Notes regarding submitting comments on this Draft Work Product:

Comments are Due June 20, 2018.

Comments shall be no longer than 5 pages.

Comments should be submitted to LDBPcomments@ebce.org

Scenario Analysis Report

for

East Bay Community Energy

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Introduction

This report is part of the East Bay Community Energy (EBCE) *Local Development Business Plan* (LDBP). The report compares a set of potential local development scenarios to allow EBCE staff to compare how different program types and levels of implementation impact revenue, jobs, greenhouse gas (GHG) emissions, and air quality. The results rely on recommendations compiled across the LDBP planning process, which can be found on the EBCE website at https://ebce.org/local-development-business-plan (individual links are given in Table 1).

Table 1: Previous LDBP deliverables

deliverable	*URL: https://ebce.org/wp-content/uploads/*
Solar Siting Survey	Task-1-EBCE-Solar-Siting-Survey-summary-report_DRAFT.pdf
Wind Assessment	Task-1-EBCE-Wind-Assessment-Narrative_DRAFT.pdf
Demand Response Assessment	EBCE-Demand-Response-Assessment_DRAFT.pdf
Net Energy Metering Strategy	EBCE-Net-Energy-Metering-Strategy-Recommendations_DRAFT.pdf
Energy Efficiency Assessment	EBCE-Energy-Efficiency-Assessment_DRAFT.pdf
Energy Storage Recommendations	EBCE-Energy-Storage-Contracting-Strategy-Recommendations_DRAFT.pdf
Feed-in-Tariff Design Recommendations	Task-3-EBCE-FIT-Design-Recommendations_DRAFT.pdf
Opportunities for Natural Gas Fuel Switching	(forthcoming)

It is important to note that none of the scenarios discussed in this document are meant to serve as recommendations. Rather, they are illustrative examples to support thinking, assessment, and eventually decision-making.

Summary of findings

Three scenarios were created for comparison in the scenario analysis tool: a ***moderate*** scenario that blends new local renewables with grid innovation programs; a ***local renewables*** scenario emphasizing investments in local renewables; and a ***grid innovation*** scenario emphasizing investments in grid innovation programs. Detailed information on the creation of these scenarios can be found in the "Scenario definitions" section of this report (Table 16).

The results of the scenario analysis are summarized in Table 2 below.

Table 2: Summarized results

metrics (2018–2025)	*Moderate*	*Local renewables*	*Grid innovation*
net surplus revenue [M$]	257	274	234
revenue change [M$]	-38	-21	-61
local renewables [MW]	386	411	391
peak local generation [GWh/yr]	714	759	723
total jobs	5,494	5,134	6,361
av. hourly wage	$32.90	$33.67	$32.63
direct jobs	3,231	3,006	3,764
av. hourly wage	$34.52	$35.68	$34.11
GHG reductions [MT CO_2e]	393,084	299,295	502,716
air pollutant reductions [kg NO_x]	67,348	66,104	101,022

Annual net costs (i.e., total costs minus additional revenue) for each scenario are graphed in Figure 1, along with surplus revenue and net revenue (surplus revenue after a 1.5% rate reduction). Figure 2 shows scenario net costs normalized as a percentage of net revenue.

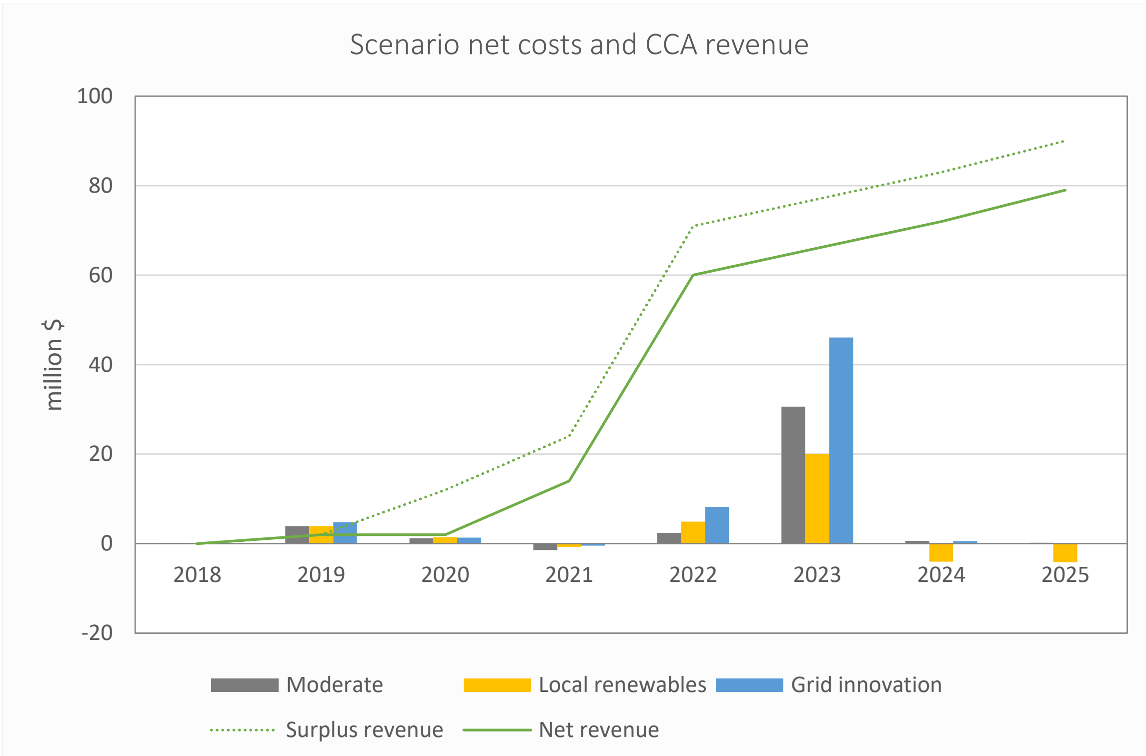

Figure 1: Scenario net costs and CCA revenue by year

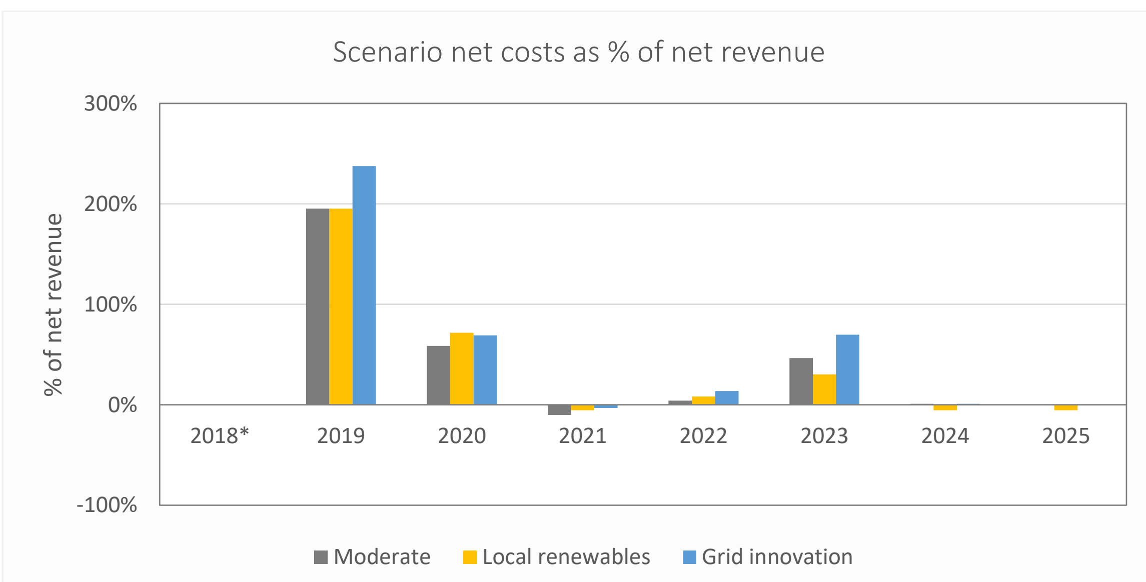

Figure 2: Scenario net costs as percentage of net revenue by year
Note: no revenue in 2018

Annual job creation by scenario is given in Figure 3 (direct) and Figure 4 (total).

