions from the model to identify actions that can be taken to channel more comprehensive health and safety services and funding resources to the low-income multi-family housing sector.

In Section 6.4 we detail Moderate Enhancements to the LIWP Multi-Family program that can be realized within the programmatic and fiscal constraints of the current program structure and that will further augment LIWP Multi-Family's Healthy Homes offerings. These enhancements have the potential of moving the program closer to achieving the second Healthy Homes tier identified in the VEIC model. Finally, Section 6.5 provides for more Substantial Enhancements to the program that if implemented would allow LIWP Multi-Family to incorporate a collaborative, cross-referral system between energy and health professionals, and potentially a fully-integrated energy and health program.

## 6.2 Evaluating Existing LIWP Multi-Family Component as a Healthy Homes Program

Utilizing the Energy-Plus-Health Playbook developed by VEIC and as described in the Section 5.3.3, the LIWP Multi-Family program as currently designed is situated between the first two tiers in the model and appears to be just short of Tier 2 as illustrated in Table 6.

*Table 6: LIWP Multi-Family Energy Plus Health Program Intersect*

| LIWP Multi-Family / Energy Plus Health Program Intersect | | | |
|---|---|---|---|
| **Tier** | **Program** | **Characteristics** | **Current LIWP Multi-Family Alignment** |
| 1 | Basic H&S | • Simple to design – most energy efficiency programs fit here<br>• Modest health impacts<br>• Do no harm approach | • Program easily meets tier requirements - comprehensive energy efficiency retrofits that have appreciable health benefits<br>• Property owners required to remediate H&S hazards |
| 2 | Cross-Sector Referrals | • More comprehensive<br>• Established cross-sector referrals between energy efficiency programs, health, and housing providers | • Provides comprehensive energy efficiency retrofits that include measures with appreciable health benefits<br>• The establishment of a cross-referral system will require additional program funding to fully implement |
| 3 | Integration | • Very comprehensive and resource intensive<br>• Greatest potential for positive health impacts through fully integrated referral & collaboration efforts<br>• Possible new funding streams from health sector | • Implementing a fully integrated program will require additional program funding and an easing of programmatic restrictions<br>• Collaborative relationships need to be established between the LIWP Multi-Family implementer and public health professionals – extensive referral and tracking tools with robust client privacy protections are critically important |

The table above demonstrates that while the current LIWP Multi-Family approach does not utilize a "strong cross-sector referral system" between the energy efficiency program and health professionals, the program offerings are much more comprehensive than those offered as part of the typical "do no harm" approach described in the Tier 1 (Basic Health & Safety) level. Additionally, although LIWP Multi-Family measure offerings are primarily directed at GHG and energy usage reduction (and solar renewable energy generation), they often provide Healthy Homes co-benefits.

As was outlined earlier in this document, there are "Eight Core Healthy Homes Principles" (Formerly "Seven Principles") as defined by the National Center for Healthy Housing (NCHH) and HUD.[15] These principles, to a varying degree depending on the study cited, underpin all

[15] https://nchh.org/information-and-evidence/learn-about-healthy-housing/healthy-homes-principles/

integrated energy and health program approaches that have been found to be effective in improving occupant health outcomes in a variety of housing types. Principles such as keeping homes dry, safe, ventilated, pest-free, contaminant-free, and thermally controlled are essential to maintaining Healthy Homes where residents can live comfortably with less stress and fewer emergency room visits.

### Current LIWP Multi-Family Healthy Homes Co-Benefits

The current LIWP Multi-Family program requires property owners to remediate health & safety deficiencies at their property before participating in the program. There are, however, a variety of Healthy Homes co-benefits that are linked to specific energy efficiency enhancements that already qualify for the LIWP Multi-Family program incentives at each property.

Table 7 below provides a sampling of these measures and their resulting healthy homes co-benefits:

**Sample Table of LIWP Multi-Family Measures with Healthy Homes Co-Benefits**

*Table 7: LIWP Multi-Family Measures with Healthy Homes Co-Benefits*

| Measure Name | Healthy Homes Co-Benefit |
|---|---|
| **Solar PV** | Reduced energy costs through renewable energy generation which increases climate resilience and improves an occupant's ability to thermally control their home. |
| **Air Sealing** | Improved indoor air quality helps to manage conditions that aggravate respiratory disease and asthma. Proper air sealing can exclude contaminants from nearby highways and industry. This measure also helps to lower energy bills and reduces access to pests. |
| **Combustion Safety Repairs and Carbon Monoxide Monitors** | Increases health & safety for residents by minimizing risks such as carbon monoxide poisoning which can cause illness or death. Additionally, improvements to local exhaust systems (those that remove contaminants with proper ventilation at the source such as kitchen range exhaust fans) also remove moisture and airborne contaminants from the home. |
| **Ducted and Ductless Heat Pump Heating and Cooling** | Lower operational costs and thermal control / climate resilience – Replacing combustion appliances with electric heat pumps not only provides improved indoor air quality by eliminating combustion gases from apartments, but also often provides cooling in communities that did not have access to cooling previously. This will be critically important as climate change continues to exacerbate temperature extremes. |
| **Attic / Wall / Floor Insulation** | Possibly the most efficient and least costly way to thermally control a home's temperature and general environment. Improves health by minimizing stress on residents and increasing comfort in their home. |

| Measure Name | Healthy Homes Co-Benefit |
|---|---|
| **LED Lighting – In-Unit and Common Area** | Good quality, well-maintained energy efficient lighting can increase safety in homes by preventing falls, providing for a sense of security, and by reducing energy costs for residents. |
| **Duct Sealing, Cleaning, and Insulation** | Maintaining proper ventilation is key to improving air quality which leads to better health for residents. Properly ventilated homes introduce clean, fresh and filtered air into the living environment which helps to reduce or avoid hazardous contaminant levels. |
| **Cool Roofs** | Very much a thermal control / climate resiliency measure, cool roofs can also effectively reduce energy costs for households and increase resident comfort in their home along with reducing the impacts of stress. Measures like this will also be increasingly important as climate change continues to cause drastic temperature swings in future years. |

As described in the table above, there are several Healthy Homes co-benefits offered by the current LIWP Multi-Family program, however enhancing the program will require addressing several challenges.

