# It's all about the jobs! Stimulating employment and economic impacts from investments in energy efficiency and renewable energy

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## Abstract

In the wake of a severe recession, United States (US) President Barack Obama signed the American Recovery and Reinvestment Act of 2009 (ARRA) into law in order to create and save jobs. As a subset of a larger ARRA funded economic stimulus package designated for California, the California Energy Commission (Energy Commission) administered a portfolio of programs. As part of an effort to measure, verify and evaluate the accomplishments of the Energy Commission's program spending of ARRA's State Energy Program (SEP) and Energy Efficiency and Conservation Block Grant Program (EECBG) funds, the Energy Commission contracted with DNV GL to investigate the economic and employment effects. This investigation used the Regional Economic Models, Inc., (REMI) Policy Insight model to estimate the number of direct, indirect, and induced jobs; the annual and cumulative outcomes for income; gross state revenue; and gross state product. Results are then presented at the state, regional, and program level and are expressed as an incremental change from a base case of no Energy Commission distribution of ARRA funds. The base case incorporates key economic drivers such as the mix of businesses, population growth and other impacts, such as those arising from the recession.

The results indicate that the funding provided through the ARRA programs generated an estimated 3,723 full-time or part-time jobs from 2010 through 2012 through direct program spending. Lower energy bills allowing residential ratepayers to have greater discretionary spending power and commercial customers greater competitiveness, are forecast by the REMI Policy Insight model to increase future employment and state revenue when compared to the base case forecast. The added household spending and gain in competitiveness by California businesses due to the ARRA spending is expected to cumulatively create 16,946 full-time or part-time jobs from 2010 through 2026.

Investments made through the Energy Commission's evaluated ARRA programs are expected to generate US$1.3 billion in increased personal income and US$2 billion in gross state product by 2026. The added employment and economic activity from these program investments are forecast to increase state revenue from taxes and fees by nearly US$243 million.

## Introduction

This paper presents the results from an evaluation of the California Energy Commission's (Energy Commission) portfolio of programs funded through the American Recovery and Reinvestment Act of 2009 (ARRA). Through these programs, the Energy Commission and its partners spent about US$251 million state wide for 2010–2012 to implement a broad range of initiatives designed to improve existing building energy efficiency, reduce carbon emissions, support clean energy workforce education and training, increase clean energy manufacturing capacity, and create jobs. More than 14,000 whole house retrofits and 7,700 controls and/or lighting projects for nonresidential buildings were supported in the period 2010–2012. In addition, more than 10,000 individuals participated in workforce education and training.

DNV GL performed the evaluation from April 2010 through December 2013.[1] The scope of the evaluation included measurement and verification activities, including 415 site visits and more than 450 participant telephone surveys, a macroeconomic assessment of the employment and economic impacts of the program, and an evaluation of program cost-effectiveness. The total budget for the evaluation effort was about US$4 million, or about 1.5 % of the overall program implementation budget.

Overall, evaluation results indicate that annual energy savings exceeded 184 GWh in electricity savings and 3.8 million therms (111 GWh) in natural gas savings. Furthermore, 4.2 GWh in annual electricity generation has resulted from the implementation of renewable energy generation projects (e.g., PV installations). Carbon emission reductions will total more than 1.15 million metric tons of carbon dioxide ($tCO_2$) over the life of the generation and energy efficiency measures installed. The overall portfolio of programs meets the cost-effectiveness threshold established by the U.S. Department of Energy (DOE) for ARRA programs.[2]

In addition to estimating these outcomes, DNV GL, and its project partner, Economic Development Research Group, investigated the economic and employment effects of the portfolio of ARRA programs.[3] Specifically, this component of the evaluation was designed to answer the following questions:

- How much gross project spending (both Energy Commission administered ARRA funds and leveraged funds) is directed toward in-state industry sectors?
- What industries and occupations are expected to experience job growth/losses as a result?
- How many total jobs (direct, indirect, and induced[4]) are expected to be created by industry and occupation?
- What are the estimated annual and cumulative: Income effects? Effect on state revenue? Influence on gross state product (GSP)?

## Overview of policy and program goals

In the wake of the worst recession since the Great Depression, US President Barack Obama signed into law the American Recovery and Reinvestment Act of 2009 (ARRA). The stated purposes of the policy were to:

- Preserve and create jobs and promote economic recovery,
- Assist households and businesses most affected by the recession,
- Provide investments needed to increase economic efficiency by spurring technological advances in science and health,
- Invest in transportation, environmental protection, and other infrastructure that will provide long-term economic benefits, and
- Stabilize state and local government budgets.[5]

The US DOE provided over US$3 billion in ARRA funding over the 2010–2012 timeframe to supplement the State Energy Program (SEP), a national program operated by DOE and providing financial assistance and technical support to 56 US states and territories for a wide variety of energy efficiency and renewable energy activities.[6] The following objectives were established specifically for SEP use of ARRA funds:

- Transform energy markets in partnership with states to accelerate near-term deployment of energy efficiency and renewable technologies,
- Promote an integrated portfolio of energy efficiency and renewable energy solutions to meet US energy security, economic vitality, and environmental quality objectives, and
- Strengthen core programs to develop and adopt leading market transformation initiatives.[7]

In addition, DOE provided over US$3 billion in ARRA funding to launch the Energy Efficiency and Conservation Block Grant (EECBG) program during the 2010–2012 timeframe. The purpose of the EECBG Program was to assist small cities and counties throughout the US in creating and implementing strategies to reduce fossil fuel emissions in a manner that is environmentally sustainable and, to the maximum extent practicable, to maximize benefits for local and regional communities.[8]

As a subset of a larger economic stimulus package designated for California, the Energy Commission utilized the SEP and EECBG funding to establish an extensive portfolio of programs in which to pursue the multiplicity of ARRA goals and objectives. The Energy Commission's ARRA portfolio represented a continuum of initiatives ranging from immediate investment in known opportunities for building retrofits, to investment in the development of market functions intended to result in ongoing market transformation and achievement of California energy efficiency and climate change goals. In combination, the En-

1. For a combined summary evaluation report, as well as the full evaluation reports for the individual programs, see: http://www.energy.ca.gov/ab758/pilot-programs.html.

