Evaluating Employment and Economic Development Impacts

Results from California's American Recovery and Reinvestment Act (ARRA) Funded Energy Efficiency and Renewable Energy Program Evaluation

Presented at:

Evaluating the Multiple Benefits of Energy Efficiency:

A technical workshop with a focus on the buildings sector

IEA Headquarters, Paris, France

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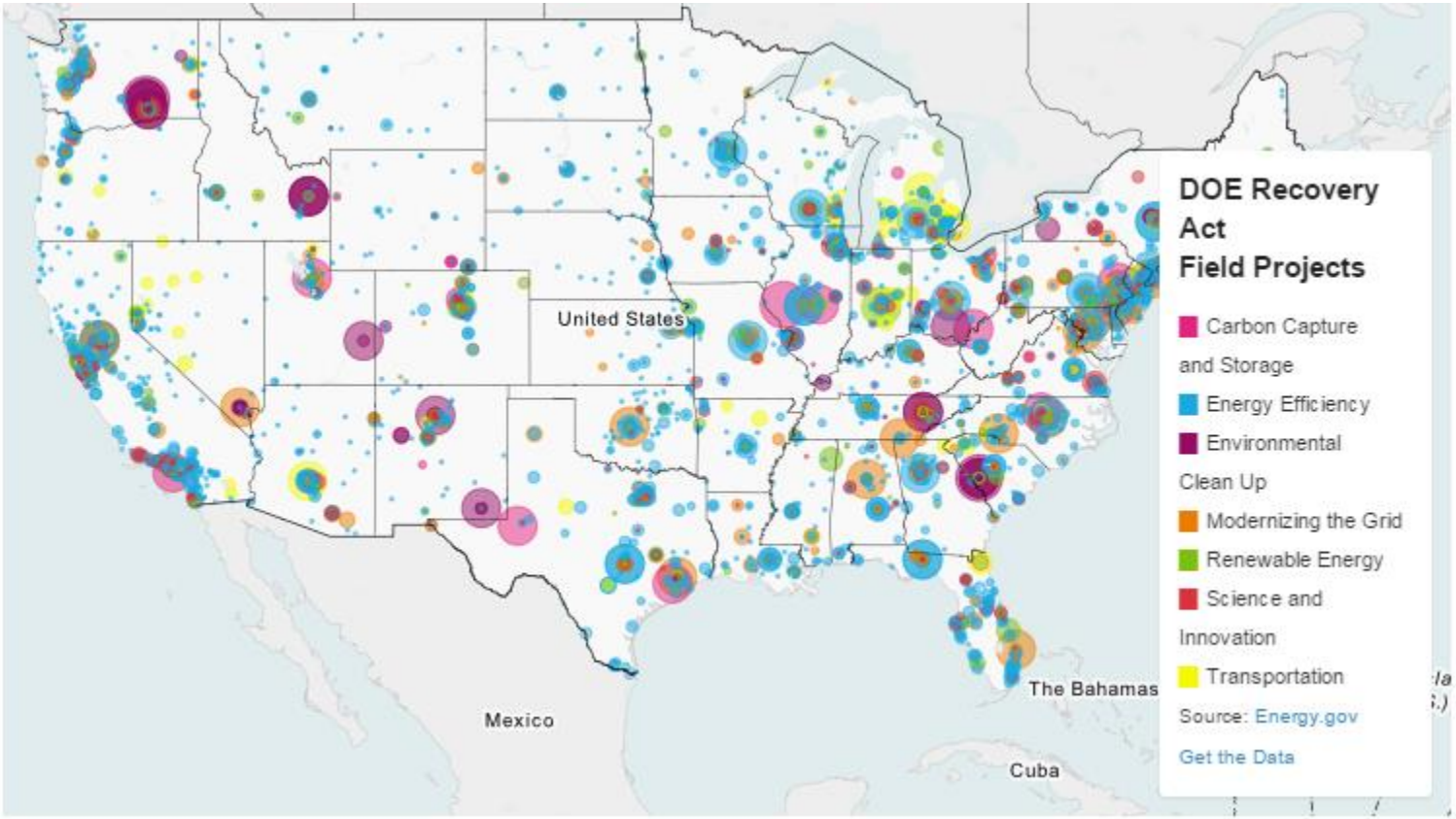
International Energy Agency

Background

- In the wake of a severe recession, US President Barack Obama signed the American Recovery and Reinvestment Act of 2009 (ARRA) into law in order to create and save jobs
  - Immediate goals
    - Create / retain jobs
    - Spur economic activity, invest in long-term growth
  - Funding provided for tax cuts & benefits, entitlement programs, and federal contracts, grants & loans
    - US$ 840 billion during 2009-2011
    - US$ 45 billion to US Department of Energy
      - 3rd highest behind Department of Education (US$ 97 billion) and Department of Transportation (US$ 48 billion)

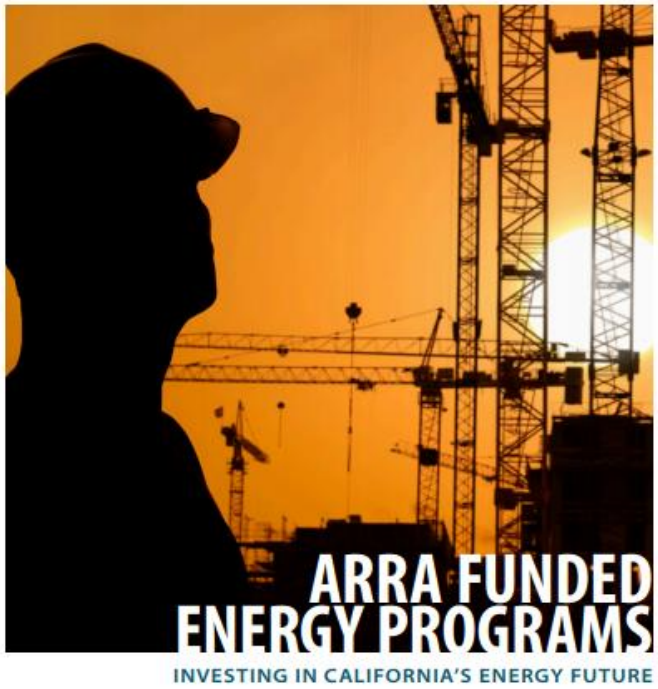
US Department of Energy ARRA Funded Projects



http://www.energy.gov/recovery-act

California's ARRA Funded Programs

- US$ 314 million in ARRA funding for energy efficiency and renewable energy programs
- The majority of funding allocated to two key programs:
  - Energy Efficiency Conservation Block Grant Program
  - State Energy Program
- Goals
  - Stimulate economy and create/retain jobs
  - Achieve lasting, measurable energy benefits
  - Expend money efficiently, with accountability and minimal administrative burden
  - Contribute to meeting California's energy and environmental policy goals
  - Leverage financing through partnerships