### 6.3 Advancing AB 1232 Healthy Homes Objectives – Strategic Approaches

To build on the current status of the LIWP Multi-Family program in relationship to the Energy-Plus-Health construct, CSD and its partners at CDPH and CEC have considered the stated Healthy Homes goals outlined in AB 1232 and are proposing a multi-faceted enhancement strategy and meaningful action plan to attain them.

The recommended program enhancements identified below can be organized under two broad categories or approaches:

- **Moderate Enhancements** that may be achievable with minor adaptations within the current program structure; and
- **Substantial Enhancements** that will require significant changes to LIWP program design, priorities, and identification of funding sources.

### 6.4 Moderate Enhancements Possible Within Current Program Design

As has been detailed in other parts of this report and in Section 6.2 (Table 7), LIWP Multi-Family retrofits already provide Healthy Homes co-benefits as a result of the energy efficiency and solar renewable investments currently being made, as well as through the requirement that property owners remediate health and safety hazards.

The following opportunities represent modifications that may be attainable within the current program structure to further goals for Healthy Homes outlined in AB 1232.

- **High-Efficiency Filters** – With little to no cost differential, LIWP Multi-Family could require higher quality air filters in the materials specifications for Heating, Ventilation and Cooling (HVAC) measures, which will improve indoor air quality (IAQ). Requiring filters at a higher Minimum Efficiency Reporting Value (MERV) could help remove up to 75 percent of airborne particles from the air. Similarly, High Efficiency Particulate Air (HEPA) filters are able to remove up to 99.7 percent of all airborne contaminants, however the dense mat of fibers used in HEPA filters require the HVAC system to work harder to circulate air, which utilizes extra energy (counter to LIWP Multi-Family goals) and can contribute to quicker depreciation of an HVAC's effective useful life (EUL).

  Another benefit of utilizing higher efficiency filters in homes is that they may help offset some of the negative health impacts California residents will likely experience in future years because of increased wildfire threats due to climate change. According to the California Department of Forestry and Fire Protection (CAL FIRE), California's 2020 fire season included five of the top six largest wildfires ever recorded in the state. Nine of the top ten occurred within the past decade.[16]

  Further, when using HEPA filters in combination with other best practices recommended by the Centers for Disease Control and Prevention (CDC) and other state and federal health agencies, a high-efficiency filter can be part of a plan to reduce the potential for airborne transmission of COVID-19 indoors.[17]

- **Quantifying Health Impacts** – Numerous studies have evaluated and documented a plethora of positive health outcomes that occur as a result of energy efficiency and solar renewable energy retrofits in residential housing. The LIWP Multi-Family program is already installing measures that positively affect resident health in affordable multi-family housing around the state.

  CSD and the LIWP Multi-Family implementer can work with our CDPH collaborators and public health partners to identify tracking mechanisms that will properly quantify the resident health benefits associated with these energy investments to make the case for additional program funding from as yet identified sources. Once obtained, these additional resources could be utilized to implement a vigorous and collaborative referral system whereby public health workers or Healthy Homes Assessors could identify multi-family buildings with significant health or indoor air quality issues which could then be addressed with the newly identified funding.

  It is important to note that while some level of quantifying health impacts can be accomplished within the current program structure as a moderate enhancement, developing and implementing a more robust, in-depth defined tracking system, such as *One Touch*®, which was used by the Vermont Weatherization Program (discussed in Section 5.3.2) will require significant new funding contributions and would move this enhancement into the Substantial Enhancement category. Having sufficient and reliable

[16] https://www.fire.ca.gov/media/4jandlhh/top20_acres.pdf
[17] https://www.epa.gov/coronavirus/air-cleaners-hvac-filters-and-coronavirus-covid-19

tracking data on housing conditions and health impacts can assist in directing investments and allow for the creation of fully integrated systems that can ensure low-income residents receive the full complement of healthy homes services and benefits.

### 6.5 Substantial Enhancements – Requires Action by Other Governmental Entities

Moving the LIWP Multi-Family program to the more advanced cross-referral tier within the Healthy Homes paradigm will require all or most of the Substantial Enhancements listed below. With these enhancements, the LIWP Multi-Family program will be better positioned to implement a cross-referral system and foster the collaborative partnerships needed to address the energy, health and housing needs of low-income residents through home energy retrofits, education, and supportive health and social services.

- **Funding Augmentation** – LIWP Multi-Family has been very well-received by affordable housing property owners, policy makers, and environmental justice and housing advocates. Currently, the program is fully subscribed, and the waiting list includes more than 180 properties consisting of more than 14,000 low-income housing units. Only a small percentage of these properties will be served with the program which is scheduled to end in 2022 based on available funding.