2. The US DOE specified a cost-effectiveness test requirement for evaluating ARRA-funded program portfolios. The "SEP Recovery Act Cost" test is expressed in millions of British thermal units (MM BTU) of energy saved or generated annually per $1,000 of program expenditures. To be considered cost-effective, the overall portfolio (not individual programs) should achieve annual savings of at least 10 MM BTUs per $1,000 of ARRA expenditures. Overall, the full portfolio of ARRA-funded programs implemented by the Energy Commission achieved 10.1 MM BTU per $1,000 of program expenditures.

3. For the full report, see: http://www.energy.ca.gov/2014publications/CEC-400-2014-016/CEC-400-2014-016.pdf.

4. Direct jobs are jobs created by program implementers, subcontractors and suppliers directly from spending by ARRA funded programs. Indirect jobs refers to subcontracts with material suppliers who make materials used in ARRA supported projects and central service providers whose employees are not directly charged to ARRA supported projects and activities. Induced jobs are created or retained elsewhere in the economy as a result of ARRA supported projects and activities, such as by the re-spending of worker income within the local community or new spending by participants due to energy bill savings.

5. U.S. Department of Energy, State Energy Program Formula Grants, American Recovery and Reinvestment Act, Funding Opportunity Number: DE-FOA-0000052, February 3, 2009, p. 5 (http://www.energy.ca.gov/recovery/documents/SEP_Recovery_Act_Guidance_DE-FOA-00000521.pdf ).

6. SEP received $3.1 billion of the ARRA funds, which were obligated to states from 2009 to early 2011 to cover the period 2010–2012. By contrast, SEP funding prior to the ARRA period was only $33 million, and funding returned to this level in the post-ARRA period.

7. Market transformation is defined as "strategic interventions that cause lasting changes in the structure or function of a market or the behaviour of market participants, resulting in an increase in adoption of energy efficiency and renewable energy products, services, and practices." (pp. 24–25 of DE-FOA-0000052).

8. U.S. Department of Energy, Recovery Act – Energy Efficiency and Conservation Block Grants – Formula Grants, Funding Opportunity Number: DE-FOA-0000013, May 11, 2009, p. 5.

ergy Commission's program portfolio was intended to achieve a balance of emphasis both on immediate upgrade projects and on sustained market transformation.

## Summary of California's ARRA programs

The Energy Commission's ARRA portfolio was composed of seven main programs implemented during the 2010–2012 timeframe, as described below. These programs focused on different markets and employed different strategies to meet the needs of the different market segments. This diversification of programs allowed the Energy Commission to pilot and field test several delivery approaches simultaneously.

- **Clean Energy Business Finance Program (CEBFP).** CEBFP offered below market interest rate loans for clean energy manufacturing companies located, or planning to locate, in California. The final four recipients were manufacturers of solar panels and received nearly US$19 million in financing through the program.
- **Clean Energy Workforce Training Program (CEWTP).** Launched in 2010, CEWTP supported public/private training partnerships and addressed the anticipated demand for trained workers in the clean energy industry. Providing nearly US$19 million in funding through interagency agreements with the California Employment Development Department and the Employment Training Panel, CEWTP trained approximately 7,400 individuals in the design, installation, and analysis of renewable energy, and building energy efficient technologies during its two years of operation. In addition, CEWTP was successful in placing nearly 1,900 students in jobs following this training, as well as ensuring job retention for nearly 3,200 "on the job" trainees.
- **California Comprehensive Residential Building Retrofit (CCRR) Programs.** The goal of the CCRR programs was to improve the efficiency of existing single-family and multifamily homes by assessing energy savings opportunities and funding equipment and building upgrades (including PV). Nearly US$100 million was provided to local and regional governments to develop and test initiatives aimed at transforming the residential energy upgrade market and building an infrastructure for whole-building energy upgrades. Together, eight sub-programs were implemented piloting innovative approaches to whole-building upgrades for single-family and multifamily buildings, and developing both the demand side (homeowner, building owner) and supply side (participating contractors and other professionals) of the marketplace. These programs upgraded more than 8,100 single-family homes and 5,700 multifamily dwelling units, and installed 370 solar electric generation (photovoltaic) systems. These efforts delivered estimated annual savings of about 21.2 GWh in electricity savings and 38.1 GWh in natural gas savings, plus more than 3.2 GWh in annual electricity generation impacts from PV installations.
- **Energy Efficient State Property Revolving Loan Program.** This program was administered by the California Department of General Services (DGS) and provided over US$23 million in low-interest loans to state-owned facilities. The program funded 12 revolving loan funds and supported 64 projects at a wide range of facilities, including various California Department of Corrections and Rehabilitation (CDCR) sites, the head office for California's Chief Information Officer, and multiple locations of the California Department of Motor Vehicles (DMV). The mix of projects implemented during 2009–2011 was diverse, ranging from simple lighting upgrades at small buildings to complicated correction and repairs of building equipment and operations and maintenance practices (often referred to as retro-commissioning).
- **Energy Conservation Assistance Act (ECAA-ARRA).** ECAA-ARRA provided nearly US$20 million to augment the existing State of California ECAA-ARRA loan program. The Energy Commission awarded 33 loans to municipal facilities across all regions of the state from Del Norte to San Diego counties. Typical facilities included public safety facilities, libraries, colleges, community centres, and other local government buildings. Examples of qualifying energy efficiency measures implemented through these projects include interior and exterior lighting, traffic and streetlights, lighting controls, HVAC retrofits and controls, and other measures such as computer management upgrades, water and wastewater equipment upgrades, variable frequency drives (VFDs), high efficiency motors, and renewable energy generation.
- **Energy Efficiency and Conservation Block Grant (EECBG).** EECBG, a state-wide grant program, targeted small municipal and county governments that are not eligible for grants directly from the Department of Energy. Small governments are defined as having populations less than 35,000 for cities and lees than 200,000 for counties. The Energy Commission awarded about US$32 million in the form of 206 individual grants to these local jurisdictions for retrofit upgrades. Typical facilities in both urban and rural areas were local government buildings and facilities, including street lighting, community centres, libraries, city halls, parking lots, and jails.
- **Municipal and Commercial Targeted Measure Retrofit Program (MCR).** MCR included three subprograms/implementers for commercial retrofit projects showcasing newer lighting and control technologies:
  - *EnergySmart Jobs (ESJ)* provided US$18 million in funding for more than 7,100 retrofits targeting grocery stores, convenience stores, and restaurants located throughout the state. The equipment installed by ESJ included light-emitting diode (LED) bi-level refrigerated case lighting, refrigeration energy management system (EMS) controls, and beverage merchandiser controllers. One program goal was to facilitate the creation of relationships across California Conservation Corps (CCC) members, trade allies, utilities, and customers to ensure that both job creation and energy efficiency opportunities continue beyond the time frame of the program.
  - *The Energy Technology Assistance Program (ETAP)* utilized nearly US$7 million to provide technical support, implementation assistance, financial incentives, and fi-

nancing to local government customers throughout the state including counties, cities, and special districts. More than 300 audits and feasibility studies were completed, along with 114 retrofit projects involving occupancy controlled bi-level lighting for parking lots/garages, and wireless controllers for lighting, and HVAC.