Program Summary

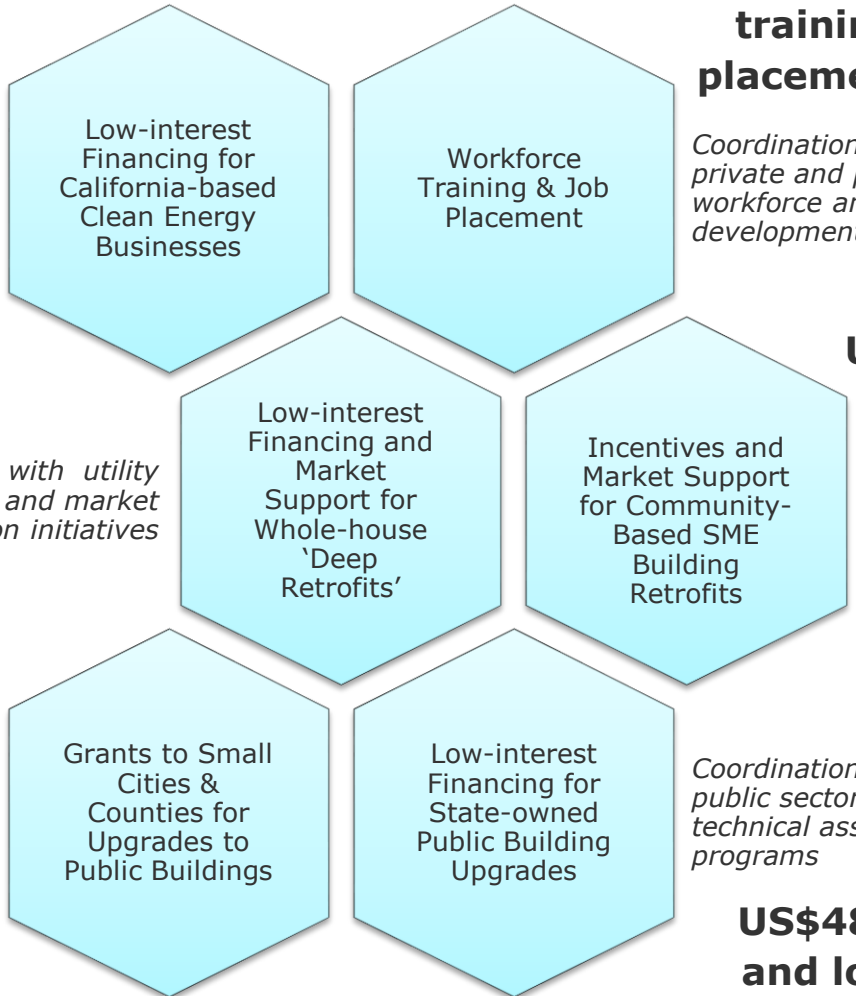
US$19m loans awarded to establish 4 solar PV manufacturing facilities

US$100m in support of multiple initiatives throughout state

Coordination with utility incentives and market transformation initiatives

~14,000 upgraded homes and 1,500 trained in whole-building services

$US34m in energy efficiency grants to 200 small cities & counties



US$19m for clean energy training, certifications, job placement (~10,000 trainees)

Coordination with other private and public sector workforce and economic development programs

US$30m for community-based initiatives targeting SMEs

Over 1,000 energy audits and 7,500 retrofit projects

Coordination with other public sector financing and technical assistance programs

US$48m in revolving loans and low-interest financing

US$7m in 'accountability contracts,' of which US$4m was for measurement, evaluation and verification (EM&V)

Evaluation Summary

- US DOE requested that state-sponsored evaluations of ARRA-funded programs focus on the following metrics:
  - Employment
  - Energy savings and renewable energy capacity and generation
  - Carbon emission reductions
- California Energy Commission also interested in process evaluation outcomes, including customer satisfaction and administrative effectiveness, as well as 'additionality' (net impact) and cost-effectiveness
- Comprehensive ARRA portfolio evaluation completed 2010-2013
  - Measurement and verification activities included 415 site visits and more than 450 telephone surveys
  - Energy-related impacts totalled more than 300 GWh in annual savings and 4 GWh in annual electricity generation
  - Lifecycle carbon emission reductions will total more than 1.15 million tCO_2
  - Levelised cost of US$0.15 and nearly US$200m in NPV benefits to participants

It's all about the jobs! (and other economic impacts)

- In addition to estimating these outcomes, DNV GL, and our project partner, Economic Development Research Group, investigated the employment and economic impacts of California's portfolio of ARRA programs
  - How much **gross project spending** (both ARRA funds and leveraged funds) is directed toward in-state sectors?
  - What **sectors and occupations** are expected to experience job growth/losses as a result?
  - How many **total jobs** are expected to be created by sector and occupation?
    - *Direct jobs* – created by spending on ARRA funded programs
    - *Indirect jobs* – created by purchases of equipment from suppliers, distributors and manufacturers
    - *Induced jobs* – created or retained elsewhere in the economy by re-spending of worker income within the local community or new spending by participants due to energy bill savings
  - What are the estimated **annual and cumulative income effects**? Effect on state revenue? Influence on gross state product (GSP)?

Introduction to REMI Policy Insights Plus (PI+) Model

- **Seven-region model of the California economy** with detail and economic assumptions at the regional level
- Address impacts on the residential **household sector** and **23 industry sectors**
- **Computable general equilibrium (CGE) model** assessing the direct influence of monetised inputs on regional economies through 2060
- Able to adjust a **full range of variables** to introduce direct elements of a policy change into the model and assess economic impacts in a targeted region
- **Customised industry and labour market interactions** to reflect the regions defined by the analysis objectives
- When inputs are changed (e.g., a change to participant estimated energy bill savings), the model **recalculates economic flows** and presents results in terms of **change from the default baseline** level of economic activity

REMI REGIONAL ECONOMIC MODELS, INC.

PI+

Overview Modelling Approach

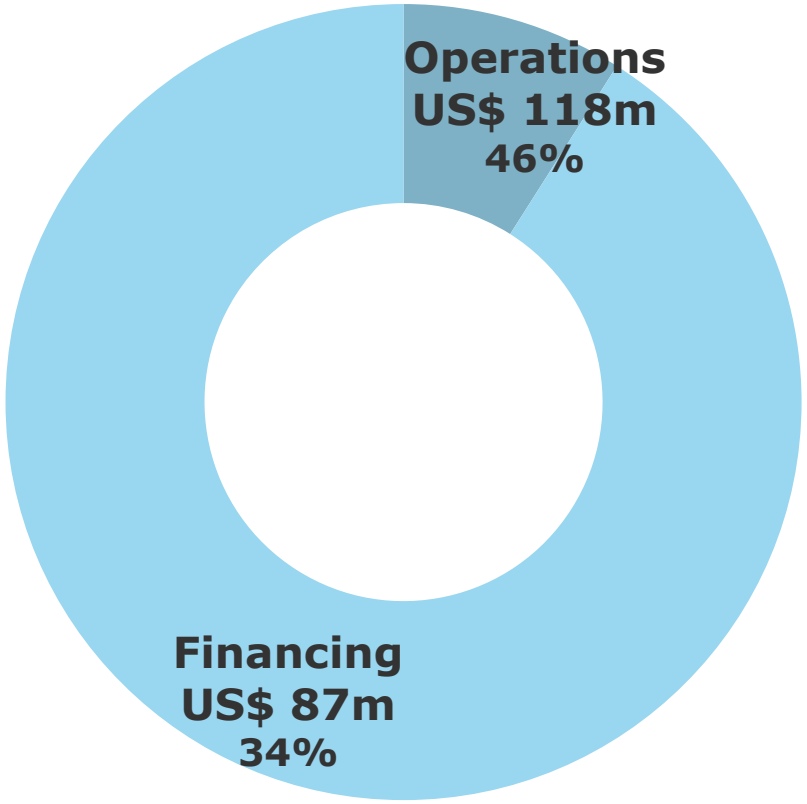
- Requires **baseline level of activity** to be modelled with REMI at the regional level
- Model includes assumptions about the regional economies, sector linkages and economic conditions (including the **impact of the recession**)
- To create an alternate case, model is rerun with the **additional spending created by ARRA**, using these same assumptions and sector linkages
- Difference between the baseline and alternate case is the **estimated incremental change** for GSP, state income, and employment
  - Results represent estimated incremental changes over what would have happened without the ARRA funding (**not annual or lifecycle totals**)
- Many **inputs and sector mappings** were developed by DNV GL as part of the ARRA program evaluation and cost-effectiveness analysis