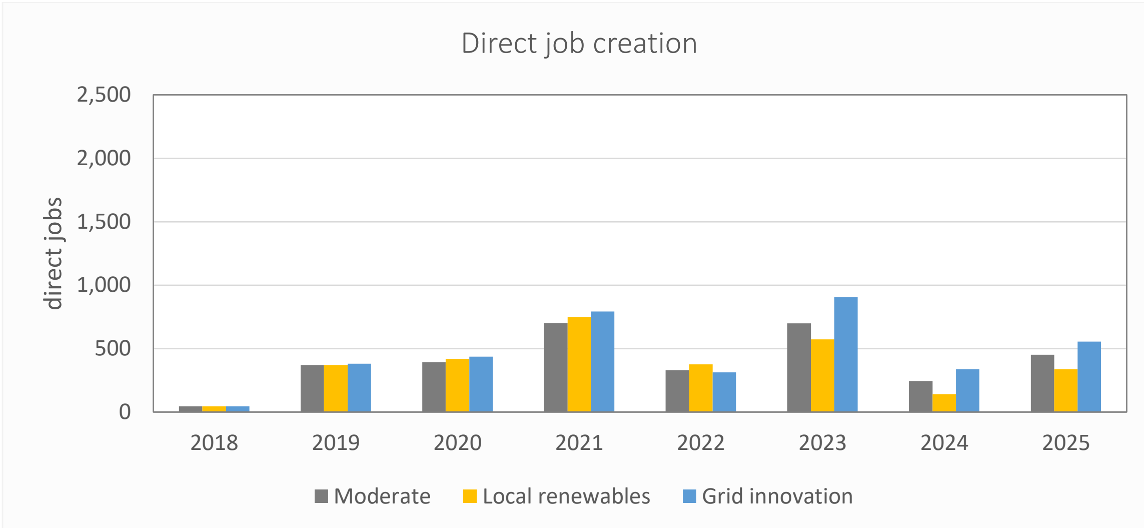

Figure 3: Direct job creation by scenario and year

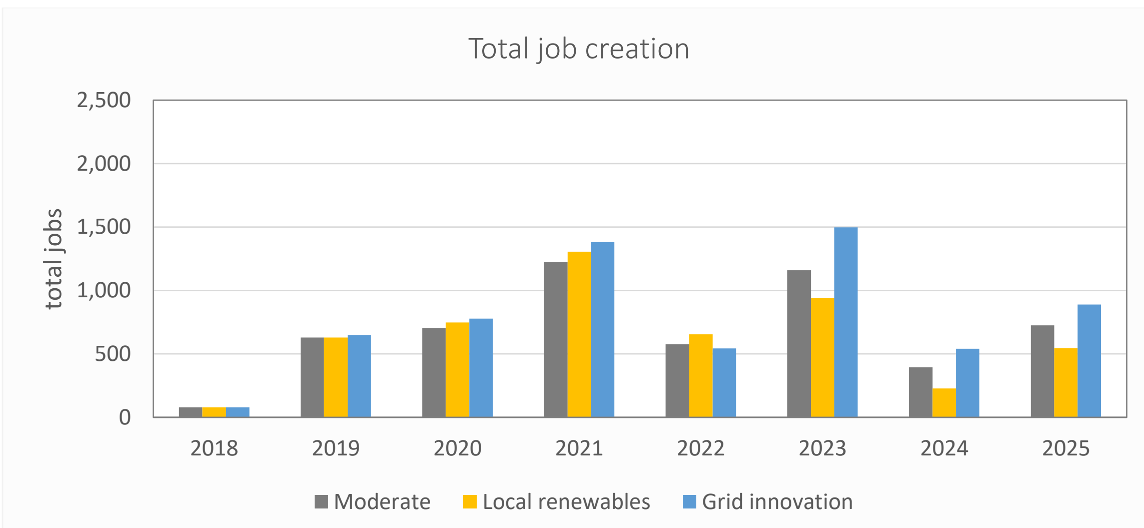

Figure 4: Total job creation by scenario and year

Moderate scenario

The moderate scenario would create **3,231 direct jobs** (5,494 total) in the 8-year time period from 2018 to 2025. It would lead to the installation of **386 MW** of new renewables with a peak annual generation of **714 GWh/yr**, approximately 11.5% of EBCE's projected annual electricity load of 6,200 GWh/yr in 2025 (from the *Feed-in-Tariff Design Recommendations* deliverable).

In addition, by incentivizing electric vehicle ownership and natural gas fuel switching (thus reducing emissions from the combustion of vehicle fuel and natural gas), as well as reducing total electricity consumption (through energy efficiency and demand response programs), the moderate scenario would reduce **393,084 MT CO_2e** of GHG emissions and **67,348 kg NO_x** of air pollutant emissions by the year 2025. It should be noted that increased local solar and wind do not lead to reduced greenhouse gas emissions or air pollution, due to the assumption that local renewables would replace distant renewables within EBCE's procurement portfolio.

In total, this suite of programs would decrease net surplus revenue by **$37.7 million** (or 13% of the business-as-usual surplus revenue of $295 million), leaving $257 million in total net surplus revenue over eight years.

Local renewables scenario

Compared to the moderate scenario, the local renewables scenario includes an expanded solar FIT program and more utility-scale solar, with lower investments in energy efficiency, demand response, and energy storage.

Over 8 years, the local renewables scenario would create **3,006 direct jobs** (5,134 total). It would lead to the installation of **411 MW** of new renewables, with a peak annual generation of **759 GWh/yr** (12.2% of projected load). As no changes are made to the electric vehicle and fuel switching programs, GHG and air pollutant emission reductions are the same as in the moderate scenario: **299,295 MT CO_2e** and **66,104 kg NO_x**. Net surplus revenue is decreased by **$21.5 million** (7% of business-as-usual), leaving $274 million in total surplus revenue by 2025.

Grid innovation scenario

In the grid innovation scenario, solar and wind FIT programs are scaled back in favor of larger investments in other programs. To accommodate higher initial costs, implementation of the energy efficiency, demand response, energy storage, and fuel switching programs are moved back one year.

Over 8 years, the grid innovation scenario would create **3,764 direct jobs** (6,361 total). It would lead to the installation of **391 MW** of new renewables, with a peak annual generation of **723 GWh/yr** (11.7% of projected load). Larger investments in electric vehicles and fuel switching would reduce **502,716 MT CO_2e** of GHG emissions and **101,022 kg NO_x** of air pollutant emissions. Net surplus revenue is decreased by **$60.6 million** (21% of business-as-usual), leaving $234 million in total surplus revenue by 2025.

About this report

Goals

The purpose of the scenario analysis is to enable comparison of multiple complex metrics and programs in one simplified format. In addition, we aim to be completely transparent in our methods. Any analysis such as this must rely on multiple assumptions. While we have used the best data available and verified our assumptions across multiple sources, we also understand any model is only as trustworthy as the data used to create it. Thus, we have clearly listed and explained all assumptions used in the methodology section below.

Scenario tool

The EBCE Scenario Analysis Tool (henceforth referred to as “the tool”) provides a quantitative assessment of various buildout scenarios for EBCE from 2018 to 2025, enabling comparison of each scenario’s multidimensional costs and benefits to the CCA, the community, and the environment. It builds upon past LDBP work, combining the results and recommendations from previous deliverables into a comprehensive and dynamic model (see “Methodology” section for details). Calculated results are presented in a clear and concise manner to support decision-making and engagement with the public audience. EBCE will use this tool to inform on-going program investments past the conclusion of the LDBP process.

Next steps

The *Local Development Business Plan* is not a static report, but rather a living document that supports the ongoing process of analyzing, implementing, and evaluating local development programs in EBCE territory. Local development will continue over the long term and EBCE needs a tool that can support ongoing data-driven discussions among multiple parties. The scenario analysis tool was developed to meet this need.

The dynamic and flexible scenario analysis tool will support EBCE staff and the community advisory committee in determining program priorities and investment allocations over the mid and long term. This transparent process will ensure long-term success and buy-in of all EBCE programs.

In early summer 2018, EBCE will host a workshop facilitated by the LDBP team to discuss the cost and benefits from different future investment scenarios. In the workshop, the group will discuss and compare the costs and benefits from a variety of program options and run several scenarios in real time. The presentation will include an in-depth overview of the job creation, environmental benefits, and financial impacts from all the programs covered in the LDBP.

Following the workshop, EBCE and the community advisory committee will continue to use the tool to further development their implementation strategy.

Methodology

In the tool, scenarios are created based on *user inputs* to the following modules:

1. Local solar
2. Local wind
3. Energy efficiency
4. Demand response
5. Energy storage
6. Electric vehicles
7. Fuel switching

Each module also contains *data sources* provided by other members of the LDBP team, such as job creation per MW of local solar or CCA savings from demand response programs. The tool combines the user inputs and data sources to calculate the following *outputs* for each scenario for the years 2018 through 2025:

- revenue change and total net surplus revenue [$]
- direct and indirect jobs created [#]
- average job wage [$/hr]
- peak annual local generation [MWh/yr]
- GHG emission reductions [kg CO_2e]
- air pollutant emission reductions [kg NO_x]

The calculation methodology and key assumptions (numbers in **bold**) for each module in the tool are described in the following sections.

Local solar

In the local solar (LS) module, quantitative user inputs in MW are qualified by program type (FIT/NEM/utility-scale), size tier, region (East/West County), and year. Based on region and whether or not single-axis tracking is used, annual generation in MWh is calculated using the assumptions in Table 3.

Table 3: Annual solar generation per MW by region

metrics (2018–2027)	*annual generation [MWh/yr/MW]*
West County (Oakland)	**1,521**
East County (Livermore)	**1,605**
East County (Livermore), single-axis tracking	**2,024**

Financial calculations: From annual generation numbers in MWh, financial metrics are calculated based on program type. For FIT projects, the cost to the CCA per MWh is:

FIT CCA cost = FIT price – FIT avoided procurement cost

For NEM projects, the CCA pays only pays for excess electricity generation, which is a portion of total generation. Self-consumed energy (generated and consumed by the customer, behind the meter) results in lost revenue for the CCA. In both cases, procurement costs are avoided. CCA costs per MWh for NEM projects are calculated as:

NEM CCA cost = excess generation cost + self-consumption cost

excess generation cost = (% excess) × (NEM price – NEM avoided procurement cost)

self-consumption cost = (1 – % excess) × (preempted revenue – NEM avoided procurement cost)

The assumptions are outlined in Table 4 below.

Table 4: FIT and NEM assumptions

assumption	*value*	*unit*
FIT price	**103**	$/MWh
FIT avoided procurement cost	**58**	$/MWh
NEM price	**70**	$/MWh
NEM avoided procurement cost	**53**	$/MWh
preempted revenue	**69**	$/MWh
excess %	**27**	%

For utility-scale solar, the price per MWh is assumed to be equivalent to the cost of alternative procurement.

Jobs calculations: Direct and indirect jobs are calculated on a per-MW basis based on size tier. There are two types of jobs created by solar projects: one-time installation jobs and annual maintenance jobs. A table detailing jobs per MW and accompanying wages can be found in Appendix B.

Local wind

The methodology for the local wind (LW) module is similar to the LS module, with a few exceptions. Annual generation is assumed to be **1,805** MWh/yr/MW, based on an average of wind generation values from the *Wind Assessment* report. Financial calculations are performed exactly as in the local solar module. One-time installation jobs and annual maintenance jobs are calculated per MW based on wind size tiers (see Appendix B).

Energy efficiency

Unlike the LS and LW modules which take quantitative user inputs in MW, the energy efficiency (EE) module is calculated based on user selection from a set of predefined EE program options. Each program option consists of a certain amount of total investment in a number of EE project types, as shown in Table 5 below:

Table 5: EE program options

	million dollars of total investment in:					
EE program option	*industrial*	*MUSH*	*large commercial*	*small/medium commercial*	*residential*	*residential (CARE)*
High C&I/MUSH	**0.18**	**1.76**	**0.72**	**0.65**	**0.98**	**1.39**
High C&I/Industrial	**1.26**	**1.18**	**0.36**	**0.44**	**0.65**	**1.39**
High Residential/CARE	**0.18**	**1.18**	**0.54**	**0.44**	**1.63**	**2.32**
High CARE	**0.18**	**1.18**	**0.54**	**0.44**	**0.65**	**3.71**

Financial calculations: The financial calculations are comprised of three parts: one-time investment costs, annual revenue loss, and annual CCA savings.

Based on the selected EE program option, investment costs to the CCA are calculated as a portion of the total investment in each EE project type (Table 6), with the remaining investment assumed to come from other sources (such as grants or private investment).

Table 6: CCA costs by EE project type

EE project type	*CCA cost [$] per million dollars of total investment*
industrial	**480,000**
MUSH	**450,000**
large commercial	**480,000**
small/medium commercial	**400,000**
residential	**630,000**
residential (CARE)	**1,000,000**

Annual revenue loss (from energy reductions) and CCA savings for each EE program option are shown in Table 7 below.

Table 7: Annual revenue loss and savings by EE program option

EE program option	*revenue loss [$/yr]*	*CCA savings [$/yr]*
High C&I/MUSH	**1,384,000**	**1,352,860**
High C&I/Industrial	**1,384,000**	**1,332,100**
High Residential/CARE	**1,384,000**	**640,100**
High CARE	**1,384,000**	**553,600**

The values defining EE program options and project types (Table 5–Table 7) were derived from a combination of the results of the *Energy Efficiency Assessment* deliverable, which includes both estimated costs to implement the programs and estimated kWh savings the programs will generate, which in turn lead to reduced procurement costs for EBCE. The selected EE program option can be scaled by using a multiplier, which affects financial and jobs calculations.