– *Oakland Shines* conducted outreach to about 1,500 businesses, delivered energy savings assessments at over 600 facilities, and completed nearly 200 retrofit projects in downtown Oakland, California. Drawing on US$5 million in ARRA funding, the program installed and paid incentives for advanced lighting and HVAC measures, including wireless control technologies in commercial buildings and parking structures.

In addition, the Energy Commission allocated US$9.6 million in support contracts, including approximately US$4 million for the evaluation of these seven programs. In total, the Energy Commission's ARRA-funded portfolio represented about 15 % of the total funding available for energy efficiency programs in California during the 2010–2012 timeframe.[9]

## Evaluation methodology

The analysis completed for this study is based on the Renewable Energy Efficiency Mapping (REEM) framework developed by Economic Development Research Group (EDRG) to translate the ways in which program dollars (in this case SEP and EECBG dollars) are injected into the economy, and how they influence economic outcomes in different market segments. REEM is used as a pre-processor to ensure that data reflecting energy policy and program implementation activities are thoroughly and properly characterized. While REEM can perform key allocation mapping, many of the REEM inputs and industrial sector mappings were developed by DNV GL as part of the ARRA program evaluation and cost-effectiveness analysis.

The resulting expenditure allocations were inputs for the REMI model (a computable general equilibrium (CGE) model) to explore their direct influence on the regional economies. The broader macroeconomic outcomes can be gauged for a given region of interest using an economic model that can react to each of the specific direct economic effects (anticipated or observed).

For example, a commercial or industrial customer with a lower energy bill has lower costs of doing business in their region and, as a result, is more competitive within those markets where the customer competes for business. This grows sales, along with jobs, labour income, and value-added product. By eventually spending less on energy consumption, households have disposable income to spend on other goods and services.

In addition, this activity may reduce energy generation that would have implicitly sent more dollars out of the region for fuel imports. This leakage from the local economy is replaced with locally provided services to install and maintain lower energy using dwellings or facilities, and provide some locally sourced equipment, components, and installation services. As businesses experience more sales, this has a multiplier effect on their suppliers. As households have more income (from energy bill savings) and spend it supporting local jobs, more local wages are created, and those new wages will have multiplier effects on the regional market.

In Figure 1, the left portion of the diagram portrays the set of direct effects that are possible with a broad range of energy-related investments and objectives. Non-energy benefits and environmental impacts were not included in the scope of the analysis.

### DATA REQUIREMENTS

The four major categories of direct effects associated with energy policies or investments and their potential to initiate macroeconomic responses are described below. In addition, the analysis requires tracking these cost data based on the geographic region where expenditures occurred and by the type of activity (for example, energy audits/assessments and energy efficiency upgrade or on-site renewable electricity generation).

#### Local administration of stimulus spending

These dollars are spent to operate the state's SEP and EECBG programs. This spending includes incentives and loans disbursed to business and household participants, as well as expenditures for program management, marketing and participant information, workforce development and training, and QA/quality control (QC).

#### Household, business, and institutional energy bill savings

These savings include estimated energy bill savings to businesses, agencies, and households from reductions in energy consumption realized as a result of the SEP- and EECBG-funded projects.

#### Household and business spending

This spending includes additional household and business expenditures associated with the incremental cost of purchasing and installing energy retrofits and upgrades, including efficient equipment or on-site renewable electricity generation. These are the full costs for the new energy upgrades, minus incentives paid by the ARRA program, and any other rebates available to the program participant. In other words, it's the participant's out-of-pocket expense.

For example, if a project has a total cost of US$100,000, this is the project cost and the level of expenditure introduced into the regional economy. However, the participant's cost is US$100,000 minus ARRA payments (US$50,000), minus IOU rebates (US$30,000), and minus municipal and local rebates (US$10,000). The resulting participant's out-of-pocket expense would be US$10,000. The estimated net savings for a participating household are the recurring energy bill savings minus the out-of-pocket expenditure for the energy upgrade project. Changes in the energy bill create changes in discretionary funds available for households to save or spend on additional goods and services in current and future periods. For participating commercial facilities, the estimated net energy bill savings lower operating costs. For participating government facilities, the net energy bill savings augment public spending.

Annual values are used for modelling purposes to generate annual economic flows within the state. DNV GL provided EDRG with annual spending, bill savings, and related cost data

9. During the three-year period (2010–2012), the California investor-owned utilities spent more than US$3 billion on energy efficiency programs (or about US$1 billion per year). By comparison, the Energy Commission's portfolio was in operation for approximately 1.5 years (spanning 2010–2012) and the total funding amounted to about US$251 million (or about US$167 million per year).