Data Requirements

- Three major categories of **direct effects** associated with energy policies or investments and their potential to initiate macroeconomic responses
  - Program Spending
  - Household, Business, and Institutional Energy Bill Savings
  - Project Expenditures
- Analysis requires tracking these cost data by
  - **geographic region** where expenditures occurred
  - **sectors affected** (e.g., residential, commercial, institutional, etc.)
  - **type of activity** (e.g., energy audits/assessments, energy efficiency upgrades, on-site renewable electricity generation)

Data Requirements – Program Spending

- Covered wide portfolio of market transformation and building energy upgrade activities in the residential, commercial, and state and local government sectors
  - **Program operations**
    - Administration and implementation
    - Marketing and communications
    - Outreach (recruitment, fieldwork)
    - Workforce development and training
    - Quality assurance
  - **Incentives and financing** for home and facility energy assessments and energy upgrade installations
- Program implementers provided data on expenditures, however, **considerable effort** was required to categorise these data consistently across programs



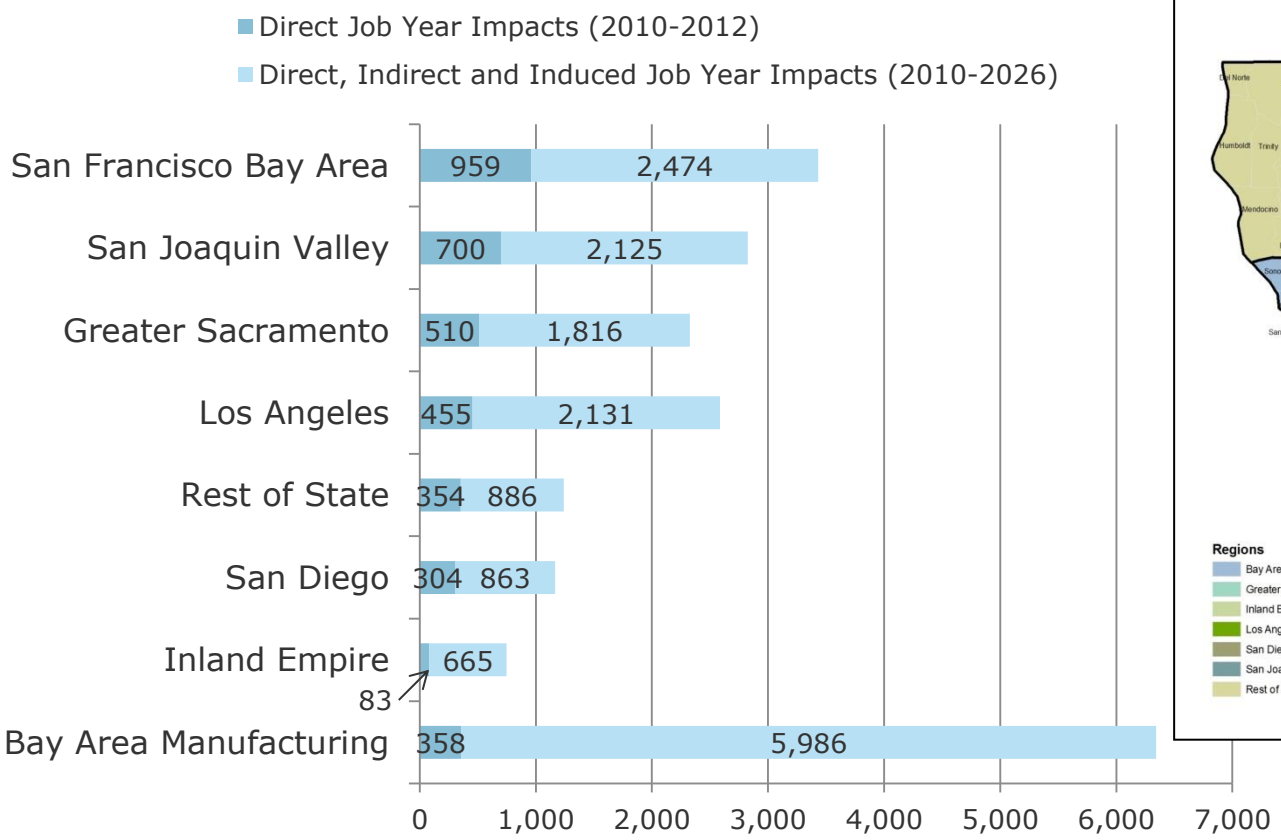
Data Requirements – Bill Savings

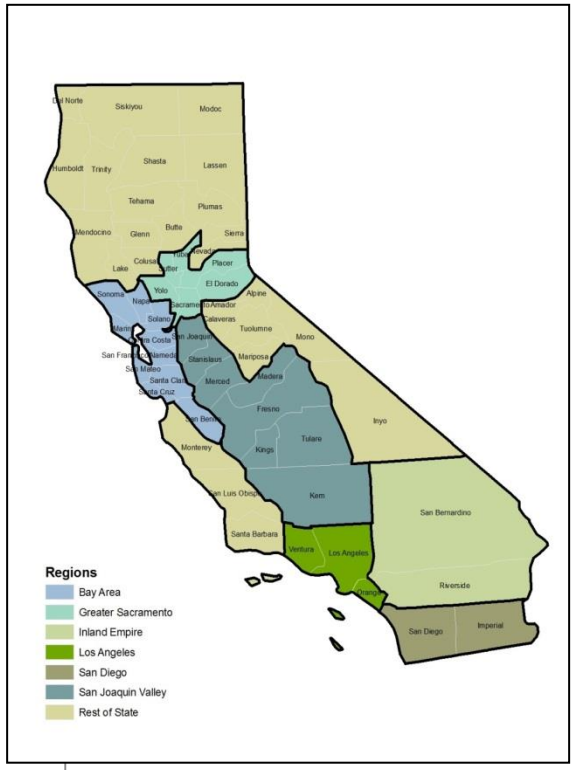
- Energy bill savings accrue to businesses, agencies, and households from reductions in energy consumption realized as a result of the ARRA-funded projects.
  - **Energy Savings Estimates**
    - developed through ex-post impact evaluations at the program and measure level
    - Determined first year and lifecycle electricity and natural gas savings, as well as onsite renewable electricity capacity and generation
  - **Bill Savings Estimates**
    - Developed by applying forecasted, average retail electric and natural gas rates by sector for each region where ARRA-funded projects were located
      - Average retail rate forecasts by utility service territory and rate class over a 20-year period
    - Bill savings streams calculated over the effective useful life of the installed energy measures

Data Requirements – Project Expenditures

- 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
  - Full costs for the new energy upgrades, minus incentives paid by the ARRA program, and any other rebates available to the program participant (e.g., 'out-of-pocket expenses')
- Project expenditures were not recorded in a standardized way, and each program implementer tracked these expenditures with varying levels of detail and accuracy
  - Evaluation team assessed available data to determine project-level expenditure averages, as well as factors representing the **split between equipment and labour costs**
  - Labour costs were further broken down by **industry type** at the two-digit level of the North American Industry Classification System (NAICS)
    - NAICS codes assigned based on the predominate end use for the project
  - Equipment costs distinguished between where they were manufactured, purchased, and installed