  Funding poses a critical challenge to the establishment of a collaborative referral process between public health workers and the program implementer. Implementing significant changes to the program as it is currently structured is not practical for various reasons, including current funding levels and project timelines. Because of the long-lead time associated with LIWP Multi-Family retrofit projects with significant capital investments and multiple funding streams, it is not currently feasible to make modifications to the existing LIWP Multi-Family program design as the program is scheduled to end in mid-2022. Significant changes to the program design that incorporate more robust healthy housing components and strong cross-referral mechanisms would require the program to remain authorized and funded beyond 2022.

- **Ensuring Long-Term Rent Affordability** – Since LIWP Multi-Family funds support low-income residents through lower energy costs and better health outcomes, it is important that improvements through Healthy Homes approaches continue to advantage these communities going forward.

  Deed-restricted affordable housing properties have built-in protections where long-term rent affordability can be guaranteed. Naturally occurring affordable housing (NOAH) multi-family properties, by contrast, where the great majority of low-income Californian's reside, offer fewer protections. Because of the built-in protections provided by deed-restricted affordable housing, LIWP Multi-Family has primarily focused on funding deed-restricted affordable housing projects in which these tenant protections already exist.

  To the extent that LIWP Multi-Family is continued and receives additional funding in future years, the program has the ability to expand services to serve the larger universe of NOAH multi-family properties. Alternatively, the program can continue to focus on the large pool of deed-restricted affordable housing properties that have not been served to

date. If the program were to shift its focus to serve more non-deed restricted properties, CSD and its partners would need to develop mechanisms to ensure that energy efficiency and cost savings benefits continue to accrue to low-income residents of NOAH properties and long-term rent affordability for residents is not compromised. This would require consulting with local and/or state governmental agencies that have expertise in housing regulatory enforcement requirements, and a stakeholder process to ensure such protections are consistent with the dual goals of delivering GHG-reducing energy efficiency improvements and protecting tenant affordability.

- **Electrification / Fuel Substitution** – Currently, LIWP Multi-Family provides opportunities for properties to consider fuel-substitution to remove older gas-burning appliances and replace them with high-efficiency electric ones. To date 41 percent of completed projects have done so, often in combination with solar PV installations that generate low-cost, clean electricity to offset the increased electric load at the property. Integrating fuel-substitution/electrification with solar PV systems can maximize the cost benefits that accrue to tenants because self-generation allows households to increase their energy use without incurring higher costs.[18] Electrification can also contribute to positive health outcomes by removing gas-burning appliances from the home, which helps to reduce the amount of particulate matter in the living space that can exacerbate respiratory and asthma symptoms for occupants.

  Possible enhancements in this area might be a higher financial incentive for property owners to encourage additional fuel-substitution opportunities within the program. Any modifications of the GHG targets established for LIWP must be considered in the broader context of California's climate investment and GHG reduction goals.

- **Balancing Health & Energy Investments** - CSD previously gained the flexibility to allow the LIWP Farmworker Housing program component, which serves some of California's most vulnerable residents, to utilize a small amount of funding to address structural deficiencies in farmworker housing that support energy efficiency investments and incorporate several small health and safety investments. Pursuing a similar strategy may enable a small percentage of the LIWP Multi-Family appropriation to be directed towards health and safety improvements that align with AB 1232 goals. However, any changes to LIWP Multi-Family program guidelines to incorporate additional health and safety investments will be dependent on future year funding for LIWP and the continuation of the program. Existing funding for LIWP Multi-Family is currently committed to projects under the existing program guideline structure.

- **Creation of a New Fund Source for LIWP Healthy Homes Investments** – To date, the primary focus of LIWP has been reducing GHG emissions. Incorporating additional health and safety components into LIWP's existing energy efficiency and solar renewable offerings may require the identification of other funding sources. While there may be

[18] Equitable Electrification: Program Models that Work for Existing Low Income Multifamily Buildings – American Council for an Energy-Efficient Economy - Summer Study on Energy Efficiency in Buildings 2020

opportunities to leverage other programs and braid non-GGRF funding sources into the program, this again would require continued funding of LIWP in future years.

Two possible approaches to leveraging LIWP with other funding sources can be seen in models utilized by two State of Washington programs.

Washington State Health Care Authority's Health Home program has been developed in partnership with Medicare, Medicaid and the Department of Social and Health Services in Washington to provide supportive services to clients such as comprehensive care management, health promotion, transitional care, and referrals to community and social support services for clients that meet several eligibility criteria that includes having one existing chronic health condition and being at risk for another, and qualifying under the Medicaid eligibility criteria. More about the program can be found here.

The Weatherization Plus Health program run by the Washington State Department of Commerce has a more direct connection to the integrated and cross-sector referral Healthy Homes approaches that LIWP Multi-Family could potentially achieve. The Weatherization Plus Health program utilized supplemental state-funded Matchmaker Low-Income Weatherization Program dollars (a State of Washington program) to pilot an innovative Weatherization Plus Health program beginning in 2016-17.

This program layered Matchmaker funding allocated by the Washington State Legislature onto traditional grant-based weatherization program funding from several different sources (federal and utility) and the enhanced services were targeted to homes where occupants had respiratory conditions. Qualified clients received comprehensive weatherization services and Matchmaker funds were used to install Healthy Homes measures such as HEPA filters, removal of toxic household chemicals, carpet removal / low VOC flooring installation, mold abatement, dust mite covers (bedding), plumbing leak repairs, pest mitigation and client education among others. The pilot grantees also worked with public health and/or medical clinics to provide consultations, home visit services, and health referrals where needed.

The pilot has been expanded during the past several annual program cycles. The State of Washington reportedly hopes to integrate Weatherization Plus Health as a regular service offering by 2021. More information on the program can be found here.