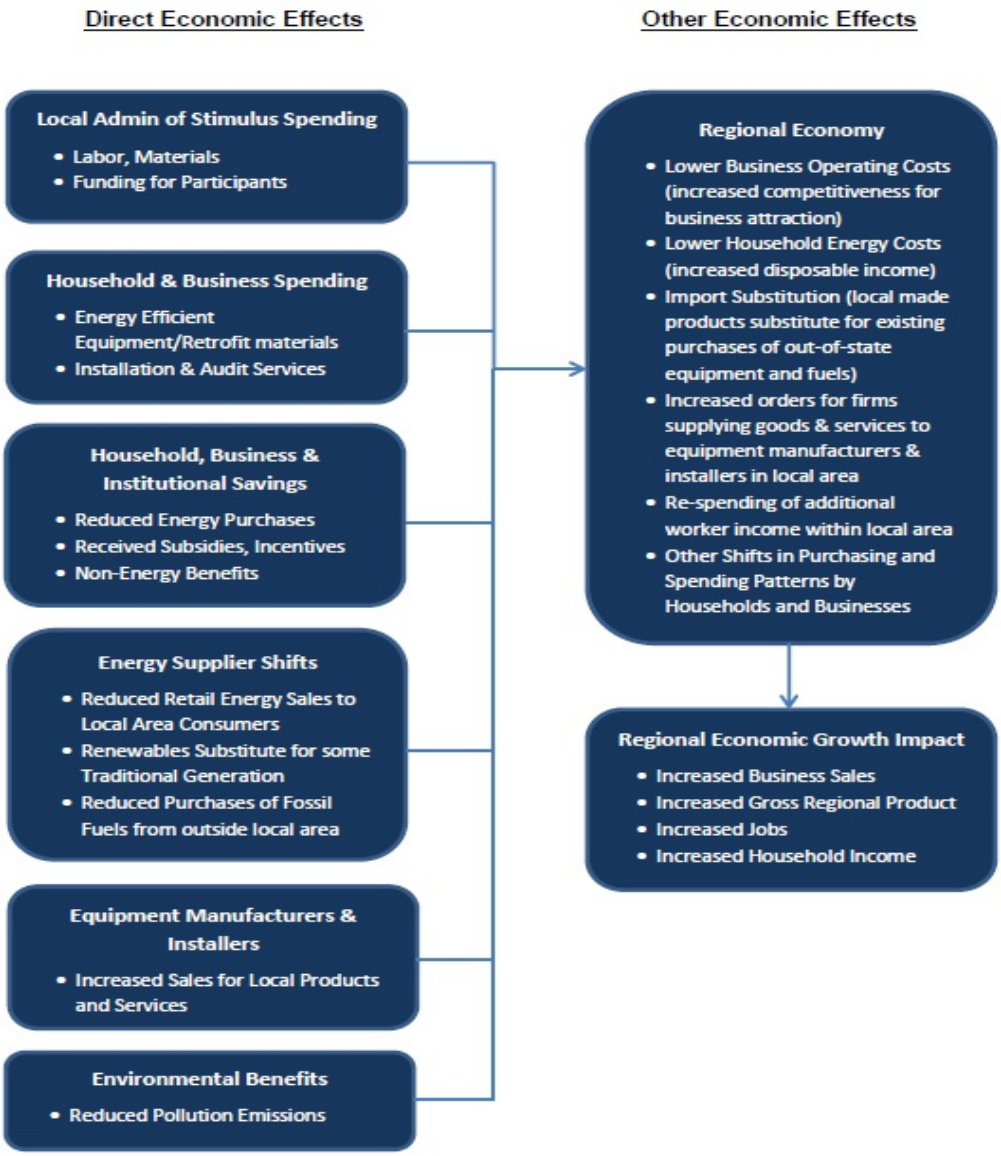


*Figure 1. REEM Framework for Energy Impact Analysis. Source: ©2005–2011 Economic Development Research Group, Inc.*

by region and year for the analysis period. The following types of household and business expenditure data were provided as REMI modelling inputs:

- Labour cost by type (e.g., energy auditor, construction labourer).
- "Locally manufactured or procured" building equipment (e.g., windows, insulation, HVAC, motors) or production system components (e.g., solar panel assembly tables, injection molding or cutting machines, chemical baths, furnaces).
- Monetised value of annual energy saved by building type (net of owner's investment cost).

#### Equipment manufacturers and installers

Wholesale: *Locally procured* in the model triggers a particular set of economic linkages associated with energy upgrade products purchased from a wholesale distributor located within one of the seven regions defined in the model, and installed within the same region. For most energy upgrades, the purchase region is the same as the region where the upgrades were installed. One notable exception is for the specialized manufacturing equipment in the CEBFP purchased directly from manufacturers outside California.

Manufacturing: *Locally manufactured* in the model triggers a different set of economic linkages associated with equipment manufactured in the region or in the state. California has a diverse manufacturing base that includes some lighting manufacturing. However, there is no documentation that energy upgrade measures implemented through the ARRA programs are part of this manufacturing base. For example, equipment for end use such as heating and cooling are manufactured outside California (Goodman in Texas, Trane in Wisconsin, and Carrier in New York). Another company, Corning, manufactures several building materials in California. These are roofing products in the Los Angeles region and stone veneer in the Bay Area region. Other product manufacturing by this company, such as thermal insulation manufacturing is done predominantly outside the state.

#### DATA AVAILABILITY AND COLLECTION

The data used for this analysis existed in many different forms and places:

- **Energy savings data:** developed by the evaluation team for evaluation reports for each program. Data collected by the evaluation team included energy savings (kWh, therms) for both the first year and life cycle of the energy upgrade measures, and onsite renewable electricity generation capacity (kW) and kWh.
- **Program operations spending:** Program implementers reported expenditures, by category (e.g., administration, marketing and outreach, incentives, financing, etc.), to the Energy Commission. The Energy Commission staff provided this program-level data to the evaluation team. The evaluation team reviewed this data and followed up with Energy Commission staff and program implementers where clarification or more detail was necessary.
- **Household, business, and institutional energy bill savings:** Participants who received services, incentives, and financing from the program were the focus of the energy bill savings impact evaluations. The energy savings reported from those evaluations were used to estimate energy bill savings by applying forecasted, average retail electric and natural gas rates by sector for each region where projects are located. The Energy Commission provided average retail rate forecasts by IOU service territory and rate class for a 20-year period. Household and business savings are the stream of estimated energy bill savings that result from energy savings for energy retrofits and upgrade projects completed through the programs over the effective useful life of the installed energy measures.
- **Household and business spending:** This spending represents the participant's "out-of-pocket" first costs. Project costs were not recorded in a standardized way, and each program implementer tracked these expenditures with varying levels of detail and accuracy. The evaluation team worked with the available data to determine project-level expenditure averages, as well as factors representing the split between equipment and labour costs. In some cases, these factors were derived from California's Database for Energy Efficient Resources;[10] in others, sample project files were examined to determine the appropriate split. After these factors were applied to project expenditures, labour costs were further broken down by industry type at the two-digit level of the North American Industry Classification System (NAICS). NAICS codes were assigned based on the predominate end use for the project.