Employment Impacts – Results by Region

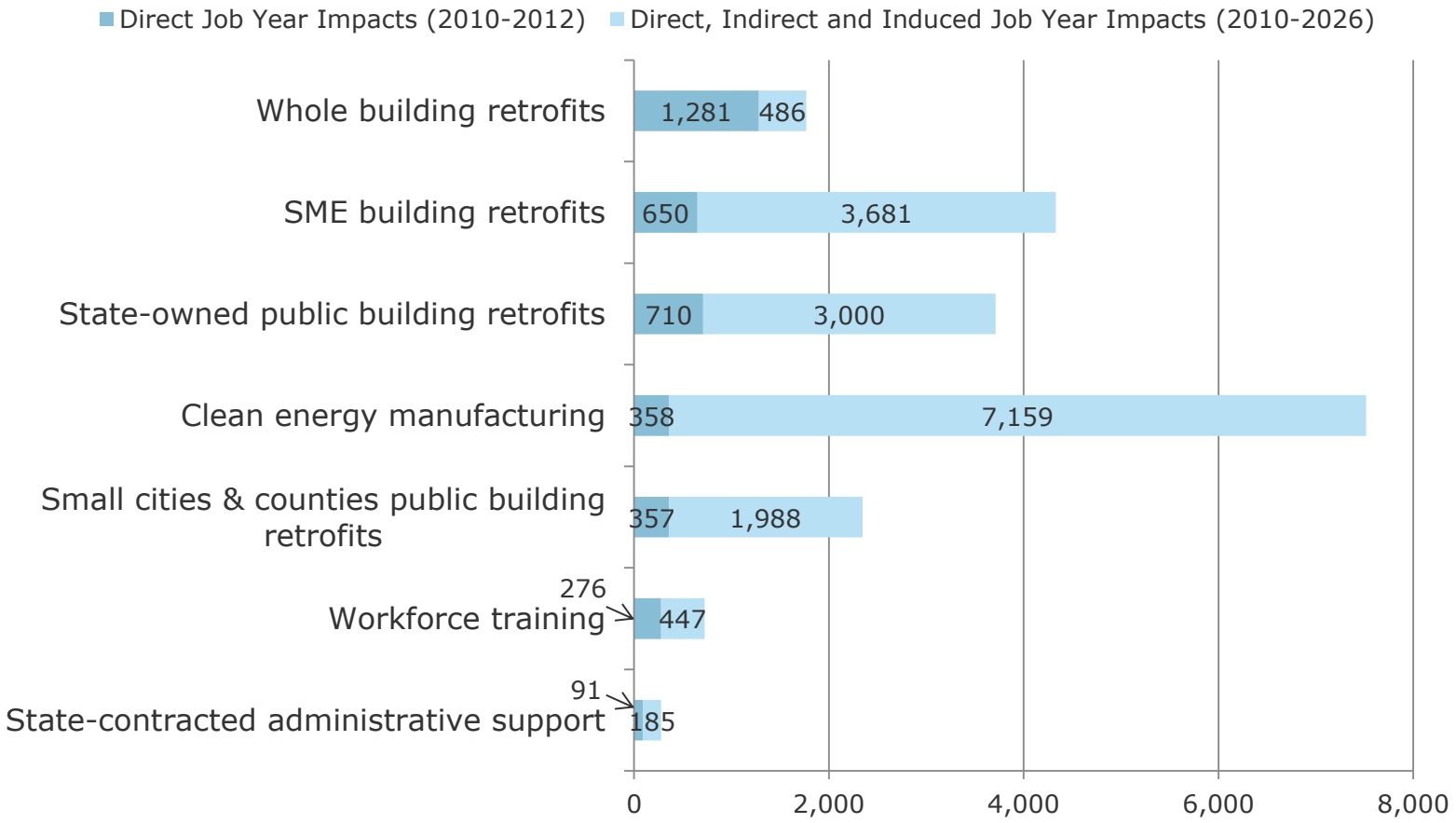




Direct Jobs Total - 3,723

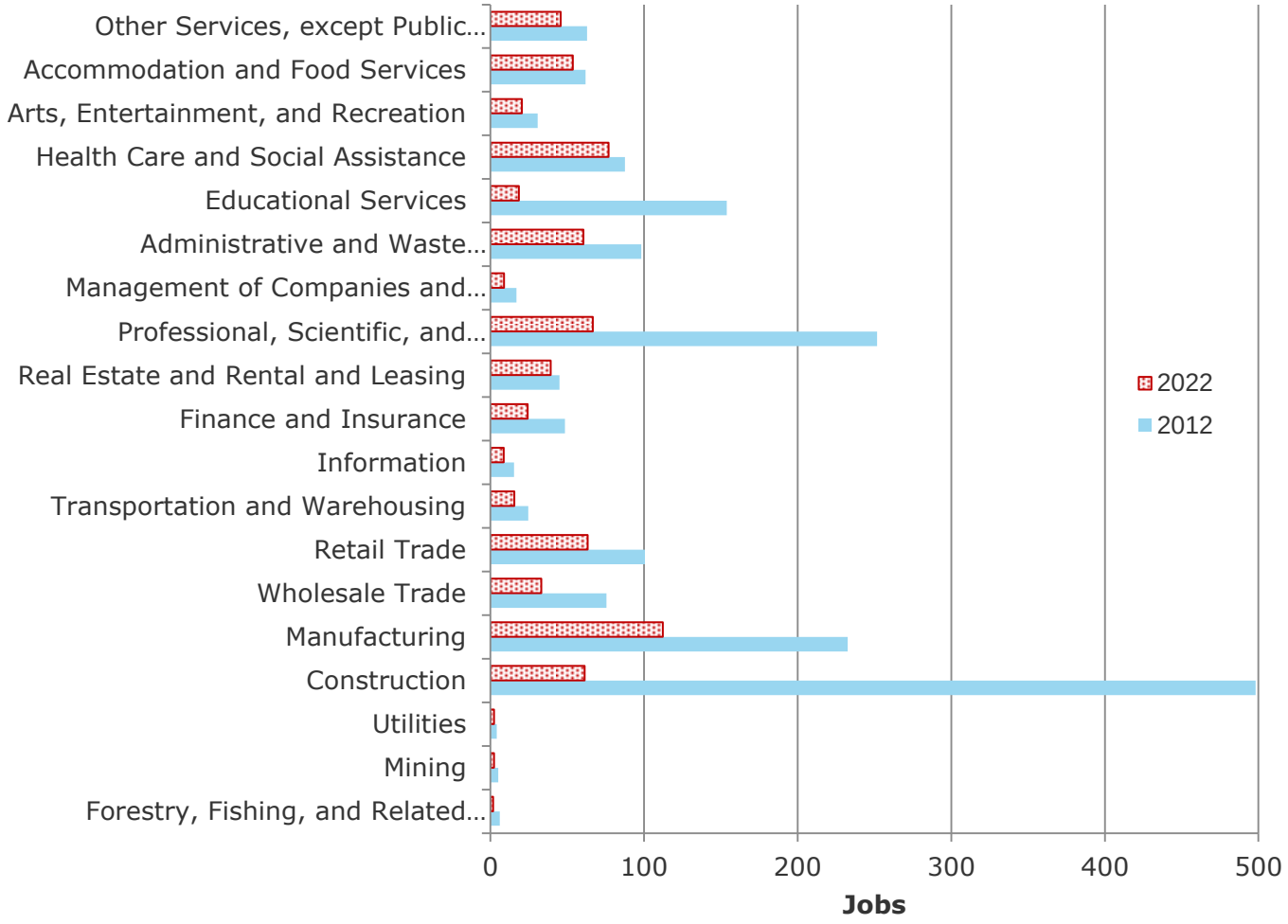
Direct, Indirect and Induced Jobs Total – 16,946