Jobs calculations: One-time installation jobs per million dollars of total investment in each of the EE project types can be found in Appendix B.

Demand response

User input in the demand response (DR) module is also based on a selection of program options; however, unlike in the EE module, the user may select more than one, as the DR program options are non-exclusive and independent of each other.

Table 8: DR program options

	million dollars of total investment in:			
DR program option	*direct load control (residential)*	*direct load control (non-residential)*	*tariff: base interruptible program*	*tariff: scheduled load reduction program*
Residential Load Control	**1.2**	--	--	--
Non-residential Load Control	--	**0.5**	--	--
Industrial Tariff	--	--	**0.2**	--
Large Commercial Tariff	--	--	--	**0.25**

Financial calculations: As in the EE module, financial calculations for the DR module consist of one-time installation costs, annual revenue loss, and annual CCA savings.

As shown in Table 9 below, the CCA bears the total cost for three of the four project types:

Table 9: CCA costs by DR project type

DR project type	*CCA cost [$] per million dollars of total investment*
direct load control (residential)	**500,000**
direct load control (non-residential)	**1,000,000**
tariff: base interruptible program	**1,000,000**
tariff: scheduled load reduction program	**1,000,000**

Table 10 gives the annual revenue loss and CCA savings for each DR program option. Also included are the installation costs and customer savings, which are not included in financial calculations but are used to calculate jobs.

Table 10: Annual revenue loss, savings, and other metrics by DR program option

DR program option	*revenue loss [$/yr]*	*CCA savings [$/yr]*	*installation cost [$]*	*customer savings [$/yr]*
Residential Load Control	**0**	**163,500**	**1,200,000**	**225,000**
Non-residential Load Control	**0**	**226,000**	**500,000**	**225,000**
Industrial Tariff	**18,000**	**–270,300**	**200,000**	**599,000**
Large Commercial Tariff	**7,000**	**172,000**	**250,000**	**66,500**

The negative savings for the "Industrial Tariff" program option indicates increased annual operation expenditures, due to the higher cost of administering this type of DR program.

The values defining DR program options and project types (Table 8–Table 10) were derived from a combination of the results from the *Demand Response Assessment* deliverable which includes both estimates of the cost to implement the programs estimates of the kWh and concurrent cost savings from the program. The selected DR program options can be scaled by using multipliers, which affect financial and jobs calculations.

Jobs calculations: Each DR program creates one-time installation jobs and annual jobs due to customer cost savings, based on the installation costs and customer savings in the table above. Data on jobs and wages can be found in Appendix B.

Energy storage

User input in the energy storage (ES) module is similar to the EE module, in which only one program option is selected. However, ES program options are defined by MWh of energy storage capacity (rather than million dollars of total investment) in each ES project type.

Table 11: ES program options

	MWh of energy storage capacity in:		
ES program option	*utility-scale*	*commercial/industrial*	*residential*
Base	**10**	**7**	**3**
High Residential	**10**	**5**	**5**
High Commercial	**8**	**10**	**2**
High Utility-scale	**15**	**3**	**2**

Financial calculations: Each MWh of energy storage capacity results in a certain amount of total investment, of which the CCA only pays a portion. Thus, the cost to the CCA per MWh can be derived.

Table 12: Total investment and CCA cost per MWh by ES project type

ES project type	*million dollars of total investment per MWh*	*CCA cost [$] per million dollars of total investment*	*CCA cost [$] per MWh*
utility-scale	**0.5**	**1,000,000**	**500,000**
commercial/industrial	**0.75**	**250,000**	**187,500**
residential	**1**	**350,000**	**350,000**

The values defining ES program options and project types (Table 11–Table 12) were derived from a combination of the results from the *Energy Storage Recommendations* deliverable. The selected ES program option can be scaled by using a multiplier, which affects financial and jobs calculations.

Jobs calculations: Both one-time installation jobs and annual maintenance jobs are created in the ES module (see Appendix B for details).

Electric vehicles

In the electric vehicle (EV) module, user input is the amount of money that the CCA puts towards electric vehicle subsidies and charger installations. The assumptions used in EV module are given in Table 13 below.

Table 13: EV assumptions

assumption	*value*	*unit*
electric vehicle subsidy	**2,500**	$/EV
total cost of electric vehicle	**37,200**	$/EV
charger cost	**1,200**	$/charger
charger installation cost	**200**	$/charger
additional electricity demand from EVs[1]	**2.5**	MWh/yr/EV
CCA revenue from additional demand	**80**	$/MWh

[1] https://www.afdc.energy.gov/fuels/electricity_charging_home.html, "General Motors estimates the annual energy use of the Chevy Volt is about 2,520 kilowatt-hours"

procurement costs from additional demand	**60**	$/MWh
total revenue from additional demand	**20**	$/MWh

Financial calculations: Costs to the CCA from the EV program come from the one-time cost of electric vehicle subsidies and chargers (from user input), as well as the annual revenue from additional demand from EVs.

Jobs calculations: One-time jobs are created by the EV program from electric vehicle sales and charger installation, based on values given in Appendix B.

GHG and air quality calculations: Replacing internal combustion vehicles with electric vehicles results in reductions of GHG and air pollutant emissions. According to the EPA, the average passenger vehicle emits **4.67 MT CO_2e** annually based on a nationwide average 22 mpg and 11,443 vehicle miles traveled per year.[2] Nitrogen oxides (NO_x), a significant source of air pollution from vehicles, are emitted at a rate of 0.47 g NO_x/mi[3], or **5.405 kg NO_x** per vehicle per year.

Fuel switching

Calculations for the fuel switching (FS) module are based on the number of initial customers in the OFF Gas program, which encourages the use of smart thermostats, electric water heaters, and electric space heaters. Data is based on a moderate implementation scenario assuming 2,980 customers (about 1% of total), with projected participation outlined in Table 14.

Table 14: Projected customer participation in fuel switching program (2,980 customers)

	new customers		
year	*thermostat*	*water heater*	*space heater*
1	**1,043**	0	0
2	**745**	**1,043**	0
3	**596**	**745**	**298**
4	**298**	**596**	**447**
5	**149**	**447**	**298**
6	**149**	**149**	**298**
7	0	0	**149**

[2] https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references, "Passenger vehicles per year"
[3] http://www.dot.ca.gov/hq/transprog/federal/cmaq/CMAQCAL.pdf, "Table 3: Average Auto Emission Factors"

Financial calculations: The projected cash flow numbers for the OFF Gas program shown in Table 15 are based on the moderate implementation scenario assuming 2,980 customers and are assumed to scale linearly with the number of customers.

Table 15: Projected cash flow for fuel switching program (2,980 customers)

year	*account balance [$]*	*cash flow [$/yr]*
1	**$337,578**	**$337,578**
2	**($15,573)**	**($353,151)**
3	**($463,089)**	**($447,516)**
4	**($870,677)**	**($407,588)**
5	**($1,005,356)**	**($134,679)**
6	**($1,005,188)**	**$168**
7	**($827,132)**	**$178,056**

The values in Table 14–Table 15 are derived from the *Opportunities for Natural Gas Fuel Switching* deliverable.

Jobs calculations: One time jobs are created by the FS program from the sale and installation of each appliance (thermostat, water heater, space heater), based on values given in Appendix B.

GHG and air quality calculations: Decreased natural gas consumption results in GHG and air pollutant emission reductions. According to the EPA, GHG and nitrogen oxide emissions per therm of natural gas combustion are **5.3 kg CO_2e**[4] and **4.147 g NO_x**,[5] respectively.

Scenario definitions

Three scenarios were created for comparison in the scenario analysis tool:

- **Moderate:** based on previous deliverables, LDBP team expertise, and EBCE staff input
- **Local renewables:** alternative scenario with more focus on local solar development
- **Grid innovation:** alternative scenario emphasizing investments in other programs like energy efficiency, demand response, energy storage, electric vehicles, and fuel switching

Table 16 below outlines the main differences between the scenarios by module, with deviations from the moderate scenario in **bold**.

[4] https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references, "Therms and Mcf of natural gas"
[5] https://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s04.pdf, "Table 1.4-1: Emission factors for nitrogen oxides (NO_x) and carbon monoxide (CO) from natural gas combustion"

Table 16: Scenario definitions by module

module	*Moderate*	*Local renewables*	*Grid innovation*
Local Solar	• 25 MW FIT (2020–22) • 100 MW NEM (2018–22) • 200 MW utility-scale (2019–25)	• **50 MW FIT** (2020–22) • 100 MW NEM (2018–22) • 200 MW utility-scale (2019–25)	• **30 MW FIT** (**2020–21**) • 100 MW NEM (2018–22) • 200 MW utility-scale (2019–25)
Local Wind	• 5 MW FIT (2020–21) • 6 MW NEM (2020–22) • 50 MW utility-scale (2021)	• 5 MW FIT (2020–21) • 6 MW NEM (2020–22) • 50 MW utility-scale (2021)	• 5 MW FIT (2020–21) • 6 MW NEM (2020–22) • 50 MW utility-scale (2021)
Energy Efficiency	• High C&I/MUSH (2022–23) [$15.7M CCA investment]	• High C&I/MUSH (2022–23) [**$10.5M CCA investment**]	• High C&I/MUSH (2022–23) [**$19.2M CCA investment**]
Demand Response	• Load control: res (2021) • Load control: non-res (2020) • Tariff: industrial (2023) • Tariff: commercial (2019) [$29.0M CCA investment]	• Load control: res (2021) • Load control: non-res (2020) • Tariff: industrial (2023) • Tariff: commercial (2019) [**$26.0M CCA investment**]	• Load control: res (2021) • Load control: non-res (**2021**) • Tariff: industrial (2023) • Tariff: commercial (2019) • [**$38.0M CCA investment**]
Energy Storage	• 20 MWh utility-scale (2022) • 14 MWh C&I (2023) • 6 MWh res (2023) [$14.7M CCA investment]	• 20 MWh utility-scale (2022) • 14 MWh C&I (2023) • 6 MWh res (2023) [$14.7M CCA investment]	• **40 MWh utility-scale** (2022) • 28 MWh C&I (2023) • 12 MWh res (2023) [**$29.5M CCA investment**]
Electric Vehicles	• 4,000 EVs (2023) • 2,500 chargers (2023) [$13M CCA investment]	• 4,000 EVs (2023) • 2,500 chargers (2023) • [$13M CCA investment]	• 6,000 EVs (2023) • 5,000 chargers (2023) [**$21M CCA investment**]
Fuel Switching	• 30,000 customers (2022)	• **15,000 customers** (2022)	• **45,000 customers** (2022)

Discussion

This section of the report discusses the costs and benefits of the local renewable and grid innovation programs covered in this report. The aim of this section is to clarify the trade-off in benefits between these two types of investment. In general, local renewables lead to more job creation than grid innovation programs. However, it should be noted that many if not all of the jobs created through NEM (roof-top solar installations) would have occurred anyway under PG&E's existing program. Thus, while EBCE can take "credit" for these jobs, they would not represent new economic activity. Further, the details of program design play a significant role in determining the level and significance of local economic benefit. For example, incentives to locate development in low-income areas, project labor agreements, and/or coupling a program with job training opportunities could increase the economic effect of the program.