### 6.6 Cross-Sector Referrals – Realizing the Possibilities

Addressing identified barriers through the integration of both Moderate and Substantial Enhancements will enable LIWP Multi-Family to move to a true Tier 2 Cross-Sector Referral model as outlined in the VEIC Energy-Plus-Health Playbook and will allow the program to make considerable progress towards achieving the goals set forth in AB 1232.

Table 8 below helps to define both required and optional elements that are typically found in programs operating in the domain of a true cross-sector referral system and may assist LIWP Multi-Family in taking the program to the next level with respect to a Healthy Homes approach.

## Tier 2 Cross-Sector Referrals[19]

*Table 8: Tier 2 Cross-Sector Referrals*

| Tier 2 Required Elements | Tier 2 Optional Elements | Elements Not Usually Present in Tier 2 Programs |
|---|---|---|
| • Do no harm health and safety checks during energy assessments and retrofits<br>• Agreements between energy efficiency and community partners for systematized cross-sector referrals to local healthy home information and services<br>• System to track referrals made among energy, health, and housing partners<br>• Partners deliver their own program services for either energy efficiency or health, or Program Administrators may contract with Community Based Organizations (CBOs) to deliver services | • Use of electronic tracking platforms such as One Touch<br>• Coordinated marketing between CBOs and efficiency Program Administrators to reach target customers and communities<br>• Energy or healthy homes coaching to strengthen customer engagement<br>• Health-related non-energy benefits of energy efficiency work can help support spending on minor repairs and may reduce deferral rates.<br>• Testing and remediation of asbestos, mold, and radon hazards | • Fully integrated healthy homes service delivery<br>• Comprehensive in-home assessments conducted by Building Performance Institute, Inc. (BPI) certified Healthy Home Evaluators<br>• Dedicated funding from Medicaid or other health funding sources to pay for in-home assessments for eligible patients |

[19] VEIC Energy-Plus-Health Playbook (July 2019)

### 6.7 Achieving Tier 3 Integrated Services - Aspirational Goals

Should LIWP Multi-Family be able to fully achieve Cross-Services Referrals as outlined above the program can consider moving to a more fully engaged Integrated Health Services model as defined in Table 9 below.

**Tier 3: Integrated Energy-Plus-Health Services[20]**

*Table 9: Integrated Energy-Plus Health Services*

| Tier 3 Required Elements | Tier 3 Optional Elements |
|---|---|
| • Formal partnership between efficiency Program Administrator and health providers to integrate or braid service delivery<br>• Screening and targeting of patients with health conditions for which integrated efficiency and health retrofits offer a remediation strategy<br>• In-home visits by community health workers or other health professionals<br>• Comprehensive in-home assessments conducted by BPI certified Healthy Home Evaluators<br>• Health impact data collection and tracking<br>• List of eligible repairs and services and consistent delivery protocols<br>• Protection of client health information | • Dedicated funding from Medicaid or other health to pay for in-home assessments for eligible patients<br>• Coordinated marketing between CBOs and efficiency program administrators to reach target customers and communities<br>• Considering health-related non-energy benefits of energy efficiency work when calculating cost-benefit tests |

**Tier 3 – Integrated Energy-Plus-Health (Tier 3) Summary**

Attaining the Tier 3 Integrated Energy-Plus-Health level of services remains a possibility in that the LIWP Multi-Family program has a well-developed and robust integrated energy efficiency and solar PV approach to multi-family retrofits that is both comprehensive in approach and based on building science. Many of the measures that are currently being approved and installed in the LIWP Multi-Family program have positive health benefits and could potentially be expanded.

Similarly, community health workers who have a basic understanding of Healthy Homes principles are already visiting low-income client homes around the state, assessing healthcare needs of these vulnerable populations and can be trained and leveraged to make connections with energy efficiency and renewable solar service providers where possible.

[20] VEIC Energy-Plus-Health Playbook (July 2019)

Below are several additional items that will need to be developed to bring Tier 3 level Healthy Homes services to fruition:

- Screening and Training – Community health workers will need training in Healthy Homes Evaluation and provided information regarding the parameters of services that are available either through LIWP Multi-Family and/or other community-based programs that can assist with healthy homes repairs.
    - Alternately, health workers can subcontract home evaluations to a Building Performance Institute certified Healthy Homes Evaluator.
- Data Sharing, Tracking, and Quality Assurance – From initial assessment to installation of Healthy Homes measures, to client referrals, coordination of home visitations and follow-up, a robust database tracking system would need to be developed to follow clients through the entire process. Establishing a system to ensure close coordination between LIWP program administrators, contractors, and public health professionals would be a significant undertaking and require advanced planning and development time prior to program implementation.
    - Special protections must be put in place to protect client health information.
- Formal Partnerships and Referral mechanism – Energy efficiency program administrators and healthcare professionals must have clearly defined areas of responsibility and a detailed, clear path of referral for clients.

# Section 7 - Next Steps

As detailed by the Literature Review and Recommended Action Plan sections of this report, the current LIWP Multi-Family program's focus since its inception has been to provide deep energy efficiency retrofits and integrated solar renewable investments to affordable housing in disadvantaged communities throughout much of California. As it was designed, these retrofit improvements help to reduce energy usage and energy expenses for low-income residents in these properties and are intended primarily to reduce GHG emissions to offset the effects of climate change.

As a co-benefit, LIWP Multi-Family investments can also help to initiate remediation efforts at multi-family properties served by the program through the requirement that property owners, as a condition of their participation in the program, address existing health and safety hazards that were identified during a thorough site analysis. Mitigating health and safety issues at multi-family properties has been demonstrated through a substantial number of studies to improve health outcomes for occupants.