Employment Impacts – Results by Program



Programs with the highest expenditures did not necessarily result in largest number of jobs → greatest long-term impacts from clean energy manufacturing followed by programs with significant lifecycle bill savings

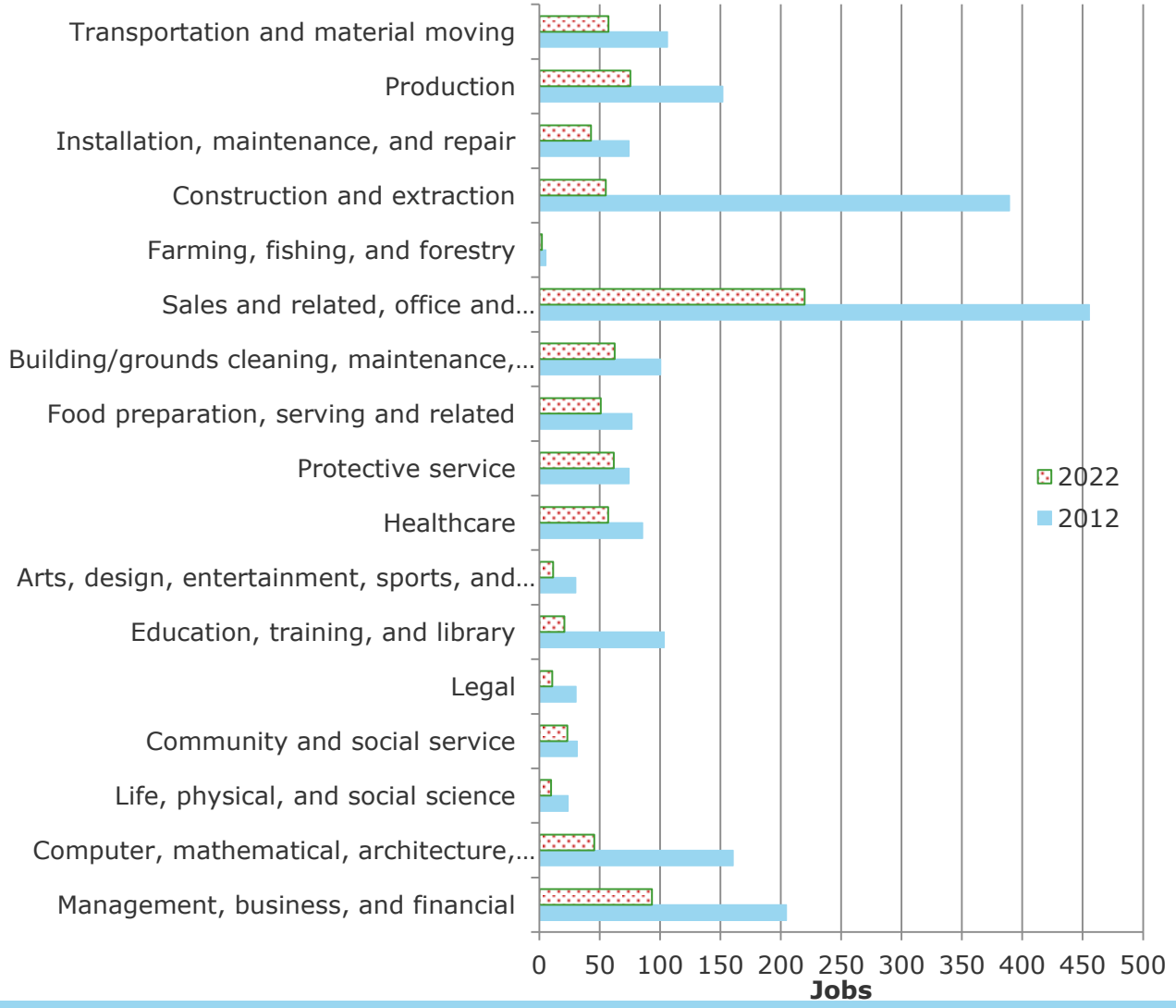
Employment Impacts – Results by Industry



During 2010-2012, employment gains are dominated by construction industry jobs, followed by professional, scientific and technical services industry

By 2022, employment in these industries has moved closer to the baseline forecast

Employment Impacts – Results by Occupation



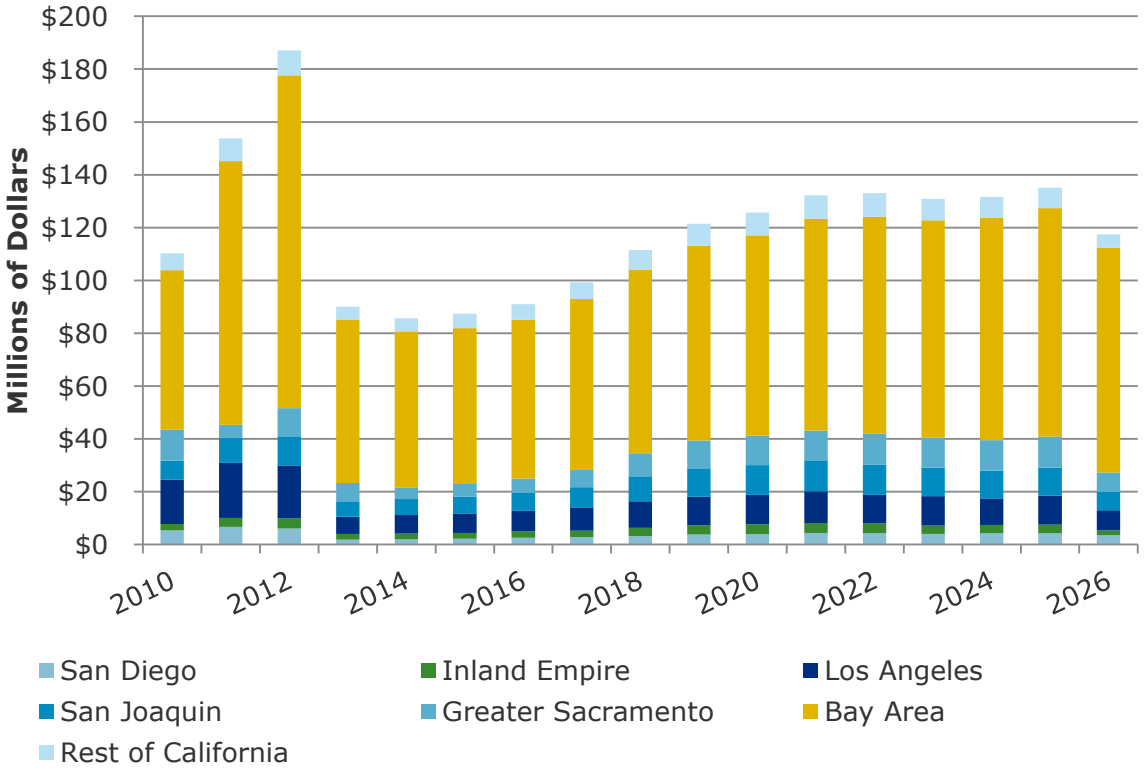
In terms of employment gains by occupation, sales jobs dominate in both the short- and long-term

Other occupations shift over time, away from construction to retail and other industries

Economic Impacts – Gross State Product

- GSP is a measure of the state's output – i.e., the market value of all goods and services produced by the state in one year

ARRA funding resulted in an additional US$ 110 million in GSP in 2010, increased until the end of the ARRA direct spending period in 2012, and accumulating over time reaching more than US$ 2 billion by 2026



Bay Area GSP results driven by higher-value add clean energy manufacturing jobs, as well as higher economic multipliers for manufacturing (as compared to service industries)

Economic Impacts – State Revenue

- 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.
- Intergovernmental revenue – representing the flow of funds between levels of government and between agencies at the same level – was also included.