While grid innovation programs do not create as many jobs through our scenario analysis, all of these jobs created would be "new" jobs and thus have a greater economic impact. In addition, these programs lead to greater environmental benefits. These benefits are likely to increase over time, as investments in energy efficiency, demand response, and energy storage increase the grid capacity for additional renewables. In addition, the grid innovation programs in particular have important benefits that are not captured through this scenario analysis. Benefits from directing these programs toward vulnerable populations can increase health and resiliency in communities that need it the most.

A discussion of the costs and benefits of each set of programs is below.

Local renewable programs

The scenario results in this report make apparent a set of relationships that have been long understood by researchers and policy-makers but difficult to quantify at the local level. The scale of renewables impacts job creation, job quality, and financial costs. In general, utility-scale renewables create higher-quality ongoing jobs than rooftop solar. These larger projects, however, lead to a fewer number of jobs per MW than smaller distributed systems. From the CCA's perspective, larger local renewable installations are also more cost-efficient than smaller installations. EBCE anticipates that new local utility scale solar can be procured for the same cost as at-a-distance solar. Thus, it is possible to create new high-quality jobs at no additional cost. Conversely, the smaller-scale solar discussed in this report comes at a premium of $16 to $45 per MWh. Due to the higher cost of smaller-scale renewables, we recommend that any EBCE investments in NEM or wholesale solar maximize other local returns- to ensure the increased cost leads to increased benefit. The municipal FIT program EBCE is considering represents an example of how to ensure the higher cost for wholesale developments results in significant local benefit. The benefit adders described in the LDBP are another way to maximize the local benefit of these investments.

The charts below show job creation benefits for the installation and maintenance of local solar projects by size tier. The size of the bubble indicates the number of jobs, and the vertical position shows the average hourly wage of induced jobs. Size tiers with asterisks (*) indicate single-axis tracking systems.

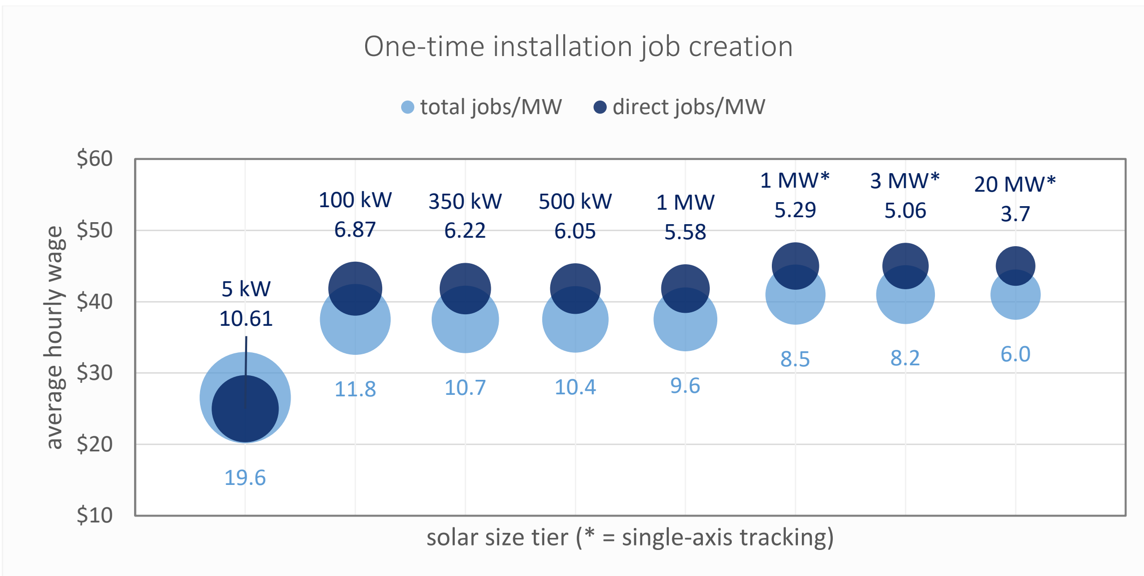

Figure 5: One-time installation jobs per MW by solar size tier

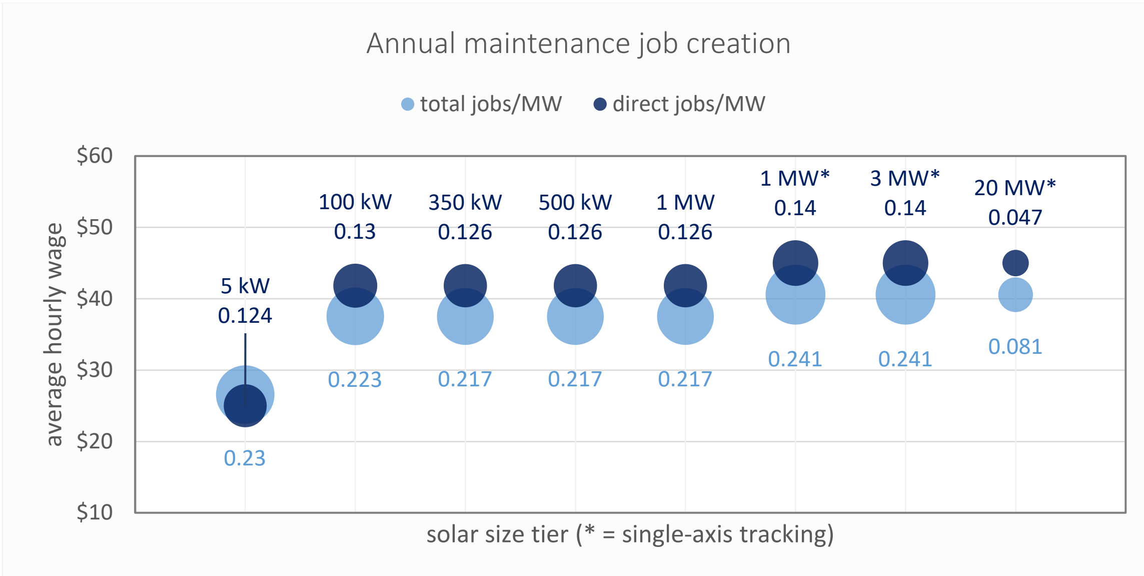

Figure 6: Annual maintenance jobs per MW by solar size tier

Another key to understanding the potential impact of different types of local renewable development is that because net energy metering (NEM) is an existing PG&E program, the increase in local economic benefit will not be equivalent to the total number of jobs created through EBCE's program. In other words, it is likely that most of the jobs created through EBCE's NEM program would have happened anyway. The local benefit adders recommended by the LDBP, however, could incentivize new development to happen in a way that increases local benefit. As this program is new, it is not possible to predict how the adders are likely to impact development. A retrospective analysis of program uptake would be the best method to capture the full local benefit from EBCE's NEM program.

Grid innovation programs

Grid innovation programs include energy efficiency, demand response, energy storage, fuel switching, and electric vehicles. In addition to creating jobs, this suite of programs leads to greenhouse gas and air pollution reductions by reducing regional fossil fuel combustion. Further, these programs are important for increasing the grid's capacity for additional renewables and thus achieving the State's ambitious goals of 40% GHG emissions reductions by 2030. Finally, by targeting these programs toward customers that are most expensive for EBCE to serve, these programs can reduce EBCE's procurement cost. Our analysis showed that early investments in demand response led to long-term savings for EBCE that could be invested back into local development programs.

In regards to environmental benefits, the greatest current challenge to reducing the GHG intensity of the grid is how to supply the evening, night, and early morning load with renewable energy. Increasing energy storage and shifting load from evening to daytime is the fundamental way to meet this challenge.

Further, transportation accounts for 40% of statewide emissions, compared to 20% from the electricity sector. Thus, electrifying the transportation sector is essential to meeting California's greenhouse gas emissions goals.

It is clear from an environmental perspective that the grid innovation programs are the primary driver of emissions reductions that result from LDBP programs. However, these programs can be designed and combined in a way to ensure local economic benefit equivalent to local renewable programs. As shown in the scenario discussion above, the grid innovation scenario reduces surplus revenue 9% more than the moderate scenario, but leads to 13% more direct jobs. Further, program design can increase the benefit of these programs even more. For example, directing energy efficiency and energy storage programs towards CARE customers can increase public health (mitigating the health impacts of both intense heat and intense cold) and decrease regional energy poverty. Further, commercial and industrial demand response and energy efficiency programs can reduce energy costs for business and increase overall regional economic activity. EBCE should thus design programs to maximize these and other local benefits.

Conclusion

It is not the role of this report to make recommendations to EBCE on how to proceed with local development. Instead we aim to provide information, support decision-making and improve communications by organizing and analyzing data to describe the impacts from a set of potential options.

The findings presented in this draft report describe a set of scenarios that reduces projected net surplus revenue by 7–21%, create 3,000—3,800 direct jobs, reduce greenhouse gas emissions by about 300,000–500,000 MT CO_2e, and reduce air pollutant emissions by about 65,000–100,000 kg NO_x.

It should be noted that while this level of investment seems financially feasible and will lead to some local economic benefits through job creation, the final projections are not high enough to create the kind of economic transformation in and of themselves. Local development programs cannot in and of themselves transform the region’s economy, environmental conditions and public health. These investments however can play a role in laying the seeds for such a transformation, particularly if they are built upon in coming years and decades. EBCE thus needs to carefully think through how it communicates the job creation impacts from local development to help ensure expectations are in line with outcomes. Further, it is often the details of program design that have the greatest impact on level of benefit, and EBCE should continue its efforts to design its programs to maximize local benefits. In particular, consideration such as that of a municipal FIT program and disadvantaged community price-adders for NEM are innovative steps no other CCA has taken to date.

Finally, it must be noted that the purpose of this study is to analyze one set of potential EBCE program investments. The true value of any investment, however, can only be assessed against how the money would have been used otherwise (i.e., its opportunity cost). In the case of investor owned utilities, surplus revenues simply become shareholder profits. In the case of CCAs, the surplus revenues can be targeted toward any number of community investments. In fact, one of the greatest powers of the CCA is its ability to direct such funds with both flexibility and consistency. While it is outside of the scope of this draft report to review other options, we would like to make one point. The programs studied in the LDBP lead to only minor reductions in air pollution. As air pollution create real and significant health impacts in Alameda county, it would be wise for EBCE to investigate additional programs that would reduce air pollution. This would likely lead to the development of programs to reduce pollution from medium and heavy duty transportation. In general, EBCE staff should consider and weigh opportunity costs in its decision-making to ensure however dollars are invested the financial, grid resilience, community, and health benefits are maximized.