#### MODELLING APPROACH

The model used for this analysis was the REMI Policy Insights Plus model (REMI).[11] Depicting a seven-region model of the California economy, with detail and economic assumptions at the regional level, REMI allows for impacts to be addressed for the residential household sector and 23 industry sectors. The model is a computable general equilibrium (CGE) annual forecasting system (capable of doing analysis through 2060). It includes the ability to adjust a full range of variables to introduce direct elements of a policy change into the model, and the resulting economic impacts for a targeted region.

The model uses inputs specified by the user to make an alternative forecast to the baseline (status quo) market, based on industry and labour market interactions, customized by REMI to reflect the regions defined by the analysis objectives. The model generates a default baseline level of economic activity based on these regional interactions. When model inputs are changed (for example, a change to participant estimated energy bill savings), the model recalculates economic flows and presents results in terms of change from the baseline.

The steps are listed below:

- Define the desired set of direct project effects for analysis.
- Develop macroeconomic model with required responses. Figure 2 presents the set of REMI model linkages. REMI populates these, and the output becomes the baseline scenario.
- Map and model region-level, project-direct effects into economic changes.
- Adjust the model to reflect ARRA-induced spending, and rerun the model.
- Introduce changes to the model, and solve for regional annual total job impacts (total equals direct plus indirect plus induced impact cycles) among other annual metrics.

To estimate job effects along with other macroeconomic changes from ARRA spending, key information was assembled from the program impact evaluations, the cost-effectiveness analyses, and other relevant sources. Changes in the model output from the baseline represent the change caused by a "proposed action." In this analysis it is the introduction of the additional ARRA spending. The impact is the resulting estimated annual change in employment, or dollars of GSP (regional), or labour income, as a change from what the macro indicator would have been without the "proposed action." A change can be shown as a difference from the baseline or as a percentage change.

In a multiregional REMI model, an economic event in one region will have varying spill over effects on surrounding regions. Triggered by the policy or investment, these effects result from pre-existing labour flows, interregional business transactions, and changes in relative competitiveness.

#### ANALYTICAL PROCESS

DNV GL provided EDRG with a consolidated dataset of expenditures and bill savings representing a time series (for the interval 2010 through 2026/2027)[12] for each of seven programs: CCRR, CEBFP, CEWTP, DGS, ECAA-ARRA, EECBG, and MCR. To support the macroeconomic analysis, program activities first were segmented by target market (residential, commercial, industrial, state government, or municipalities) and then by region. The dataset for each program had administrative costs, projects costs, and estimated energy savings from reduced electricity and/or natural gas consumption.

10. http://www.energy.ca.gov/deer/.

11. General model developed by Regional Economic Models, Inc. www.remi.com.

12. Expressed in 2012 constant dollars.

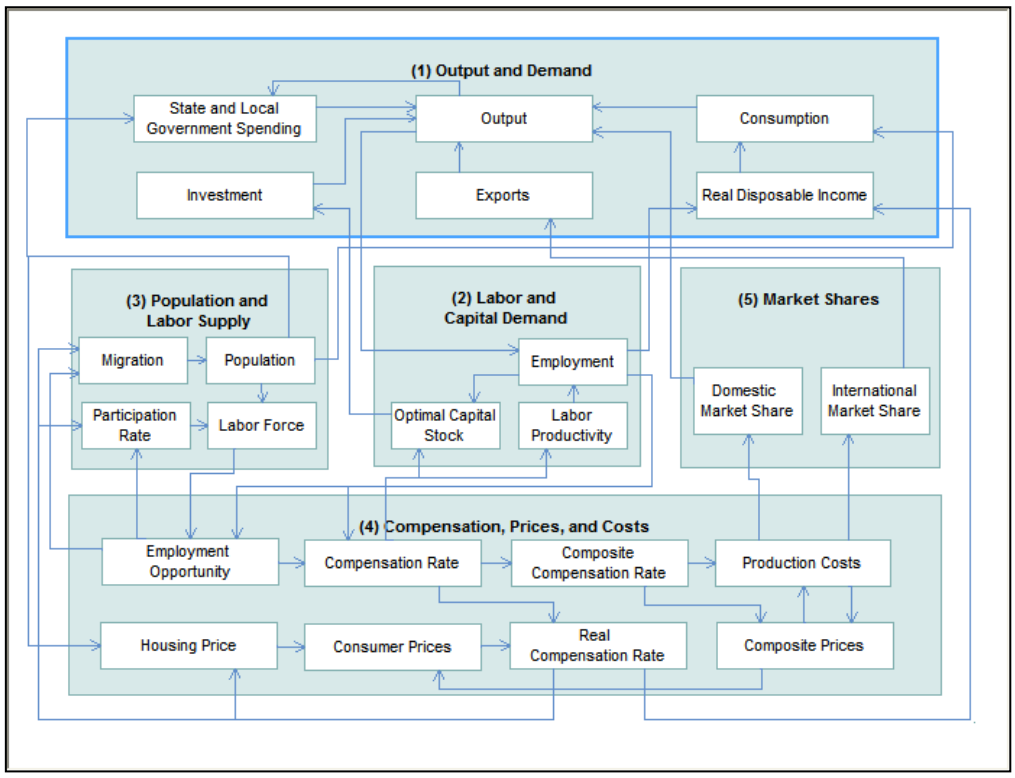


*Figure 2. REMI Model Linkages. Source: Regional Economic Modelling, Inc., REMI documentation.*

Gross (total) project costs were broken out:

- As project cost for labour and equipment.
- For CCRR only, labour was additionally allocated either to Sector 23 "Construction Labour" or to Sector 54 "Misc. Professional and Technical Services." This was done because CCRR included stand-alone energy assessment activity.
- For CEWTP, all of the labour was assigned to Sector 61 "Educational Services."

Along with a set of assumptions described below, the steps above make it possible to map or translate these concepts into a set of interactions initiated by the programs that alters the baseline macroeconomic trajectory across each region.