Additional revenue of US$ 243 million is expected to flow to the state through taxes and fees through 2026

Caveats and Interpretations

- Results are **well supported** by the data and analysis, but must be considered as **conservative estimates** of the employment and economic impacts from ARRA funding on California into the future
  - **Economic recovery** of highest priority in the analysis
  - **Market transformation impacts** excluded from analysis, to be included in future, coordinated analyses
  - ARRA in comparison to **California's economic and energy efficiency spending context**
    - California was the ninth largest economy in the world in 2012, with GSP of nearly US$ 2 trillion
    - California investor-owned utilities spent more than US$ 3 billion on energy efficiency programs during ARRA period
    - Large cities and counties received direct ARRA awards from US DOE of more than US$ 300 million
    - Public utilities and municipalities also provided (non-ARRA) funding for energy efficiency programs

Caveats and Interpretations (continued)

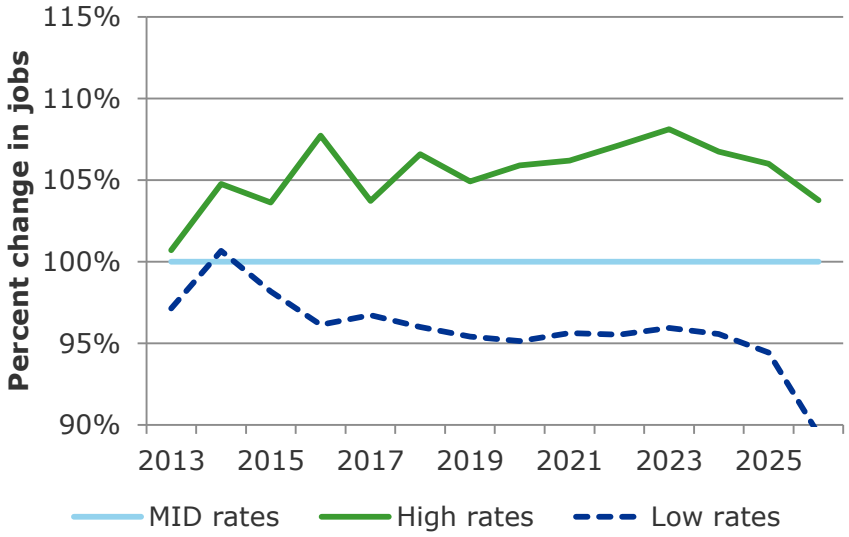
- The contributions to job creation were modelled at a specific point in time (2012) and **if market conditions dramatically change** the actual results will be different
  - In the shorter term, programs that were labour intensive by design generated the most jobs; in the longer term, induced jobs became more important
- Manufacturing activities associated with establishing the ARRA-funded **clean energy manufacturing facilities** in California support the most significant state-wide job creation and drive the highest multipliers of spending
  - Results based on information through 2012 and should be considered optimistic given subsequent challenges in solar market conditions
    - One of the loan recipients ceased operations in California (not included in model results)

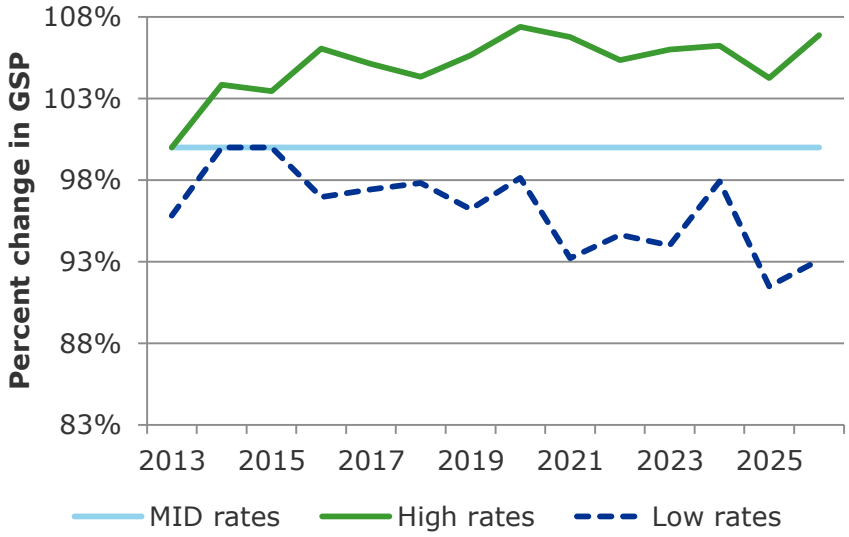
Caveats and Interpretations (continued)

- **Non-energy benefits excluded**
  - 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
    - Reduced exposure to volatility in future energy prices
    - Enhanced comfort
    - Improved health and safety
    - Improved productivity
    - Increase in the building's property value at resale
- **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

Bill Savings Scenarios

- California's electricity and gas retail rate forecasts used to test scenarios involving future streams of bill savings benefits (LOW, MID, HIGH)
  - These retail rate forecasts involve assumptions about the future level of state economic activity

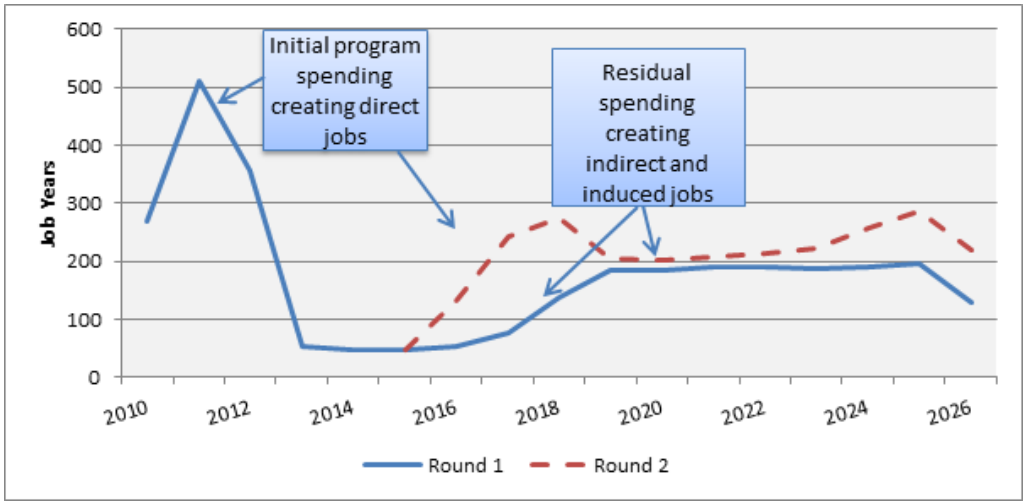




Higher energy bill savings increases household discretionary income and lower operating costs frees up capital for business/government investments. This expansion leads to higher employment and gains in GSP. Conversely, lower energy bill savings has the opposite effect.