It is clear that EBCE's surplus revenue presents an opportunity to make investments with the potential to yield powerful economic, environmental, and social benefit. It is also clear that in a region as diverse as the EBCE's territory, there will be differences of opinion and priority on how the organization should invest. We thus commend EBCE for undertaking this process. EBCE is the first CCA to analyze local development in such detail and with such sophistication.

We also strongly suggest that this process be seen as a first step. EBCE board, staff, and stakeholders should continue to work together to develop an iterative process that transparently supports short-term and long-term investments upon a clear set of priorities and well-vetted data analysis.

Appendix A: Detailed results

The following tables contain detailed results data by year. Table 17–Table 21 show results broken out by module; where results can be further broken down, they are provided in the subsections below.

Table 17: Annual revenue change [$M] by scenario and module

scenario	module	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		**(0.13)**	**(3.90)**	**(1.17)**	**1.42**	**(2.43)**	**(30.61)**	**(0.63)**	**(0.23)**	***(37.70)***
	Local Solar	(0.13)	(0.50)	(1.66)	(3.21)	(4.52)	(4.52)	(4.52)	(4.52)	*(23.58)*
	Local Wind	0.00	0.00	(0.22)	(0.52)	(0.58)	(0.58)	(0.58)	(0.58)	*(3.07)*
	Energy Efficiency	0.00	0.00	(0.41)	(1.60)	(3.64)	(10.34)	(0.14)	(0.14)	*(16.28)*
	Demand Response	0.00	(3.40)	1.12	6.76	12.76	5.43	8.43	8.43	*39.52*
	Energy Storage	0.00	0.00	0.00	0.00	(9.84)	(4.24)	0.48	0.48	*(13.12)*
	Electric Vehicles	0.00	0.00	0.00	0.00	0.00	(12.80)	0.20	0.20	*(12.40)*
	Fuel Switching	0.00	0.00	0.00	0.00	3.40	(3.56)	(4.51)	(4.10)	*(8.77)*
Local renewables		**(0.13)**	**(3.90)**	**(1.43)**	**0.75**	**(4.91)**	**(20.06)**	**4.00**	**4.20**	***(21.49)***
	Local Solar	(0.13)	(0.50)	(2.06)	(4.41)	(6.51)	(6.51)	(6.51)	(6.51)	*(33.15)*
	Local Wind	0.00	0.00	(0.22)	(0.52)	(0.58)	(0.58)	(0.58)	(0.58)	*(3.07)*
	Energy Efficiency	0.00	0.00	(0.27)	(1.07)	(2.43)	(6.90)	(0.09)	(0.09)	*(10.85)*
	Demand Response	0.00	(3.40)	1.12	6.76	12.76	12.76	12.76	12.76	*55.50*
	Energy Storage	0.00	0.00	0.00	0.00	(9.84)	(4.24)	0.48	0.48	*(13.12)*
	Electric Vehicles	0.00	0.00	0.00	0.00	0.00	(12.80)	0.20	0.20	*(12.40)*
	Fuel Switching	0.00	0.00	0.00	0.00	1.70	(1.78)	(2.25)	(2.05)	*(4.38)*
Grid innovation		**(0.13)**	**(4.75)**	**(1.38)**	**0.46**	**(8.18)**	**(46.07)**	**(0.58)**	**0.02**	***(60.61)***
	Local Solar	(0.13)	(0.50)	(2.06)	(4.41)	(4.92)	(4.92)	(4.92)	(4.92)	*(26.77)*
	Local Wind	0.00	0.00	(0.22)	(0.52)	(0.58)	(0.58)	(0.58)	(0.58)	*(3.07)*
	Energy Efficiency	0.00	0.00	(0.50)	(1.96)	(4.45)	(12.64)	(0.17)	(0.17)	*(19.90)*
	Demand Response	0.00	(4.25)	1.40	7.35	16.35	6.59	10.59	10.59	*48.61*
	Energy Storage	0.00	0.00	0.00	0.00	(19.68)	(8.49)	0.96	0.96	*(26.24)*
	Electric Vehicles	0.00	0.00	0.00	0.00	0.00	(20.70)	0.30	0.30	*(20.10)*
	Fuel Switching	0.00	0.00	0.00	0.00	5.10	(5.33)	(6.76)	(6.15)	*(13.15)*

Table 18: Annual direct job creation by scenario and module

scenario	module	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		**44**	**370**	**392**	**701**	**331**	**698**	**244**	**451**	***3,231***
	Local Solar	44	324	304	523	236	208	23	210	*1,871*
	Local Wind	0	0	18	80	15	6	6	6	*133*
	Energy Efficiency	0	0	4	20	20	105	0	0	*149*
	Demand Response	0	46	66	78	39	90	79	79	*478*
	Energy Storage	0	0	0	0	12	19	2	2	*34*
	Electric Vehicles	0	0	0	0	0	181	0	0	*181*
	Fuel Switching	0	0	0	0	9	89	133	153	*385*
Local renewables		**44**	**370**	**418**	**749**	**377**	**571**	**140**	**337**	***3,006***
	Local Solar	44	324	331	578	292	211	26	214	*2,020*
	Local Wind	0	0	18	80	15	6	6	6	*133*
	Energy Efficiency	0	0	3	13	13	70	0	0	*99*
	Demand Response	0	46	66	78	39	39	39	39	*347*
	Energy Storage	0	0	0	0	12	19	2	2	*34*
	Electric Vehicles	0	0	0	0	0	181	0	0	*181*
	Fuel Switching	0	0	0	0	5	45	67	77	*193*
Grid innovation		**44**	**381**	**437**	**792**	**311**	**906**	**338**	**555**	***3,764***
	Local Solar	44	324	331	578	183	209	24	211	*1,903*
	Local Wind	0	0	18	80	15	6	6	6	*133*
	Energy Efficiency	0	0	5	24	24	129	0	0	*182*
	Demand Response	0	58	83	109	51	118	104	104	*627*
	Energy Storage	0	0	0	0	24	37	3	3	*68*
	Electric Vehicles	0	0	0	0	0	273	0	0	*273*
	Fuel Switching	0	0	0	0	14	134	200	230	*578*

Table 19: Annual total job creation by scenario and module

scenario	module	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		**79**	**630**	**704**	**1,226**	**577**	**1,158**	**393**	**726**	***5,494***
	Local Solar	79	551	549	905	417	338	40	342	*3,223*
	Local Wind	0	0	33	148	28	12	12	12	*244*
	Energy Efficiency	0	0	7	34	31	198	0	0	*270*
	Demand Response	0	79	115	140	67	155	137	137	*830*
	Energy Storage	0	0	0	0	20	33	3	3	*59*
	Electric Vehicles	0	0	0	0	0	287	0	0	*287*
	Fuel Switching	0	0	0	0	14	135	201	231	*581*
Local renewables		**79**	**630**	**747**	**1,307**	**654**	**943**	**228**	**546**	***5,134***
	Local Solar	79	551	595	997	512	344	46	348	*3,472*
	Local Wind	0	0	33	148	28	12	12	12	*244*
	Energy Efficiency	0	0	4	23	21	132	0	0	*180*
	Demand Response	0	79	115	140	67	67	67	67	*602*
	Energy Storage	0	0	0	0	20	33	3	3	*59*
	Electric Vehicles	0	0	0	0	0	287	0	0	*287*
	Fuel Switching	0	0	0	0	7	67	101	116	*291*
Grid innovation		**79**	**650**	**779**	**1,382**	**542**	**1,499**	**541**	**889**	***6,361***
	Local Solar	79	551	595	997	330	340	42	344	*3,276*
	Local Wind	0	0	33	148	28	12	12	12	*244*
	Energy Efficiency	0	0	8	42	38	242	0	0	*330*
	Demand Response	0	99	143	195	87	204	180	180	*1,089*
	Energy Storage	0	0	0	0	39	66	6	6	*117*
	Electric Vehicles	0	0	0	0	0	434	0	0	*434*
	Fuel Switching	0	0	0	0	21	202	302	347	*872*

Table 20: Annual GHG reduction [MT CO_2e] by scenario and module

scenario	module	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		**0**	**1,946**	**52,181**	**55,656**	**55,656**	**75,935**	**75,871**	**75,840**	***393,084***
	Energy Efficiency	0	0	43,285	43,285	43,285	43,285	43,285	43,285	*259,708*
	Demand Response	0	1,946	8,896	12,371	12,371	14,248	14,248	14,248	*78,327*
	Electric Vehicles	0	0	0	0	0	17,290	17,290	17,290	*51,870*
	Fuel Switching	0	0	0	0	0	1,113	1,049	1,018	*3,180*
Local renewables		**0**	**1,946**	**37,752**	**41,227**	**41,227**	**59,074**	**59,042**	**59,026**	***299,295***
	Energy Efficiency	0	0	28,856	28,856	28,856	28,856	28,856	28,856	*173,138*
	Demand Response	0	1,946	8,896	12,371	12,371	12,371	12,371	12,371	*72,697*
	Electric Vehicles	0	0	0	0	0	17,290	17,290	17,290	*51,870*
	Fuel Switching	0	0	0	0	0	556	525	509	*1,590*
Grid innovation		**0**	**2,433**	**64,023**	**69,236**	**69,236**	**99,342**	**99,247**	**99,199**	***502,716***
	Energy Efficiency	0	0	52,903	52,903	52,903	52,903	52,903	52,903	*317,420*
	Demand Response	0	2,433	11,120	16,333	16,333	18,835	18,835	18,835	*102,721*
	Electric Vehicles	0	0	0	0	0	25,935	25,935	25,935	*77,805*
	Fuel Switching	0	0	0	0	0	1,669	1,574	1,526	*4,770*

Table 21: Annual air pollutant reduction [kg NO_x] by scenario and module

scenario	module	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		**0**	**0**	**0**	**0**	**0**	**22,491**	**22,441**	**22,416**	***67,348***
	Electric Vehicles	0	0	0	0	0	21,620	21,620	21,620	*64,860*
	Fuel Switching	0	0	0	0	0	871	821	796	*2,488*
Local renewables		**0**	**0**	**0**	**0**	**0**	**22,055**	**22,031**	**22,018**	***66,104***
	Electric Vehicles	0	0	0	0	0	21,620	21,620	21,620	*64,860*
	Fuel Switching	0	0	0	0	0	435	411	398	*1,244*
Grid innovation		**0**	**0**	**0**	**0**	**0**	**33,736**	**33,662**	**33,624**	***101,022***
	Electric Vehicles	0	0	0	0	0	32,430	32,430	32,430	*97,290*
	Fuel Switching	0	0	0	0	0	1,306	1,232	1,194	*3,732*