Additionally, LIWP Multi-Family as it is currently structured makes significant investments in energy efficiency and renewable energy measures that also have Healthy Homes co-benefits, such as air sealing (improved indoor air quality), ceiling, wall and floor insulation (thermal control, resilience and comfort) and duct sealing and cleaning (maintains proper ventilation and avoids harmful contaminant levels).

This report demonstrates that the LIWP Multi-Family program component currently offers significant benefits to low-income residents in the form of energy savings, which allows these households the ability to use their income to pay for other basic necessities such as food, medicine and healthcare. Similarly, LIWP Multi-Family provides health benefits to occupants by requiring property owners to address health and safety hazards and through installing energy efficiency and solar renewable energy measures at properties. These improvements help make residents' homes safer and more comfortable, which can reduce stress and enable better management of conditions that aggravate asthma and other respiratory illnesses. Moreover, these improvements can help vulnerable households as temperature extremes become more common as a result of global warming by increasing the climate resilience of affordable multi-family housing. Similar benefits can be realized for indoor air quality as extreme wildfire events become more common across California.

Despite all of the above, under its existing program structure and focus on reducing GHG emissions and energy savings LIWP Multi-Family likely falls short of achieving what is considered mid-range Healthy Homes level. With the program fully subscribed under current program guidelines and scheduled to conclude in June 2022, the design and implementation of a real-time cross-referral process between public health workers and LIWP Multi-Family would ultimately depend on the continuation of the program.

While LIWP is well situated to advance a meaningful Healthy Homes approach towards multi-family housing, incorporating additional health enhancements into the program such as a collaborative cross-referral system between health and energy partners will depend on

addressing the challenges previously identified. Actions that would be needed to advance this goal are as follows:

Substantial Enhancements

1. Funding Augmentation – The LIWP Multi-Family program is oversubscribed. All existing funding is reserved through its end date in mid-2022 and a waiting list of more than 180 properties exists. Future funding has not been appropriated.
2. Ensuring Long-Term Rent Affordability – LIWP Multi-Family has primarily served deed-restricted affordable multi-family housing properties, and these investments will provide energy, financial, and health benefits to the low-income residents for many years into the future. For LIWP Multi-Family in the future to address the significant stock of naturally occurring affordable housing that exists in California, CSD will need assistance from local and/or state governmental entities with expertise in regulatory enforcement mechanisms to help create protections for low-income renters in these properties. As currently constituted, the program is focused on serving deed-restricted affordable housing with available funding.
3. Electrification and Fuel-Substitution – Replacing older gas-burning appliances with high-efficiency electric furnaces, stoves, and water heaters can provide both a direct financial benefit to low-income residents when the substitution is paired with clean, renewable electric energy generated from site-installed solar PV arrays. Fuel substitution also provides numerous health benefits because without carbon producing appliances in the home indoor air quality is improved as particulate matter that may aggravate asthma and respiratory illness is reduced. However, absent changes in the current cost structure, incentivizing electrification and fuel substitution will likely continue to require higher incentive costs to achieve GHG reductions comparable to other energy efficiency measures.
4. Balancing Health & Energy Investments -– Similar to the Electrification and Fuel-Substitution action step detailed above, increasing the scope of health and safety measures provided by LIWP Multi-Family will require significant program modifications and would likely reduce the program's GHG reduction outcomes .
5. Creation of a New Fund Source for Healthy Homes Investments – The health benefits of energy efficiency and solar PV retrofits and associated co-benefits of health and safety investments at multi-family properties are well established. Increasing the ability of these improvements to address health and safety through an enhanced Health Homes program is likely dependent on identifying non-GGRF funding sources to supplement LIWP appropriations. Additional funding could help facilitate projects where cross-referral collaboration between public health workers and the LIWP Multi-Family program implementer. While other states like Washington have successfully leveraged multiple funding sources to expand healthy homes services, doing so requires long-term commitments.

With the substantial enhancements identified by this action plan, LIWP Multi-Family and its public health partners would be able to implement a collaborative referral process that includes

a robust tracking system to ensure services are implemented, that clients fully benefit from the investments, and positive healthcare outcomes are able to be tracked and ensured. At a minimum, these elements must be in place for the program to meet the level of a mid-level Health Homes program.

LIWP Multi-Family can serve as a program vehicle for delivering comprehensive energy and healthy home improvements to the low-income multi-family housing sector. The Recommended Action Plan outlines an integrated energy and health services approach that will require significant investment in training for community health workers to develop a full understanding of Health Homes evaluations, potential engagement of Building Performance Institute certified Healthy Homes Evaluators, data sharing agreements and detailed tracking of services and outcomes, and a formal referral mechanism between energy efficiency program implementers and community healthcare professionals to ensure high quality service delivery and positive health outcomes.

Meeting AB 1232's goals of implementing a cross-referral strategy to integrate energy and health services strategies into LIWP Multi-Family is achievable, but the strategy's efficacy is dependent upon long-term funding strategies to support continued program operation. By combining the best practices of comprehensive energy efficiency services and healthy homes approaches, energy programs such as LIWP Multi-family can be positioned to deliver services that improve the social determinants of health, provide greater economic security for tenants through lower energy costs, and offer low-income Californians a safe, clean, healthy, and more comfortable place to call home.