- Gross project cost is the basis for creating the "demands" allocated between energy-efficient equipment and labour for installation/inspection/audit activities.
- Equipment purchases for CEBFP are considered as manufactured out-of-state and sourced factory-direct.
- Equipment purchases for all other programs conservatively assume zero in-state manufacturing. Each region contains a wholesale distribution sector for sourcing and credits the distributor's mark-up to the region.
- Direct expenditures on project labour occur in the region where the project was implemented.
- Program-related costs (net of the incentive and financing budgets) form the basis for more local spending to implement the program, including hiring external consultants to support program management, marketing, training, QA/QC, and evaluation activities. Some of these dollars pay state and local government employees to run day-to-day aspects of the program.
- Participant costs (out-of-pocket costs for energy retrofit and upgrade projects) are the gross project costs minus any rebate or other form of incentive.
- The participant's estimated net energy bill savings are specified after considering any future stream of loan repayment cost.
- Net energy bill savings streams for programs are estimated over the period of analysis, which for most programs is consistent with the program's savings-weighted average measure life. For most programs the estimated net energy bill savings stream was determined through 2026.

#### MODELLING ARRA ACTIVITIES IN REMI

The first distinction to be made with program-specific information is to assign the customer segment(s) participating in the programs, as indicated by:

- Participant contributions to cover project costs, either through cash or loan payments (after rebates, incentive monies, or other leveraged funds are received).
- Estimated participant energy bill savings expected through reduced energy consumption due to energy efficiency or solar PV installations.

The ARRA programs targeted specific customer segments, so assignments were relatively straightforward. Table 1 provides this segment information.

**Table 1. Market Segments by Program.**

| | CCRR & LGC | DGS | ECAA-ARRA | EECBG-SCC | MCR | CEBFP | CEWTP |
|---|---|---|---|---|---|---|---|
| Customer Segment | Residential, Commercial | State | Municipal | Municipal | Municipal, Commercial | Manu-facturing | Working Age Cohorts |

To create an alternative macroeconomic forecast across the California regions, costs and benefits are entered into the REMI analysis model for each program as described below:

- Labour dollars are local labour compensation payments by sector at the two-digit NAICS code level. For the ARRA programs, the NAICS names and codes were construction trades (23), professional and technical services (54), and educational services (61).
- "Equipment" dollars represent the energy upgrade measures installed through the ARRA programs, which are procured through wholesale distributors and not directly from manufacturers. The exception is CEBFP, where all equipment is considered to be procured factory-direct from outside California.
- Incentives and rebate dollars are applied to project costs to reduce the cost of projects to participants. Energy Commission ARRA dollars were reported by the Energy Commission. Rebate dollars from other sources such as IOUs, publicly owned utilities (POUs), and municipal governments are included where reported by implementers.
- Financing cost payment flows are determined using program-specific interest rates and loan durations.
- Financing cost flows are deducted from estimated energy bill reductions to determine net energy bill dollar flows, which affect changes in the cost of living in the residential segment and the cost of doing business in the commercial segment.
- Participant costs also represent changes in the cost of living in the residential segment and the cost of doing business in the commercial segment. Gross projects costs are restated as net project costs by deducting incentives and rebates. Net project costs are referred to as participant costs.
- Program operations spending (apart from incentives and financing) includes state government employee compensation for day-to-day program activities, along with professional and technical services paid through ARRA funding for all other aspects of administering the program.

## Results

Results from this analysis are presented at the state, region, and program level. All results are stated in 2012 dollars.

- Program expenditures directly generated a combination of 3,723 full-time and part-time jobs from 2010 through 2012. Much of this direct employment, with a possible exception in the manufacturing sector, ended along with the ARRA funding.
- From 2010 through 2026, the spending from the programs is estimated to generate 16,946 job-years. This is a combination of direct jobs created by program delivery; indirect jobs through purchases of equipment from suppliers, distributors, and manufacturers; and induced jobs that result from consumer spending made possible by energy bill reductions.
- Modelled job effects resulting from estimated lower energy bills are due to a combination of extra spending by households and governmental entities, along with the increased market shares for participating businesses.
- Incremental personal income of US$1.27 billion was created through additional wages and salaries over the 16-year period.
- The economic activity resulting from the Energy Commission's administered ARRA programs is expected to generate a cumulative value of US$2.04 billion in gross state product over 16 years.
- Additional revenue of about US$243 million is expected to flow to the state through taxes and fees over the same period. This incremental revenue is prior to subtracting any incremental expenses.

### OVERALL EMPLOYMENT AND ECONOMIC IMPACTS

Program (ARRA) and base case (no-ARRA) results are summarized in Table 2. The base case represents the entire California economy. ARRA results represent incremental changes to the no-ARRA base case. As shown, the spending from the ARRA programs during 2010–2012 created an estimated total of 16,946 direct, indirect, and induced jobs (or, more precisely, job-years) through 2026. Programs with the highest expenditures did not necessarily result in the highest, estimated direct, indirect, and induced employment effects. Instead, the results suggest the greatest long-term impacts are from manufacturing programs followed by programs that provided the most net energy bill savings to participants.

### EMPLOYMENT IMPACTS BY INDUSTRY AND OCCUPATION

Industry-level job impacts describe the expected job changes in private-sector activities. Occupational impacts, on the other hand, account for the type of jobs in either the private-sector or the public sector. Employment depends not only on initial spending (for direct jobs), but how effectively the program created lasting financial benefits for participants. Each sector of the economy has its own growth response to cost savings.

Employment changes occur across industries over time. During the three years of ARRA program spending, employment gains come from program implementation activities. After year three, the effects on the California economy are due to the esti-

mated reduced energy bills realized by participants and the economic multipliers associated with specific industries and regions.

For all regions and all programs in the state, employment gain is dominated by the construction industry followed by the professional, scientific and technical industry. This domination reflects the initial capital and labour spending on selling and installing efficiency upgrades such as lighting and HVAC equipment and on the jobs needed to implement the program related activities. By 2022, construction and professional scientific and technical industries employment has moved closer to the base forecast level, and spending throughout the economy generated by ARRA has shifted the type of employment gains to manufacturing followed by service industries such as health care, retail, and professional services.

Occupations within these industries are shown in Figure 3. Sales remain a dominant occupation, but these jobs have shifted in type from construction to retail and other industries.