Local solar

Table 22: Annual revenue change [M$] by scenario and LS type

scenario	LS type	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		**(0.13)**	**(0.50)**	**(1.66)**	**(3.21)**	**(4.52)**	**(4.52)**	**(4.52)**	**(4.52)**	***(23.58)***
	FIT	0.00	0.00	(0.40)	(1.20)	(1.99)	(1.99)	(1.99)	(1.99)	*(9.57)*
	NEM	(0.13)	(0.50)	(1.26)	(2.02)	(2.53)	(2.53)	(2.53)	(2.53)	*(14.01)*
	utility	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*
Local renewables		**(0.13)**	**(0.50)**	**(2.06)**	**(4.41)**	**(6.51)**	**(6.51)**	**(6.51)**	**(6.51)**	***(33.15)***
	FIT	0.00	0.00	(0.80)	(2.39)	(3.99)	(3.99)	(3.99)	(3.99)	*(19.14)*
	NEM	(0.13)	(0.50)	(1.26)	(2.02)	(2.53)	(2.53)	(2.53)	(2.53)	*(14.01)*
	utility	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*
Grid innovation		**(0.13)**	**(0.50)**	**(2.06)**	**(4.41)**	**(4.92)**	**(4.92)**	**(4.92)**	**(4.92)**	***(26.77)***
	FIT	0.00	0.00	(0.80)	(2.39)	(2.39)	(2.39)	(2.39)	(2.39)	*(12.76)*
	NEM	(0.13)	(0.50)	(1.26)	(2.02)	(2.53)	(2.53)	(2.53)	(2.53)	*(14.01)*
	utility	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*

Table 23: Annual generation [GWh] by scenario and LS type

scenario	LS type	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		**8**	**132**	**188**	**353**	**402**	**503**	**503**	**604**	***2,693***
	FIT	0	0	9	27	44	44	44	44	*213*
	NEM	8	31	77	124	155	155	155	155	*861*
	utility	0	101	101	202	202	304	304	405	*1,619*
Local renewables		**8**	**132**	**196**	**380**	**446**	**547**	**547**	**649**	***2,906***
	FIT	0	0	18	53	89	89	89	89	*425*
	NEM	8	31	77	124	155	155	155	155	*861*
	utility	0	101	101	202	202	304	304	405	*1,619*
Grid innovation		**8**	**132**	**196**	**380**	**411**	**512**	**512**	**613**	***2,764***
	FIT	0	0	18	53	53	53	53	53	*284*
	NEM	8	31	77	124	155	155	155	155	*861*
	utility	0	101	101	202	202	304	304	405	*1,619*

Table 24: Annual direct job creation by scenario and LS type

scenario	LS type	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		**44**	**324**	**304**	**523**	**236**	**208**	**23**	**210**	***1,871***
	FIT	0	0	27	55	57	3	3	3	*149*
	NEM	44	136	274	278	174	12	12	12	*944*
	utility	0	187	2	190	5	192	7	194	*778*
Local renewables		**44**	**324**	**331**	**578**	**292**	**211**	**26**	**214**	***2,020***
	FIT	0	0	55	110	113	7	7	7	*298*
	NEM	44	136	274	278	174	12	12	12	*944*
	utility	0	187	2	190	5	192	7	194	*778*
Grid innovation		**44**	**324**	**331**	**578**	**183**	**209**	**24**	**211**	***1,903***
	FIT	0	0	55	110	4	4	4	4	*181*
	NEM	44	136	274	278	174	12	12	12	*944*
	utility	0	187	2	190	5	192	7	194	*778*

Table 25: Annual total job creation by scenario and LS type

scenario	LS type	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		**79**	**551**	**549**	**905**	**417**	**338**	**40**	**342**	***3,223***
	FIT	0	0	45	92	94	6	6	6	*249*
	NEM	79	249	500	507	315	23	23	23	*1,717*
	utility	0	302	4	306	8	310	12	314	*1,257*
Local renewables		**79**	**551**	**595**	**997**	**512**	**344**	**46**	**348**	***3,472***
	FIT	0	0	91	184	189	11	11	11	*498*
	NEM	79	249	500	507	315	23	23	23	*1,717*
	utility	0	302	4	306	8	310	12	314	*1,257*
Grid innovation		**79**	**551**	**595**	**997**	**330**	**340**	**42**	**344**	***3,276***
	FIT	0	0	91	184	7	7	7	7	*303*
	NEM	79	249	500	507	315	23	23	23	*1,717*
	utility	0	302	4	306	8	310	12	314	*1,257*

Local wind

Table 26: Annual revenue change [M$] by scenario and LW type

scenario	LW type	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
All scenarios		**0.00**	**0.00**	**(0.22)**	**(0.52)**	**(0.58)**	**(0.58)**	**(0.58)**	**(0.58)**	***(3.07)***
	FIT	0.00	0.00	(0.16)	(0.41)	(0.41)	(0.41)	(0.41)	(0.41)	*(2.19)*
	NEM	0.00	0.00	(0.06)	(0.12)	(0.18)	(0.18)	(0.18)	(0.18)	*(0.88)*
	utility	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*

Table 27: Annual generation [GWh] by scenario and LW type

scenario	LW type	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
All scenarios		**0**	**0**	**7**	**106**	**110**	**110**	**110**	**110**	***554***
	FIT	0	0	4	9	9	9	9	9	*49*
	NEM	0	0	4	7	11	11	11	11	*54*
	utility	0	0	0	90	90	90	90	90	*451*

Table 28: Annual direct job creation by scenario and LW type

scenario	LW type	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
All scenarios		**0**	**0**	**18**	**80**	**15**	**6**	**6**	**6**	***133***
	FIT	0	0	9	13	1	1	1	1	*26*
	NEM	0	0	10	10	11	2	2	2	*36*
	utility	0	0	0	57	4	4	4	4	*71*

Table 29: Annual total job creation by scenario and LW type

scenario	LW type	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
All scenarios		**0**	**0**	**33**	**148**	**28**	**12**	**12**	**12**	***244***
	FIT	0	0	16	23	2	2	2	2	*46*
	NEM	0	0	18	19	20	3	3	3	*66*
	utility	0	0	0	106	7	7	7	7	*132*

Energy efficiency

Table 30: Annual revenue change [M$] by scenario and EE type

scenario	EE type	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		0.00	0.00	**(0.41)**	**(1.60)**	**(3.64)**	**(10.34)**	**(0.14)**	**(0.14)**	***(16.28)***
	industrial	0.00	0.00	(0.41)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	*(0.53)*
	MUSH	0.00	0.00	0.00	0.00	(3.60)	(0.02)	(0.02)	(0.02)	*(3.67)*
	large comm	0.00	0.00	0.00	(1.58)	(0.02)	(0.02)	(0.02)	(0.02)	*(1.67)*
	small/medium comm	0.00	0.00	0.00	0.00	0.00	(1.20)	(0.02)	(0.02)	*(1.25)*
	residential	0.00	0.00	0.00	0.00	0.00	(2.79)	(0.02)	(0.02)	*(2.84)*
	residential (CARE)	0.00	0.00	0.00	0.00	0.00	(6.28)	(0.02)	(0.02)	*(6.33)*
Local renewables		0.00	0.00	**(0.27)**	**(1.07)**	**(2.43)**	**(6.90)**	**(0.09)**	**(0.09)**	***(10.85)***
	industrial	0.00	0.00	(0.27)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	*(0.35)*
	MUSH	0.00	0.00	0.00	0.00	(2.40)	(0.02)	(0.02)	(0.02)	*(2.44)*
	large comm	0.00	0.00	0.00	(1.05)	(0.02)	(0.02)	(0.02)	(0.02)	*(1.11)*
	small/medium comm	0.00	0.00	0.00	0.00	0.00	(0.80)	(0.02)	(0.02)	*(0.83)*
	residential	0.00	0.00	0.00	0.00	0.00	(1.86)	(0.02)	(0.02)	*(1.89)*
	residential (CARE)	0.00	0.00	0.00	0.00	0.00	(4.19)	(0.02)	(0.02)	*(4.22)*
Grid innovation		0.00	0.00	**(0.50)**	**(1.96)**	**(4.45)**	**(12.64)**	**(0.17)**	**(0.17)**	***(19.90)***
	industrial	0.00	0.00	(0.50)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	*(0.65)*
	MUSH	0.00	0.00	0.00	0.00	(4.40)	(0.03)	(0.03)	(0.03)	*(4.48)*
	large comm	0.00	0.00	0.00	(1.93)	(0.03)	(0.03)	(0.03)	(0.03)	*(2.04)*
	small/medium comm	0.00	0.00	0.00	0.00	0.00	(1.47)	(0.03)	(0.03)	*(1.52)*
	residential	0.00	0.00	0.00	0.00	0.00	(3.41)	(0.03)	(0.03)	*(3.47)*
	residential (CARE)	0.00	0.00	0.00	0.00	0.00	(7.68)	(0.03)	(0.03)	*(7.74)*

Table 31: Annual direct job creation by scenario and EE type

scenario	EE type	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		**0**	**0**	**4**	**20**	**20**	**105**	**0**	**0**	***149***
	industrial	0	0	4	0	0	0	0	0	*4*
	MUSH	0	0	0	0	20	0	0	0	*20*
	large comm	0	0	0	20	0	0	0	0	*20*
	small/medium comm	0	0	0	0	0	18	0	0	*18*
	residential	0	0	0	0	0	36	0	0	*36*
	residential (CARE)	0	0	0	0	0	51	0	0	*51*
Local renewables		**0**	**0**	**3**	**13**	**13**	**70**	**0**	**0**	***99***
	industrial	0	0	3	0	0	0	0	0	*3*
	MUSH	0	0	0	0	13	0	0	0	*13*
	large comm	0	0	0	13	0	0	0	0	*13*
	small/medium comm	0	0	0	0	0	12	0	0	*12*
	residential	0	0	0	0	0	24	0	0	*24*
	residential (CARE)	0	0	0	0	0	34	0	0	*34*
Grid innovation		**0**	**0**	**5**	**24**	**24**	**129**	**0**	**0**	***182***
	industrial	0	0	5	0	0	0	0	0	*5*
	MUSH	0	0	0	0	24	0	0	0	*24*
	large comm	0	0	0	24	0	0	0	0	*24*
	small/medium comm	0	0	0	0	0	22	0	0	*22*
	residential	0	0	0	0	0	44	0	0	*44*
	residential (CARE)	0	0	0	0	0	63	0	0	*63*