# Appendix 1 - Resource List


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## Appendix 2 – Healthy Homes Principles: Relationships among the "Seven Principles," recommended actions, reduced hazards, and outcomes

| Principle | Actions | Hazard and Contaminant Reduction | Associated Health and Other Impacts |
|---|---|---|---|
| **Keep it Dry** | **Water Intrusion:** Prevent water from entering the home through leaks in roofing systems, windows, and exterior shell.<br>**Drainage Problems:** Control ground drainage to prevent intrusion in crawlspaces and basements. Address inadequate gutter and downspout systems.<br>**Interior Leaks:** Prevent plumbing or sewage leaks or overflows.<br>**Humidity:** Control humidity from occupant behavior such as use of room humidifiers, and unvented clothes dryers.<br>**Exterior Leaks:** Respond to water intrusion and leaks, and correct condensation problems on walls, windows, and fixtures. | • Cockroaches<br>• Mold<br>• Rodents<br>• Lead-based paint<br>• Dust mites<br>• Termites<br>• Injuries associated with slips, trips, and falls<br>• Volatile organic compounds | • Reduction in asthma triggers and respiratory irritants.<br>• Reduction in risk for childhood lead poisoning.<br>• Reduced risk of injuries.<br>• Increased physical comfort and energy efficiency.<br>• Decrease in structural deterioration related to decay and pest damage. |
| **Keep it Clean** | Control dust and contaminants.<br>Create smooth and cleanable surfaces.<br>Reduce clutter.<br>Store food in pest-resistant containers.<br>Use wet-cleaning methods and HEPA-equipped vacuum.<br>Address hoarding behavior. | • Cockroaches<br>• Rodents<br>• Contaminant residues in dust<br>• Injuries | • Reduction in asthma triggers and respiratory irritants.<br>• Reduction in risk for childhood lead poisoning.<br>• Reduced exposure to contaminants in dust. |
| **Keep it Safe** | Store chemicals and medicines out of the reach of children.<br>Add child-safety devices such as cabinet locks, electrical outlet covers and safety gates.<br>Secure loose rugs and keep children's play areas free from hard or sharp surfaces.<br>Add grab bars in bath, two handrails on stairs, and other measures to prevent falls, especially for seniors.<br>Install smoke and carbon monoxide alarms.<br>Keep fire extinguishers charged and accessible.<br>Assure adequate lighting.<br>Reduce clutter.<br>Avoid circuit overloads and extension cords.<br>Keep water temperature below 120F. | • Injuries associated with slips, trips, and falls.<br>• Fires<br>• Household chemicals, pesticides, and medicines.<br>• Carbon monoxide poisoning | • Reduced exposure to chemicals and poisonings.<br>• Reduced risk of burns.<br>• Reduced risk of injury, especially to children and the elderly. |

| Principle | Actions | Hazard and Contaminant Reduction | Associated Health and Other Impacts |
|---|---|---|---|
| **Keep it Ventilated** | Ventilate bathrooms and kitchens.<br>Use whole house ventilation to provide fresh air.<br>Use active ventilation systems to manage indoor moisture, provide occupant comfort. | • Carbon Monoxide<br>• Formaldehyde<br>• Mold and Moisture<br>• Nitrogen Oxides<br>• Radon<br>• Volatile organic compounds | • Reduced respiratory irritation.<br>• Reduction in asthma triggers.<br>• Reduced chemical exposure.<br>• Reduced risk of lung cancer. |
| **Keep it Pest Free** | Make the home less habitable for pests by identifying sources of water, food, and shelter.<br>Remove harborage sites.<br>Seal cracks and openings throughout the home.<br>Address overgrown vegetation.<br>Store food in pest-resistant containers.<br>Monitor for pests and respond with integrated pest management approaches that prevent pests and use lower risk pesticides. | • Cockroaches<br>• Mice<br>• Rats<br>• Pesticides<br>• Bed bugs<br>• Ants | • Reduction in asthma triggers and respiratory irritants.<br>• Protection of central nervous system.<br>• Increased physical comfort.<br>• Decrease in bite-related injuries. |
| **Keep it Contaminant-Free** | Reduce contaminants coming into the home through purchasing decisions.<br>Limit spread of contaminants.<br>Stop smoking or move smoking outside.<br>Test for radon and, if needed, install a radon removal system. | • Environmental Tobacco Smoke<br>• Asbestos<br>• Formaldehyde<br>• Lead-based Paint<br>• Pesticides<br>• Radon<br>• Volatile and semi-volatile organic compounds<br>• Flame retardants<br>• Treated lumber | • Reduced risk of lung cancer.<br>• Reduced respiratory irritation.<br>• Reduced risk for childhood lead poisoning. |
| **Keep it Maintained** | Inspect, clean and repair the home and its equipment at regular intervals.<br>Change air filters and similar equipment.<br>Respond to problems quickly before minor problems become more serious.<br>Use lead-safe work practices for deteriorated paint in homes built before 1978. | • All of the above | • Reduced risk of lung cancer.<br>• Protection of central nervous system.<br>• Reduced asthma triggers.<br>• Reduced risk for childhood lead poisoning.<br>• Increased physical comfort and energy efficiency. |

*The contents of this table related to hazards and contaminants are not exhaustive. For more detailed information go to* https://nchh.org/information-and-evidence/learn-about-healthy-housing/healthy-homes-principles/