Revolving Loan Scenarios

- Four of the ARRA programs incorporate a self-sustaining revolving loan fund into their program design
  - 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
- Simplified scenario illustrating the employment gains from the revolving loans provided to fund state-owned public building retrofits



More than 1,000 incremental jobs from activities funded from repaid loans

APPENDIX

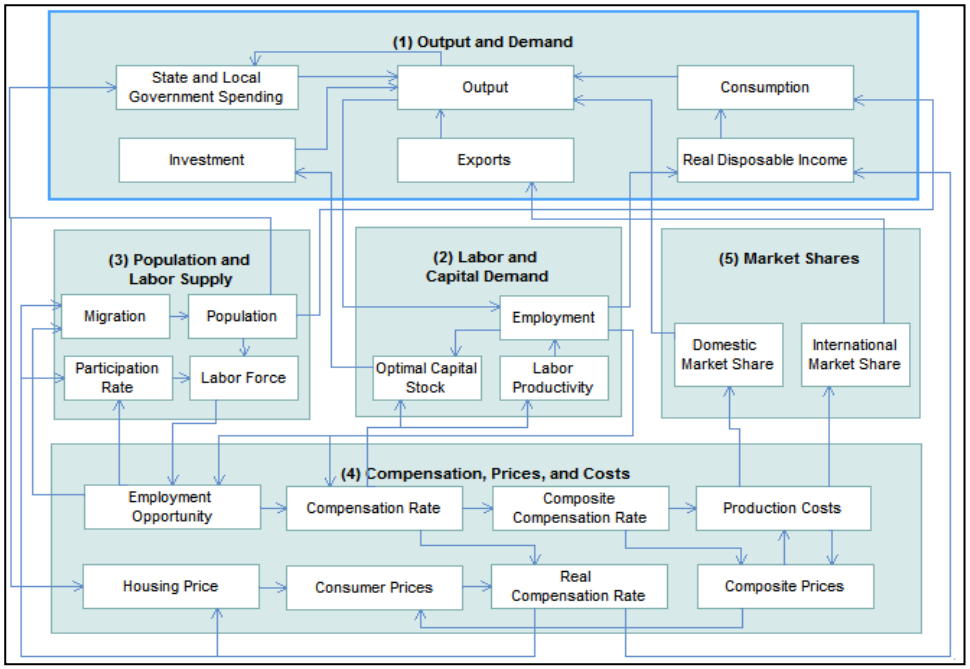
Additional Details on Methods, Inputs, Results

Methods

REMI Policy Insights Plus (PI+) Model Framework

Each block describes a different portion of the economy:

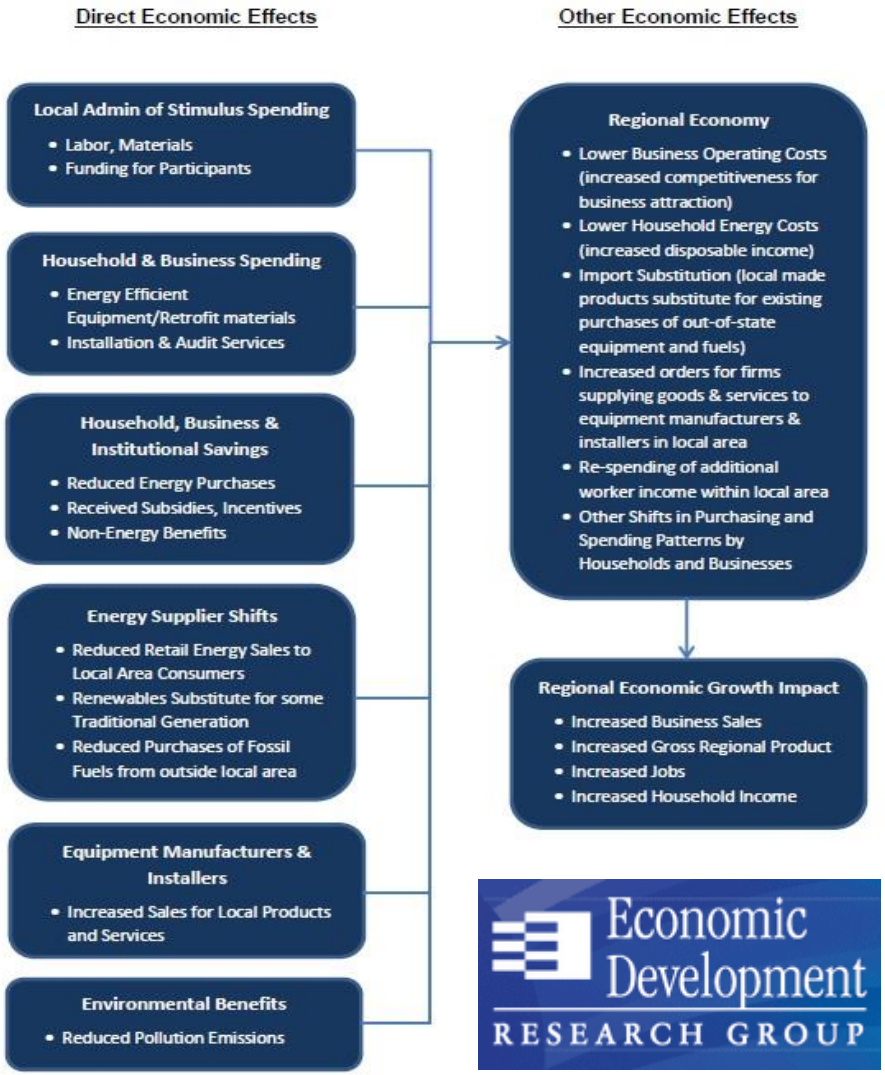
1. **Macroeconomics** of the model with final demand and GDP by component
2. Calculations making up the "business" perspective on the economy where firms will **maximize profits by minimizing costs** in hiring decisions (employment) and capital (their investments)



3. **Full demographic model**, as well as **interactions of households with the general economy** through labour force participation, wages, and consumer spending
4. **Equilibrium concepts**, including the **cost of living** (including energy prices) and **production costs** for labour, capital, fuel inputs, and intermediate goods
5. Regional purchase coefficients (RPCs) address **import/export competitiveness**

Developing the Baseline and Alternative Cases

- **Renewable Energy Efficiency Mapping (REEM) Framework** developed by Economic Development Research Group (EDRG)
  - Translates how dollars are **injected** into the economy and how they **influence** economic outcomes in different market segments
  - Used as a **pre-processor** to ensure that data reflecting energy policy and program implementation activities are thoroughly and properly characterized
  - Many **inputs and sector mappings** were developed by DNV GL as part of the ARRA program evaluation and cost-effectiveness analysis



Overview of Analytic Approach & Assumptions

- Program-specific expenditures and bill savings provided as a time series for the interval 2010 through 2026
  - Segmented by target market (residential, commercial, industrial, state government, or municipalities) and then by region
    - The ARRA programs targeted specific customer segments in specific geographies, so segment and regional assignments were relatively straightforward
  - Gross (total) program and project expenditures were broken out:
    - Project costs were split between labour and equipment
    - Programs with stand-alone energy assessment activity had additional labour allocations (i.e., a portion of costs were allocated to 'miscellaneous professional and technical services')
    - Programs with workforce training and educational components had labour allocations to 'educational services'