Table 32: Annual total job creation by scenario and EE type

scenario	EE type	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		0	0	**7**	**34**	**31**	**198**	0	0	***270***
	industrial	0	0	7	0	0	0	0	0	*7*
	MUSH	0	0	0	0	31	0	0	0	*31*
	large comm	0	0	0	34	0	0	0	0	*34*
	small/medium comm	0	0	0	0	0	31	0	0	*31*
	residential	0	0	0	0	0	67	0	0	*67*
	residential (CARE)	0	0	0	0	0	101	0	0	*101*
Local renewables		0	0	**4**	**23**	**21**	**132**	0	0	***180***
	industrial	0	0	4	0	0	0	0	0	*4*
	MUSH	0	0	0	0	21	0	0	0	*21*
	large comm	0	0	0	23	0	0	0	0	*23*
	small/medium comm	0	0	0	0	0	21	0	0	*21*
	residential	0	0	0	0	0	44	0	0	*44*
	residential (CARE)	0	0	0	0	0	67	0	0	*67*
Grid innovation		0	0	**8**	**42**	**38**	**242**	0	0	***330***
	industrial	0	0	8	0	0	0	0	0	*8*
	MUSH	0	0	0	0	38	0	0	0	*38*
	large comm	0	0	0	42	0	0	0	0	*42*
	small/medium comm	0	0	0	0	0	38	0	0	*38*
	residential	0	0	0	0	0	82	0	0	*82*
	residential (CARE)	0	0	0	0	0	123	0	0	*123*

Demand response

Table 33: Annual revenue change [M$] by scenario and DR type

scenario	DR type	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		**0.00**	**(3.40)**	**1.12**	**6.76**	**12.76**	**5.43**	**8.43**	**8.43**	***39.52***
	res load control	0.00	0.00	0.00	(4.37)	1.64	1.64	1.64	1.64	*2.18*
	non-res load control	0.00	0.00	(5.48)	4.52	4.52	4.52	4.52	4.52	*17.12*
	industrial tariff	0.00	0.00	0.00	0.00	0.00	(7.32)	(4.32)	(4.32)	*(15.97)*
	large comm tariff	0.00	(3.40)	6.60	6.60	6.60	6.60	6.60	6.60	*36.20*
Local renewables		**0.00**	**(3.40)**	**1.12**	**6.76**	**12.76**	**12.76**	**12.76**	**12.76**	***55.50***
	res load control	0.00	0.00	0.00	(4.37)	1.64	1.64	1.64	1.64	*2.18*
	non-res load control	0.00	0.00	(5.48)	4.52	4.52	4.52	4.52	4.52	*17.12*
	industrial tariff	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*
	large comm tariff	0.00	(3.40)	6.60	6.60	6.60	6.60	6.60	6.60	*36.20*
Grid innovation		**0.00**	**(4.25)**	**1.40**	**7.35**	**16.35**	**6.59**	**10.59**	**10.59**	***48.61***
	res load control	0.00	0.00	0.00	(6.55)	2.45	2.45	2.45	2.45	*3.26*
	non-res load control	0.00	0.00	(6.85)	5.65	5.65	5.65	5.65	5.65	*21.40*
	industrial tariff	0.00	0.00	0.00	0.00	0.00	(9.77)	(5.77)	(5.77)	*(21.30)*
	large comm tariff	0.00	(4.25)	8.25	8.25	8.25	8.25	8.25	8.25	*45.25*

Table 34: Annual direct job creation by scenario and DR type

scenario	DR type	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		0	**46**	**66**	**78**	**39**	**90**	**79**	**79**	***478***
	res load control	0	0	0	46	7	7	7	7	*73*
	non-res load control	0	0	54	20	20	20	20	20	*156*
	industrial tariff	0	0	0	0	0	51	40	40	*132*
	large comm tariff	0	46	12	12	12	12	12	12	*118*
Local renewables		0	**46**	**66**	**78**	**39**	**39**	**39**	**39**	***347***
	res load control	0	0	0	46	7	7	7	7	*73*
	non-res load control	0	0	54	20	20	20	20	20	*156*
	industrial tariff	0	0	0	0	0	0	0	0	*0*
	large comm tariff	0	46	12	12	12	12	12	12	*118*
Grid innovation		0	**58**	**83**	**109**	**51**	**118**	**104**	**104**	***627***
	res load control	0	0	0	69	10	10	10	10	*110*
	non-res load control	0	0	68	25	25	25	25	25	*195*
	industrial tariff	0	0	0	0	0	68	54	54	*175*
	large comm tariff	0	58	15	15	15	15	15	15	*147*

Table 35: Annual total job creation by scenario and DR type

scenario	DR type	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		0	**79**	**115**	**140**	**67**	**155**	**137**	**137**	***830***
	res load control	0	0	0	84	11	11	11	11	*128*
	non-res load control	0	0	94	35	35	35	35	35	*270*
	industrial tariff	0	0	0	0	0	88	70	70	*228*
	large comm tariff	0	79	21	21	21	21	21	21	*204*
Local renewables		0	**79**	**115**	**140**	**67**	**67**	**67**	**67**	***602***
	res load control	0	0	0	84	11	11	11	11	*128*
	non-res load control	0	0	94	35	35	35	35	35	*270*
	industrial tariff	0	0	0	0	0	0	0	0	*0*
	large comm tariff	0	79	21	21	21	21	21	21	*204*
Grid innovation		0	**99**	**143**	**195**	**87**	**204**	**180**	**180**	***1,089***
	res load control	0	0	0	125	17	17	17	17	*192*
	non-res load control	0	0	117	44	44	44	44	44	*337*
	industrial tariff	0	0	0	0	0	117	94	94	*304*
	large comm tariff	0	99	26	26	26	26	26	26	*255*

Table 36: Annual GHG reduction [MT CO_2e] by scenario and DR type

scenario	DR type	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		0	**1,946**	**8,896**	**12,371**	**12,371**	**14,248**	**14,248**	**14,248**	***78,327***
	res load control	0	0	0	3,475	3,475	3,475	3,475	3,475	*17,375*
	non-res load control	0	0	6,950	6,950	6,950	6,950	6,950	6,950	*41,700*
	industrial tariff	0	0	0	0	0	1,877	1,877	1,877	*5,630*
	large comm tariff	0	1,946	1,946	1,946	1,946	1,946	1,946	1,946	*13,622*
Local renewables		0	**1,946**	**8,896**	**12,371**	**12,371**	**12,371**	**12,371**	**12,371**	***72,697***
	res load control	0	0	0	3,475	3,475	3,475	3,475	3,475	*17,375*
	non-res load control	0	0	6,950	6,950	6,950	6,950	6,950	6,950	*41,700*
	industrial tariff	0	0	0	0	0	0	0	0	*0*
	large comm tariff	0	1,946	1,946	1,946	1,946	1,946	1,946	1,946	*13,622*
Grid innovation		0	**2,433**	**11,120**	**16,333**	**16,333**	**18,835**	**18,835**	**18,835**	***102,721***
	res load control	0	0	0	5,213	5,213	5,213	5,213	5,213	*26,063*
	non-res load control	0	0	8,688	8,688	8,688	8,688	8,688	8,688	*52,125*
	industrial tariff	0	0	0	0	0	2,502	2,502	2,502	*7,506*
	large comm tariff	0	2,433	2,433	2,433	2,433	2,433	2,433	2,433	*17,028*

Energy storage

Table 37: Annual revenue change [M$] by scenario and ES type

scenario	ES type	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		0.00	0.00	0.00	0.00	**(9.84)**	**(4.24)**	**0.48**	**0.48**	***(13.12)***
	utility-scale	0.00	0.00	0.00	0.00	(9.84)	0.16	0.16	0.16	*(9.36)*
	commercial/industrial	0.00	0.00	0.00	0.00	0.00	(2.46)	0.16	0.16	*(2.14)*
	residential	0.00	0.00	0.00	0.00	0.00	(1.94)	0.16	0.16	*(1.62)*
Local renewables		0.00	0.00	0.00	0.00	**(9.84)**	**(4.24)**	**0.48**	**0.48**	***(13.12)***
	utility-scale	0.00	0.00	0.00	0.00	(9.84)	0.16	0.16	0.16	*(9.36)*
	commercial/industrial	0.00	0.00	0.00	0.00	0.00	(2.46)	0.16	0.16	*(2.14)*
	residential	0.00	0.00	0.00	0.00	0.00	(1.94)	0.16	0.16	*(1.62)*
Grid innovation		0.00	0.00	0.00	0.00	**(19.68)**	**(8.49)**	**0.96**	**0.96**	***(26.24)***
	utility-scale	0.00	0.00	0.00	0.00	(19.68)	0.32	0.32	0.32	*(18.72)*
	commercial/industrial	0.00	0.00	0.00	0.00	0.00	(4.93)	0.32	0.32	*(4.29)*
	residential	0.00	0.00	0.00	0.00	0.00	(3.88)	0.32	0.32	*(3.24)*

Table 38: Annual direct job creation by scenario and ES type

scenario	ES type	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		**0**	**0**	**0**	**0**	**12**	**19**	**2**	**2**	***34***
	utility-scale	0	0	0	0	12	1	1	1	*14*
	commercial/industrial	0	0	0	0	0	12	1	1	*13*
	residential	0	0	0	0	0	6	0	0	*7*
Local renewables		**0**	**0**	**0**	**0**	**12**	**19**	**2**	**2**	***34***
	utility-scale	0	0	0	0	12	1	1	1	*14*
	commercial/industrial	0	0	0	0	0	12	1	1	*13*
	residential	0	0	0	0	0	6	0	0	*7*
Grid innovation		**0**	**0**	**0**	**0**	**24**	**37**	**3**	**3**	***68***
	utility-scale	0	0	0	0	24	1	1	1	*28*
	commercial/industrial	0	0	0	0	0	23	1	1	*25*
	residential	0	0	0	0	0	13	1	1	*15*

Table 39: Annual total job creation by scenario and ES type

scenario	ES type	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		**0**	**0**	**0**	**0**	**20**	**33**	**3**	**3**	***59***
	utility-scale	0	0	0	0	20	1	1	1	*23*
	commercial/industrial	0	0	0	0	0	20	1	1	*22*
	residential	0	0	0	0	0	12	1	1	*14*
Local renewables		**0**	**0**	**0**	**0**	**20**	**33**	**3**	**3**	***59***
	utility-scale	0	0	0	0	20	1	1	1	*23*
	commercial/industrial	0	0	0	0	0	20	1	1	*22*
	residential	0	0	0	0	0	12	1	1	*14*
Grid innovation		**0**	**0**	**0**	**0**	**39**	**66**	**6**	**6**	***117***
	utility-scale	0	0	0	0	39	2	2	2	*46*
	commercial/industrial	0	0	0	0	0	40	2	2	*44*
	residential	0	0	0	0	0	24	2	2	*27*