# Appendix 3 – LIWP Multi-Family Measures

| Measure Category | Measure |
|---|---|
| Solar | Solar PV System - Tenant and / or Common Areas |
| | Solar Thermal |
| Appliances | ENERGY STAR® Refrigerator |
| | High Efficiency Clothes Washers - Common or In-Unit |
| | Vending Machine Controller |
| Building Envelope | Cool Roof |
| | Attic Insulation |
| | Air Sealing |
| | Title 24 Compliant Windows |
| | Wall Insulation |
| | Floor Insulation |
| Health and Safety * | CO Monitors |
| | Dryer Exhaust Repair |
| | Combustion Safety Repairs |
| | Repair or replace gas lines |
| | Other - Duct repair and sealing, lining open returns |
| Lighting | Exterior/Common Area LED Lighting |
| | In-Unit LED Lighting |
| Other | Smart Thermostats |
| Pool | Variable Speed Pool and Spa Pumps |
| | Condensing Pool/Spa Heater |
| | Other - Install Cartridge Filter, Clean Piping |
| Space Heating & Cooling | Duct Sealing/Insulation |
| | Central HVAC Control Upgrade |
| | Central Hydronic Boiler |
| | Variable Speed Pumps and Fans |
| | Steam/Hydronic Distribution Upgrades (Balancing, TRV, etc.) |
| | Packaged Terminal A/C (PTAC) or Heat Pump |
| | Ductless Heat Pump |
| | Central Cooling Equipment |
| | PTAC Occupancy Sensor |
| Water Heating | Low Flow Showerheads |
| | Recirculation Pump Demand Controls |
| | Heat Pump DHW |
| | Pipe Insulation |
| | Upgrade Water Heaters to Condensing |
| | Condensing Domestic Hot Water Heaters in units |
| | Tankless Gas |
| | Recirculation Pump Temperature Controls |
| | In-Unit Heat Pump Water Heaters |

* Unless related to an energy efficiency upgrade these measures are paid for by property owner participants

# Appendix 4 – Complete LIWP Multi-Family Energy Efficiency Example Scope of Work

| LIWP Energy Efficiency Scope of Work | | | | | | |
|---|---|---|---|---|---|---|
| **Measure Detail** (see measure performance requirements for full measure and installation requirements) | Energy Savings % | Annual GHG Savings (MTCO2) | Owner or Tenant Savings | Incentive per **Annual** $MTCO_2$ See Note Below | **Completion Date** | **LIWP Incentive** |
| Low Flow Aerators and Showerheads (1.0 gpm Bathroom, 1.5 gpm Kitchen, 1.5 gpm Showerhead) | 0.30% | 0.75 | Tenant | $4,500 | Before 2/28/2020 | $3,375 |
| In-Unit LED Lighting | 1.70% | 6.37 | Tenant | $4,500 | Before 2/28/2020 | $28,665 |
| Common Area and Exterior LED Lighting (vacancy sensors for common area upgrades) | 2.00% | 6.28 | Owner | $3,000 | Before 2/28/2020 | $18,840 |
| High Efficiency Central Washing Machines (Front Load, MEF > 2.4, WF < 4.0) | 1.60% | 3.26 | Owner | $3,000 | Before 2/28/2020 | $9,780 |
| Energy Star Rated Refrigerators – 12 Units, 358 kWh | 0.10% | 0.48 | Tenant | $4,500 | Before 2/28/2020 | $2,160 |
| Attic Insulation – Triplex, Cottage, & Townhouse Units (bring to R-38; insulate attic hatches with rigid foam board and weatherstrip) | 4.80% | 10.31 | Tenant | $4,500 | Before 2/28/2020 | $46,395 |
| Attic Insulation – Office (bring to R-38, cap off/remove evaporative cooler ducts in office and community rooms) | 0.10% | 0.13 | Owner | $3,000 | Before 2/28/2020 | $390 |
| Aeroseal and Professionally Clean Ductwork – Townhouse Units (max 6% leakage at test out) | 0.20% | 0.48 | Tenant | $4,500 | Before 2/28/2020 | $2,160 |
| Aeroseal and Professionally Clean Ductwork – Office (max 6% leakage at test out) | 0.00% | 0.02 | Owner | $3,000 | Before 2/28/2020 | $60 |
| High Efficiency Tankless Gas Water Heater – Laundry Rooms (UEF .95) | 0.20% | 0.37 | Owner | $3,000 | Before 2/28/2020 | $1,110 |
| High Efficiency Tankless Gas Water Heater – Office (UEF .95) | 0.40% | 0.73 | Owner | $3,000 | Before 2/28/2020 | $2,190 |
| T24 Window Replacement – Triplexes (remaining 17 units; U-Factor: 0.3, SHGC: 0.22) | 1.20% | 3.92 | Tenant | $4,500 | Before 2/28/2020 | $17,640 |
| Exterior Wall Insulation – Triplexes (insulate cinder block walls with 2" minimum exterior rigid insulation (R11), reclad building) | 12.40% | 22.47 | Tenant | $4,500 | Before 2/28/2020 | $101,115 |
| Nest Thermostats – Triplexes | 0.50% | 1.31 | Tenant | $4,500 | Before 2/28/2020 | $5,895 |
| Airseal and insulate crawlspace – Cottages (R19) | 1.10% | 1.76 | Tenant | $4,500 | Before 2/28/2020 | $7,920 |
| Nest Thermostats – Cottages | 0.50% | 1.12 | Tenant | $4,500 | Before 2/28/2020 | $5,040 |