Overview of Analytic Approach & Assumptions (continued)

- These steps make it possible to map or translate these inputs 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
- Other assumptions:
  - Equipment purchases to set up/expand the ARRA-funded clean energy manufacturing facilities 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

Modelling ARRA Activities in REMI

- To create an alternative macroeconomic forecast across the California regions, costs and benefits are entered into the REMI analysis model for each program
  - Labour dollars are local labour compensation payments by sector at the two-digit NAICS code level
    - 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 (exception: clean energy manufacturing)
  - Incentives and rebate dollars are applied to project costs to reduce the cost of projects to participants
  - 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
  - Program operations spending

Data Requirements

- Program Spending
- Bill Savings
- Project Expenditures

Data Requirements – Program Spending

- Financing
  - Principal and interest payments converted to amortized costs allocated to participants over the life of the financing
  - Monetised value of below-market interest rates allocated to participants as benefits
  - Four programs provided financing: clean energy renewable energy technologies, state-owned building retrofits, and whole-house 'deep retrofits'
    - In many cases, financing covered 100% of project costs
  - Energy bill savings contributed to repaying principal and interest payments over duration of loan
    - Loan duration = measure life → bill savings = loan amount
  - Full value bill savings accrue to participants after loan is repaid

Data Requirements – Program Spending (continued)

- Incentives
  - One-time payments (e.g., rebates or grants)
    - Provided for whole-house 'deep retrofits', SME building retrofits, and small cities & counties public building retrofits
  - Covered up to 100% of project costs (a few programs covered 100%)
  - Allocated at the program and county-level
  - Bill savings fully accrue to the program participant immediately
- Leveraged Funding
  - Analysis included any leveraged funding reported by investor-owned utilities, other federal, state, or local government programs, etc.
  - Inconsistently reported, conservative
- "In-kind" Leveraged Resources
  - Joint marketing, curriculum development, and other donated activities
  - Difficult to quantify in general, and may not have been 'incremental' (would have been expended into the economy in other ways)

Data Requirements – Bill Savings

- Energy Savings Impact Evaluation Methods: Residential measures
  - Reviewed project-specific whole-house building model files for pre-retrofit conditions, measures installed, and building characteristics following general M&V plan
    - Brief descriptions of the data requirements and analysis approaches for model review, modification, and simulation runs
  - Onsite activities included:
    - Collecting data to catalogue pre- and post-retrofit operations and conditions, including equipment nameplates, self-reported operational data, and building envelope characteristics
    - Performance testing of home air leakage (infiltration) using blower door equipment
    - Performance testing of duct leakage and leakage to outside using Duct Blaster® equipment

Data Requirements – Bill Savings (continued)

- Energy Savings Impact Evaluation Methods: Non-residential measures
  - Site-specific M&V activities for non-residential programs typically involved:
    - Reviewing savings calculation spreadsheets, feasibility studies, tracking databases, and related information provided by manufacturers, contractors, and vendors
    - Developing site-specific M&V plans
    - Collecting data to catalogue pre- and post-retrofit operations and conditions, including equipment quantities, nameplate information, self-reported operational data, and spot measurements
    - Installing data loggers, collecting short-term (two weeks or, in some cases, longer) measurements, and conducting pre-retrofit monitoring to establish baseline conditions for HVAC measures
    - Completing participant surveys and in-depth interviews to assess additionality ('net-to-gross' ratios)

Data Requirements – Bill Savings (continued)

- Energy Savings Estimates
  - Annual and lifecycle
  - Electricity and natural gas savings, and renewable generation (PV measures)
  - Weighted average measure life

Program	Annual Energy Impacts			Life-cycle Energy Impacts			Weighted Average Measure Life		
	Electricity Savings (MWh/year)	Natural Gas Savings (1,000 therm/year)	Electricity Generation (MWh/year)	Electricity Savings (MWh)	Natural Gas Savings (1,000 therms)	Electricity Generation (MWh)	Electric Energy Efficiency Measures	Gas Energy Efficiency Measures	PV Measures
Whole-house 'deep retrofits'	21,209	1,263	3,176	424,181	25,257	63,519	20.0	20.0	20.0
SME building retrofits	84,181	944		877,341	14,875		10.4	15.8	
State-owned public building retrofits	45,786	1,461	1,060	670,673	23,558	31,815	14.6	16.1	30.0
Small cities & counties public building retrofits	32,621	151		456,698	2,419		14.0	16.0	
All Retrofit Programs	**183,797**	**3,819**	**4,236**	**2,428,893**	**66,109**	**95,334**	**13.2**	**17.3**	**22.5**

Data Requirements – Bill Savings (continued)

- Bill Savings Estimates
  - Forecasted electricity and gas retail rates
    - California's Integrated Energy Policy Report (IEPR) forecast contains three sets of estimated average retail rates under three demand scenarios (High, Medium, and Low)
      - Medium demand scenario applied to the appropriate market segment and utility service territory
    - Analysis used November 2012 forecasts through 2022
      - To account for measures with expected >20 year life, a 10-year average annual growth rate was used to extend these forecasts
  - Notes:
    - Analysis does not attempt to monetise peak demand reductions (from any perspective)
    - Analysis could not address bill savings when moving from higher rate tiers (only average rates were used)

Data Requirements – Project Expenditures

Program	Total Project Costs	Energy Commission ARRA Financing	Other Leveraged Financing	Energy Commission ARRA Incentives	Other Leveraged Incentives
	(US$ million)				
Whole-house 'deep retrofits'	$134.5	$24.0	$7.4	$8.3	$36.8
SME building retrofits	$40.9	$0.0	$0.0	$16.4	$8.8
State-owned public building retrofits	$56.6	$42.6	$0.0	$0.0	$8.5
Small cities & counties public building retrofits	$39.7	$0.0	$0.0	$31.9	$7.8
All Programs	$271.7	$66.7	$7.4	$56.6	$62.0
Percent of All Programs	100%	25%	3%	21%	23%

Data Requirements – Project Expenditures (continued)

Project Type	Equipment	Labor
Nonresidential Lighting	70%	30%
Nonresidential HVAC	60%	40%
Residential Whole House Retrofit	65%	35%

Labor Category	NAICS Descriptions
Training	61 Educational Services
Home Inspection Services	54 Professional-Technical Services
Solar Cells Manufacturing	33 Manufacturing
Marketing	54 Professional-Technical Services
Electrical	23 Construction
HVAC	23 Construction
PV installation	23 Construction
Insulation	23 Construction

	Whole-House 'Deep Retrofits'	Small Cities & Counties Public Buildings Retrofits	State-owned Public Buildings Retrofits	SME Building Retrofits	Clean Energy Manufacturing	Workforce Training & Job Placement
Segment Mapping	Residential	Municipal	State	Municipal, Commercial	Select Manu-facturing	Working Age Cohorts

Results

Employment Impacts – 'Job Year' Definition

- Employment refers to incremental jobs created in the year they are reported
  - Does not distinguish between full-time and part-time or permanent versus temporary jobs
- Estimated cumulative employment numbers reported in terms of job-years
  - Job-years are defined as one job for one year
    - For example:
      - One job reported in Year One is one job, and cumulatively is referred to as 'one job-year'
      - One job reported in Year Two is one job, and the combination of this job reported in Year Two and the job reported in Year One is cumulatively referred to as 'two job-years'
  - Some, but not all, jobs continue into future years

Questions?
Detailed reports?
Follow-up discussions?
Results from national study?

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