## ECONOMIC IMPACTS

### Gross state impacts

Gross State Product (GSP) is a measure of the state's output. It is the market value of all goods and services produced by the state in one year. Typically when GSP is growing, economic activity is increasing, and households and businesses are made better off. Under the ARRA case, the federal stimulus spending generated an additional US$110 million GSP in the first year of ARRA expenditures (Figure 4). The incremental annual increase in GSP over the base case after the ARRA spending ends and reaches an estimated annual peak of US$133 million in 2022 as the benefits of estimated lower energy bills flow through the state economy. Stated another way, an additional US$100 million per year on average over a 20-year period creates a cumulative US$2.04 billion in economic activity generated as a result of ARRA spending.

**Table 2. Summary of estimated employment and economic outcomes in California (2010–2026).**

| | Direct outcomes (2010–2012) | Direct, indirect, and induced outcomes (2010–2026) | | | |
|---|---|---|---|---|---|
| | Employment[1] | Employment[1] | Personal income | Gross state product | State revenue |
| ARRA | 3,723 full-time and part-time | 16,946 full-time and part-time | $1.27 billion | $2.04 billion | $243 million |
| Base case | 60 million | 374 million | $35 trillion | $40 trillion | $4 trillion |

*1 Direct employment during 2010–2012 is a subset of the direct, indirect and induced employment total during 2010–2026. Employment is presented in job years (one job for one year). One job year can be due to either full or part time employment. Source: Economic Development Research Group.*

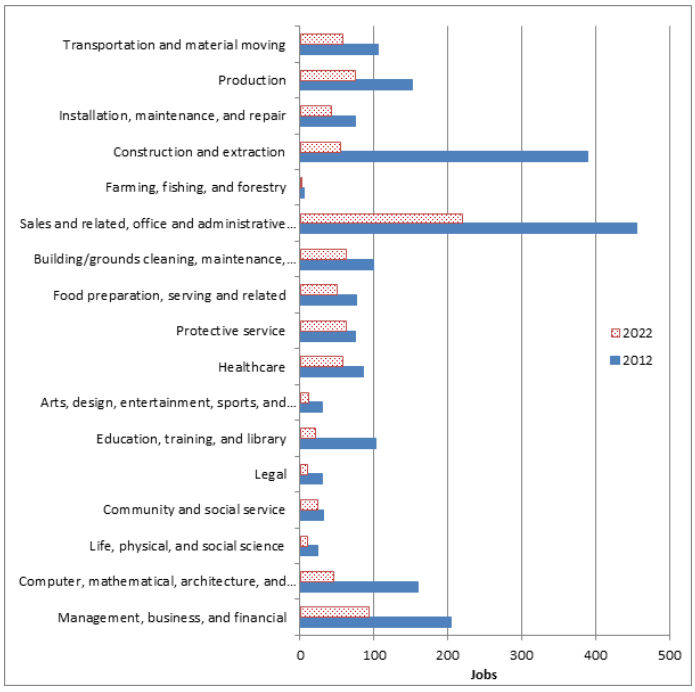


*Figure 3. Estimated Annual Employment Changes in California by Occupation. Source: Economic Development Research Group.*

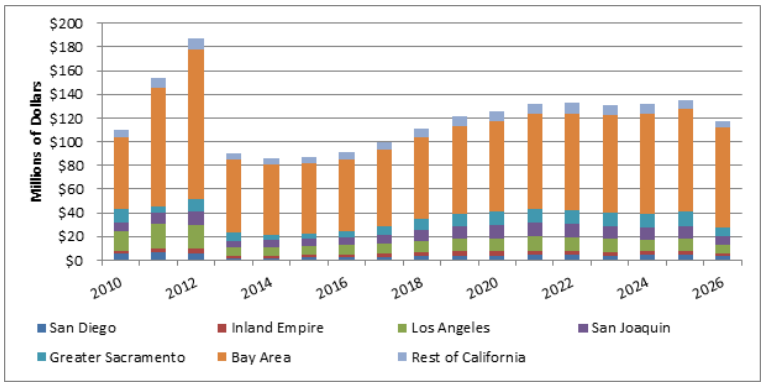


*Figure 4. Annual Gross State Product by Region (Millions of 2012 Dollars). Source: Economic Development Research Group.*


*Figure 5. ARRA-Inducted Employment Changes Relative to Different Energy Bill Savings Scenarios. Source: Economic Development Research Group, Inc., using the REMI PI+ impact model.*

#### State revenue impacts

Revenue will flow to the state through a range of taxes and fees. The majority of these taxes are income taxes and state sales tax generated through more or higher wage-earning employment and higher consumption of goods. More jobs mean more people earning wages and paying taxes on those wages. This also may result in higher sales taxes as workers spend their wages on taxable goods and services. Business also will pay taxes from their sales. In addition, intergovernmental revenue represents the flow of funds between levels of government and between agencies at the same level. Funds may originate at the local, state or federal levels. This revenue can include money from shared taxes, grants and loans, or reimbursement for services rendered. Across all regions and programs, additional state revenue impacts are estimated at about US$243 million.

### ENERGY COST SCENARIOS

The Energy Commission produces three retail rate scenarios (low, mid, and high). Each retail rate scenario represents underlying assumptions about the forecasted future level of state economic activity. These scenarios are not absolutes but represent a range of economic activity, and can be used to investigate employment and economic impacts within a range of bill savings.

Holding the program expenditures, project expenditures, and REMI macroeconomic conditions constant, more energy bill savings for program participants translates to more discretionary income available to spend on other goods and services and more consumption for households. Businesses become more competitive through lower operating costs and may choose to reinvest, pay higher wages, or hire more employees. Government entities also experience lower operating costs, and these may translate into capital reinvestment or reallocation of budgets. These changes support the expansion of economic activity leading to higher employment. Conversely, lowering energy bill savings has the opposite effect.

High and low bill savings scenarios are presented as annual percentage changes relative to the 'mid' bill savings case. Figure 5 provides aggregate changes in state-wide employment under each scenario, and Figure 6 illustrates estimated aggregate changes in gross state product under these same scenarios.

### SELF-SUSTAINING FINANCING SCENARIOS

Four of the ARRA programs incorporate a self-sustaining revolving loan fund into their program design. That is, once the funds are disbursed, the loan pool is replenished through ongoing repayment of the loans. By replenishing the loan pool, energy efficiency or onsite renewable generation projects will continue to be funded well after the initial ARRA period has ended.