Electric vehicles

Table 40: Annual revenue change [M$] by scenario and EV product

scenario	EV product	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		0.00	0.00	0.00	0.00	0.00	**(12.80)**	**0.20**	**0.20**	***(12.40)***
	electric vehicle	0.00	0.00	0.00	0.00	0.00	(9.80)	0.20	0.20	*(9.40)*
	charger	0.00	0.00	0.00	0.00	0.00	(3.00)	0.00	0.00	*(3.00)*
Local renewables		0.00	0.00	0.00	0.00	0.00	**(12.80)**	**0.20**	**0.20**	***(12.40)***
	electric vehicle	0.00	0.00	0.00	0.00	0.00	(9.80)	0.20	0.20	*(9.40)*
	charger	0.00	0.00	0.00	0.00	0.00	(3.00)	0.00	0.00	*(3.00)*
Grid innovation		0.00	0.00	0.00	0.00	0.00	**(20.70)**	**0.30**	**0.30**	***(20.10)***
	electric vehicle	0.00	0.00	0.00	0.00	0.00	(14.70)	0.30	0.30	*(14.10)*
	charger	0.00	0.00	0.00	0.00	0.00	(6.00)	0.00	0.00	*(6.00)*

Table 41: Annual direct job creation by scenario and EV product

scenario	EV product	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		0	0	0	0	0	**181**	0	0	***181***
	electric vehicle	0	0	0	0	0	179	0	0	*179*
	charger	0	0	0	0	0	3	0	0	*3*
Local renewables		0	0	0	0	0	**181**	0	0	***181***
	electric vehicle	0	0	0	0	0	179	0	0	*179*
	charger	0	0	0	0	0	3	0	0	*3*
Grid innovation		0	0	0	0	0	**273**	0	0	***273***
	electric vehicle	0	0	0	0	0	268	0	0	*268*
	charger	0	0	0	0	0	5	0	0	*5*

Table 42: Annual total job creation by scenario and EV product

scenario	EV product	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		0	0	0	0	0	**287**	0	0	***287***
	electric vehicle	0	0	0	0	0	283	0	0	*283*
	charger	0	0	0	0	0	5	0	0	*5*
Local renewables		0	0	0	0	0	**287**	0	0	***287***
	electric vehicle	0	0	0	0	0	283	0	0	*283*
	charger	0	0	0	0	0	5	0	0	*5*
Grid innovation		0	0	0	0	0	**434**	0	0	***434***
	electric vehicle	0	0	0	0	0	424	0	0	*424*
	charger	0	0	0	0	0	9	0	0	*9*

Fuel switching

Table 43: Annual direct job creation by scenario and FS product

scenario	FS product	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		0	0	0	0	**9**	**89**	**133**	**153**	***385***
	thermostat	0	0	0	0	9	7	5	3	*24*
	water heater	0	0	0	0	0	83	59	47	*189*
	space heater	0	0	0	0	0	0	69	104	*173*
Local renewables		0	0	0	0	**5**	**45**	**67**	**77**	***193***
	thermostat	0	0	0	0	5	3	3	1	*12*
	water heater	0	0	0	0	0	41	30	24	*94*
	space heater	0	0	0	0	0	0	35	52	*86*
Grid innovation		0	0	0	0	**14**	**134**	**200**	**230**	***578***
	thermostat	0	0	0	0	14	10	8	4	*35*
	water heater	0	0	0	0	0	124	89	71	*283*
	space heater	0	0	0	0	0	0	104	155	*259*

Table 44: Annual total job creation by scenario and FS product

scenario	FS product	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		0	0	0	0	**14**	**135**	**201**	**231**	***581***
	thermostat	0	0	0	0	14	10	8	4	*36*
	water heater	0	0	0	0	0	125	89	71	*285*
	space heater	0	0	0	0	0	0	104	156	*260*
Local renewables		0	0	0	0	**7**	**67**	**101**	**116**	***291***
	thermostat	0	0	0	0	7	5	4	2	*18*
	water heater	0	0	0	0	0	62	45	36	*143*
	space heater	0	0	0	0	0	0	52	78	*130*
Grid innovation		0	0	0	0	**21**	**202**	**302**	**347**	***872***
	thermostat	0	0	0	0	21	15	12	6	*53*
	water heater	0	0	0	0	0	187	134	107	*428*
	space heater	0	0	0	0	0	0	156	234	*391*

Table 45: Annual GHG reduction [MT CO_2e] by scenario and FS product

scenario	FS product	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		0	0	0	0	0	**1,113**	**1,049**	**1,018**	***3,180***
	thermostat	0	0	0	0	0	0	0	0	*0*
	water heater	0	0	0	0	0	1,113	795	636	*2,544*
	space heater	0	0	0	0	0	0	254	382	*636*
Local renewables		0	0	0	0	0	**556**	**525**	**509**	***1,590***
	thermostat	0	0	0	0	0	0	0	0	*0*
	water heater	0	0	0	0	0	556	397	318	*1,272*
	space heater	0	0	0	0	0	0	127	191	*318*
Grid innovation		0	0	0	0	0	**1,669**	**1,574**	**1,526**	***4,770***
	thermostat	0	0	0	0	0	0	0	0	*0*
	water heater	0	0	0	0	0	1,669	1,192	954	*3,816*
	space heater	0	0	0	0	0	0	382	572	*954*

Table 46: Annual air pollutant reduction [kg NO_x] by scenario and FS product

scenario	FS product	2018	2019	2020	2021	2022	2023	2024	2025	*Total*
Moderate		**0**	**0**	**0**	**0**	**0**	**871**	**821**	**796**	***2,488***
	thermostat	0	0	0	0	0	0	0	0	*0*
	water heater	0	0	0	0	0	871	622	498	*1,990*
	space heater	0	0	0	0	0	0	199	299	*498*
Local renewables		**0**	**0**	**0**	**0**	**0**	**435**	**411**	**398**	***1,244***
	thermostat	0	0	0	0	0	0	0	0	*0*
	water heater	0	0	0	0	0	435	311	249	*995*
	space heater	0	0	0	0	0	0	100	149	*249*
Grid innovation		**0**	**0**	**0**	**0**	**0**	**1,306**	**1,232**	**1,194**	***3,732***
	thermostat	0	0	0	0	0	0	0	0	*0*
	water heater	0	0	0	0	0	1,306	933	746	*2,986*
	space heater	0	0	0	0	0	0	299	448	*746*

Appendix B: Jobs metrics

Local solar

Table 47: One-time installation jobs per MW by LS size tier

	direct		indirect	
LS size tier	jobs	wage	jobs	wage
5 kW	10.61	$25.00	9.02	$28.39
100 kW	6.87	$41.83	4.95	$31.53
350 kW	6.22	$41.83	4.48	$31.53
500 kW	6.05	$41.83	4.35	$31.53
1 MW	5.58	$41.83	4.01	$31.53
1 MW (SAT)	5.29	$45.00	3.23	$34.43
3 MW (SAT)	5.06	$45.00	3.09	$34.43
20 MW (SAT)	3.7	$45.00	2.26	$34.43

Table 48: Annual maintenance jobs per MW by LS size tier

	direct		indirect	
LS size tier	jobs	wage	jobs	wage
5 kW	0.124	$25.00	0.106	$28.39
100 kW	0.13	$41.83	0.093	$31.53
350 kW	0.126	$41.83	0.091	$31.53
500 kW	0.126	$41.83	0.091	$31.53
1 MW	0.126	$41.83	0.091	$31.53
1 MW (SAT)	0.14	$45.00	0.101	$34.43
3 MW (SAT)	0.14	$45.00	0.101	$34.43
20 MW (SAT)	0.047	$45.00	0.034	$34.43

Local wind

Table 49: One-time installation jobs per MW by LW size tier

	direct		indirect	
LW size tier	jobs	wage	jobs	wage
10 kW	5.55	$25.00	4.72	$28.39
50 kW	3.37	$25.00	2.87	$28.39
1 MW	2.84	$39.63	1.74	$31.53
50 MW	1.07	$39.63	0.92	$31.53

Table 50: Annual maintenance jobs per MW by LW size tier

	direct		indirect	
LW size tier	jobs	wage	jobs	wage
10 kW	0.304	$25.00	0.243	$28.39
50 kW	0.3	$25.00	0.24	$28.39
1 MW	0.08	$39.63	0.072	$31.53
50 MW	0.07	$39.63	0.06	$31.53

Energy efficiency

Table 51: One-time installation jobs per million dollars of investment by EE type

	direct		indirect	
EE type	jobs	wage	jobs	wage
industrial	4.7	$49.08	3.38	$31.53
MUSH	2.5	$49.08	1.4	$31.53
large commercial	6.1	$49.08	4.39	$31.53
small/medium commercial	6.1	$25.00	4.39	$31.53
residential	8.2	$25.00	7.0	$28.39
residential (CARE)	8.2	$25.00	7.86	$28.39

Demand response

Table 52: Annual jobs per million dollars of customer cost savings by DR type

	direct		indirect	
DR type	jobs	wage	jobs	wage
direct load control: residential storage	3.04	$26.69	1.86	$29.19
direct load control: non-residential storage	4.5	$33.09	3.32	$29.17
tariff: base interruptible program	4.5	$33.09	3.32	$29.17
tariff: scheduled load reduction program	4.5	$33.09	3.32	$29.17

Table 53: One-time installation jobs per million dollars of installation cost by DR type

	direct		indirect	
DR type	jobs	wage	jobs	wage
direct load control: residential storage	3.27	$25.00	2.78	$28.39
direct load control: non-residential storage	3.41	$25.00	2.45	$28.39
tariff: base interruptible program	3.41	$47.56	2.45	$31.53
tariff: scheduled load reduction program	3.41	$47.56	2.45	$31.53

Energy storage

Table 54: One-time installation jobs per MWh by ES type

	direct		indirect	
ES type	jobs	wage	jobs	wage
direct load control: residential storage	0.58	$47.56	0.35	$34.43
direct load control: non-residential storage	0.79	$47.56	0.57	$31.53
tariff: base interruptible program	1	$25.00	0.85	$28.39
tariff: scheduled load reduction program	1	$25.00	0.85	$28.39

Table 55: Annual maintenance jobs per MWh by ES type

	direct		indirect	
ES type	jobs	wage	jobs	wage
direct load control: residential storage	0.03	$45.00	0.025	$34.43
direct load control: non-residential storage	0.04	$41.83	0.03	$31.53
tariff: base interruptible program	0.08	$25.00	0.06	$28.39
tariff: scheduled load reduction program	0.08	$25.00	0.06	$28.39

Electric vehicles

Table 56: One-time retail/installation jobs per million dollars by EV product

	direct		indirect	
EV product	jobs	wage	jobs	wage
electric vehicle (retail)	1.2	$38.53	0.7	$30.03
charger (installation)	5.0	$53.25	4.2	$29.53

Fuel switching

Table 57: One-time retail jobs per million dollars by FS product

	direct		indirect	
FS product	jobs	wage	jobs	wage
thermostat	2.95	$23.97	1.5	$29.46
water heater	2.95	$23.97	1.5	$29.46
space heater	2.95	$23.97	1.5	$29.46

Table 58: One-time installation jobs per million dollars by FS product

	direct		indirect	
FS product	jobs	wage	jobs	wage
thermostat	5.02	$25.00	4.29	$28.39
water heater	5.02	$25.00	4.29	$28.39
space heater	5.02	$25.00	4.29	$28.39