| LIWP Energy Efficiency Scope of Work | | | | | | |
|---|---|---|---|---|---|---|
| **Measure Detail** (see measure performance requirements for full measure and installation requirements) | Energy Savings % | Annual GHG Savings (MTCO2) | Owner or Tenant Savings | Incentive per **Annual** $MTCO_2$ See Note Below | **Completion Date** | **LIWP Incentive** |
| Heat Pump Water Heaters – Cottages (UEF 3.55) | 6.50% | 9.28 | Tenant | $4,500 | Before 2/28/2020 | $41,760 |
| Standard Efficiency Ducted Heat Pump – Townhouses (min HSPF 8, SEER 16; must recalculate loads, insulate supply and return plenums) | 5.10% | 10.69 | Tenant | $4,500 | Before 2/28/2020 | $48,105 |
| Nest Thermostats – Townhouses | 0.50% | 1.54 | Tenant | $4,500 | Before 2/28/2020 | $6,930 |
| Heat Pump Water Heaters – Townhouses (UEF 3.55) | 12.80% | 17.34 | Tenant | $4,500 | Before 2/28/2020 | $78,030 |
| **Non-Incentivized:** Required Combustion Safety Repairs – Confirm all units have functioning Carbon Monoxide (CO) alarms **Assuming Cottages get new water heaters** | | | | | Before 2/28/2020 | |
| **Totals** | **52.10%** | **98.61** | | | | **$427,560** |
| **Leveraged Rebate Summary** | | | | | | |
| **Is this project leveraging other major rebate sources, including but not limited to Investor Owned Utilities, OU, REN, or CCA whole building program rebates, CSI thermal rebates, or the federal ITC for solar thermal systems? If yes, the overall scope of work must achieve a minimum of 25% modeled energy savings.** | | | | | | Yes |
| **If yes, list rebate programs:** | PG&E ESA CAM, PG&E ESA In-Unit, PG&E Cooling Optimizer Program | | | | | |

# Appendix 5 - Common Acronyms

| Acronym | Definition |
|---|---|
| AB 1232 | Assembly Bill 1232 (Affordable housing: weatherization) |
| ACEEE | American Council for an Energy-Efficient Economy |
| AMI | Area Median Income |
| BAAQMD | Bay Area Air Quality Management District |
| BEE | Base Energy Efficiency |
| BPI | Building Performance Institute |
| CAL FIRE | California Department of Forestry and Fire Prevention |
| CARB | California Air Resources Board |
| CBO | Community Based Organizations |
| CCA | Community Choice Aggregator |
| CCHEU | Climate Change and Health Equity Unit |
| CCI | California Climate Investments |
| CDC | U.S. Centers for Disease Control and Prevention |
| CDPH | California Department of Public Health |
| CEC | California Energy Commission |
| CO | Carbon Monoxide |
| COPD | Chronic Obstructive Pulmonary Disease |
| COVID-19 | Coronavirus |
| CPUC | California Public Utilities Commission |
| CSBG | Community Services Block Grant |
| CSD | California Department of Community Services and Development |
| CSI | California Solar Initiative |
| DAC | Disadvantaged Community |
| DHW | Domestic Hot Water |
| DOE | U.S. Department of Energy |
| DOE WAP | Department of Energy Weatherization Assistance Program |
| EE | Energy Efficiency |
| EEE | Enhanced Energy Efficiency |
| EPA | U.S. Environmental Protection Agency |
| EUL | Effective Useful Life |
| GGRF | Greenhouse Gas Reduction Fund |
| GHG | Greenhouse Gas |
| GPM | Gallons Per Minute |
| GRC | Green Renovation Construction |
| H&S | Health & Safety |
| HEPA | High-Efficiency Particulate Air (filters) |
| HHS | U.S. Department of Health and Human Services |
| HiAP | Health in All Policies |
| HSPF | Heating Seasonal Performance Factor (heating efficiency, heat pump) |
| HUD | U.S. Department of Housing and Urban Development |

| Acronym | Definition |
|---|---|
| HVAC | Heating, Ventilation, and Air Conditioning |
| IAQ | Indoor Air Quality |
| IOU | Investor Owned Utility |
| IPM | Integrated Pest Management |
| ITC | Investment Tax Credit |
| LED | Light Emitting Diode (lighting) |
| LIHEAP | Low-Income Home Energy Assistance Program |
| LIWP | Low-Income Weatherization Program |
| LIWP MF | Low-Income Weatherization Program Multi-family |
| MEF | Modified Energy Factor (washing machine) |
| MERV | Minimum Efficiency Reporting Value |
| NCHH | National Center for Healthy Housing |
| NOAH | Naturally Occurring Affordable Housing |
| OEHHA | Office of Environmental Health Hazard Assessment |
| OHE | Department of Public Health Office of Health Equity |
| OPEC | Organization of the Petroleum Exporting Countries |
| PA | Program Administrator |
| PG&E ESA CAM | Pacific Gas & Electric Energy Savings Assistance Program Common Area Measures |
| PG&E ESA In-Unit | Pacific Gas & Electric Energy Savings Assistance Program In-Unit Measures |
| PI | Program Implementer |
| PRI | Proactive Rental Inspection |
| PSHPS | Potential Supplemental Home Performance Services |
| PTAC | Packaged Terminal Air Conditioning |
| PV | Photo Voltaic |
| RAMP | Regional Asthma Management & Prevention |
| REAP | Rent Escrow Account Program |
| REN | Regional Energy Network |
| SEER | Seasonal Energy Efficiency Ratio (cooling efficiency, heat pump) |
| SHGC | Solar Heat Gain Coefficient (window replacement) |
| SOW | Scope of Work |
| SPOC | Single Point of Contact |
| TA | Technical Assistance |
| Three$^3$ | Three Cubed |
| TRV | Thermostatic Radiator Valve |
| UEF | Uniform Energy Factor (water heater) |
| U-Factor | Thermal Transmittance (window replacement) |
| VEIC | Vermont Energy Investment Corporation |
| VENT | Ventilation |
| VOC | Volatile Organic Compound |
| WF | Water Factor (washing machine) |
| Wx | Weatherization |