While the employment and economic impacts from these future projects are not included in the scope of the analysis presented above, a simplified scenario was completed to illustrate the potential impacts from these types of self-sustaining financing programs. This scenario was completed using results from

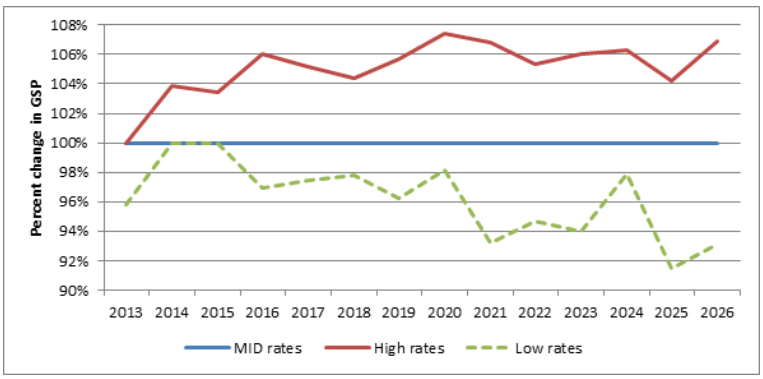


*Figure 6. ARRA-Inducted GSP Changes Relative to Different Energy Bill Savings Scenarios. Source: Economic Development Research Group, Inc., using the REMI PI+ impact model.*

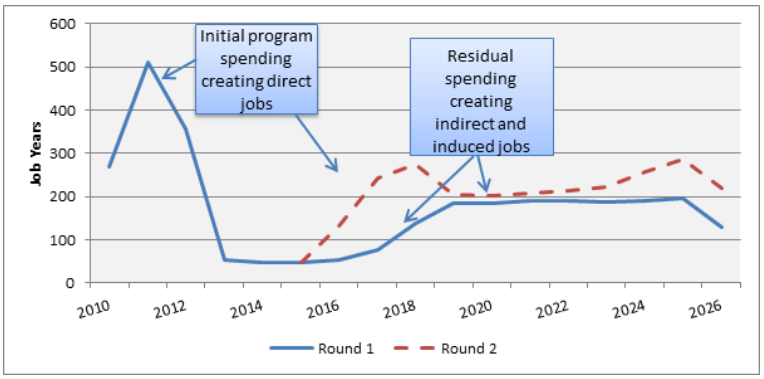


*Figure 7. Self-Sustaining Financing Program Example. Source: DNV GL.*

two of the Energy Commission's revolving loan fund programs – ECCA-ARRA and DGS.

Figure 7 illustrates the estimated employment effects resulting from the initial ARRA loan pool for these two programs (Round 1) and the next pool of loans funded through repayments of the first round of loans (Round 2).

## Conclusions and caveats

While the results of this analysis are well supported by the data and analysis that was completed, the results must be considered as conservative estimates of the employment and economic impacts from ARRA funding on California into the future. We conclude this paper with a discussion of the conservative aspects of the analysis and recommendations for these matters to be addressed in future study.

- **Economic Recovery of Highest Priority in the Analysis.** The Energy Commission's entire portfolio of programs placed foremost priority on economic recovery during the ARRA period. The direct employment reported in the 2010–2012 period demonstrates that priority. In addition, the direct, indirect, and induced employment and economic impacts (through 2026) are driven by the estimated energy bill reductions that resulted from the energy upgrade projects completed in residential, commercial, and municipal buildings during the ARRA period. The employment and economic analysis presented in this report assumes a static market without the market structural changes that were the goal of the Energy Commission's ARRA efforts.
- **Market Transformation Impacts Excluded from Analysis.** In addition to economic recovery, the Energy Commission also placed a high priority on the achievement of national and state-level market transformation objectives. The intent was to use ARRA as a launching pad for lasting changes in the structure and function of California's market for energy upgrades, and in the behaviour of homeowners and the professionals who deliver energy upgrade services to accomplish California energy and climate change goals, which demand substantial gains in California's clean energy economy. Unfortunately, data, time, and resources did not allow for modelling and analysis of additional employment and economic impacts generated by these market transforming effects of the Energy Commission's programs. As a result, the employment and economic analysis completed for this study assumes a static market without consideration of the market structural changes that were the goal of the Energy Commission's ARRA efforts. Investigation of the potential for positive employment and economic outcomes from these types of market transformational changes should be included in future studies.
- **ARRA in Comparison to California's Economic and Energy Efficiency Spending Context.** The ARRA program funding

for California was small compared to the overall California economy or the other energy efficiency spending in the state. During 2012, California was the ninth largest economy in the world.[13] In 2012, California had a GSP of nearly US$2 trillion. In addition, during the ARRA period, the California investor-owned utilities spent more than US$3 billion on energy efficiency programs. Public utilities and municipalities also participated in funding energy efficiency programs. By contrast, the Energy Commission ARRA funding amounted to only about US$251 million. As such, the employment and economic impacts determined through this analysis to be attributable to the Energy Commission's ARRA funding are small and should be interpreted within this context.

- **Non-Energy Benefits.** The residential, commercial, and municipal building owners who decided to make energy upgrades as a result of their ARRA program participation often did so for the economic value they would receive due to reasons beyond reducing their energy bills. Non-energy benefits include reduced exposure to volatility in future energy prices, enhanced comfort, improved health and safety, and, in non-residential buildings, improved worker productivity. Another important non-energy benefit resulting from energy upgrades in residential, commercial, and municipal buildings is the increase in the building's property value at resale. Similar to other building improvements, building owners who invest in energy upgrades anticipate that a portion of the upgrade cost will be returned in the form of a sales premium when the building is sold. This creates a substantial repayment, on top of the energy bill savings, of the original price of the upgrades. The quantification of non-energy benefits is beginning to be addressed for energy efficiency programs in other states, but doing so was outside the scope of this analysis.
- **Environmental Benefits Excluded.** Energy efficiency and onsite renewable generation upgrades provide substantial environmental benefits to society and California residents, as a result of avoided power plant electricity generation and avoided natural gas use. The inclusion of these environmental benefits was outside the scope of this analysis.

13. Center for Continuing Study of the California Economy, www.cccse.com/Numbersnews.php.