



The Los Angeles 100% Renewable Energy Study

# Jobs and Economic Impact Modeling

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## Modeling objectives

Estimate **workforce needs** within and outside of the LADWP basin

JEDI Model

Assess **potential net employment and income impacts** within the City of LA for different LA100 scenarios

CGE Model

Estimate **both positive and negative impacts** to the economy, along with **who** is most affected

CGE Model

Address LADWP and AG **feedback**

- LADWP funded construction and operation of energy facilities requires **workers and supports economic activity** within and outside of LA
- Identify the **energy workforce** needed for each LA100 scenario
- NREL suite of Jobs and Economic Development Impacts (JEDI) models can be used to estimate **jobs supported** by the construction and operation of renewable and non-renewable technologies
- Impacts estimated using **expenditures** for construction, installation, and operation of each scenario

**Onsite, supply chain, and induced impacts**

Impacts for **construction** (equivalent of one year) and **O&M** (annual, ongoing)

**Jobs:** Full-time equivalent – equal to one person working full time for one year

**Earnings:** Total compensation to workers, including benefits

**GDP:** The contribution of an industry to an economy – earnings, property-type income such as profits, and taxes

**Gross output:** An overall level of economic activity – at the business level can be thought of as revenue

# Types of impacts included in results

JEDI Model

## Onsite

- Occur solely within immediately impacted industries
  - For example, a change in electricity expenditures directly impacts the electricity provider

## Supply Chain

- “Ripple effect” through industries that provide goods and services to onsite companies
  - In the electricity expenditure example, this could include construction companies within LA that maintain facilities

## Induced

- Accrue as a result of expenditures made by workers in the onsite and supply chain impacts
  - For example, if a ratepayer pays more for electricity she or he may reduce leisure activities

- Scenarios that are more expensive and/or have more expenditures made within LA will tend to support **higher job numbers**
- Installation of rooftop solar is **more labor intensive** than the construction of a wind plant outside of the LADWP basin, so it would support more jobs in LA
- JEDI does not consider **who makes these expenditures**, which could slow economic growth as those who pay for each scenario spend less money elsewhere in the economy

- No assumptions about **changes in the economy** such as future recessions
- No assumptions about **technological advances** or other changes in the productivity of workers or equipment
- Prices – including electricity rates – **stay fixed**
- JEDI shows **jobs that are supported** by each scenario, not overall economy-wide impacts that account for how consumers and businesses react to price changes
- Industries and consumers **don't make substitutions** because the economy remains fixed
  - All inputs (e.g., different materials, labor) used by industries remain fixed at the same proportions
  - Households make purchases (e.g., housing, transportation) in the same proportions as well

- JEDI provides information about the workforce but what about **net** economy-wide impacts that account for changes in prices?
- Businesses and consumers change how they spend when prices change
- Increased spending in one area will result in less spending in other areas
  - i.e., if electricity prices increase a household would react both by trying to **reduce electricity consumption** and **spending less elsewhere** such as at restaurants



# Modeling team

CGE Model

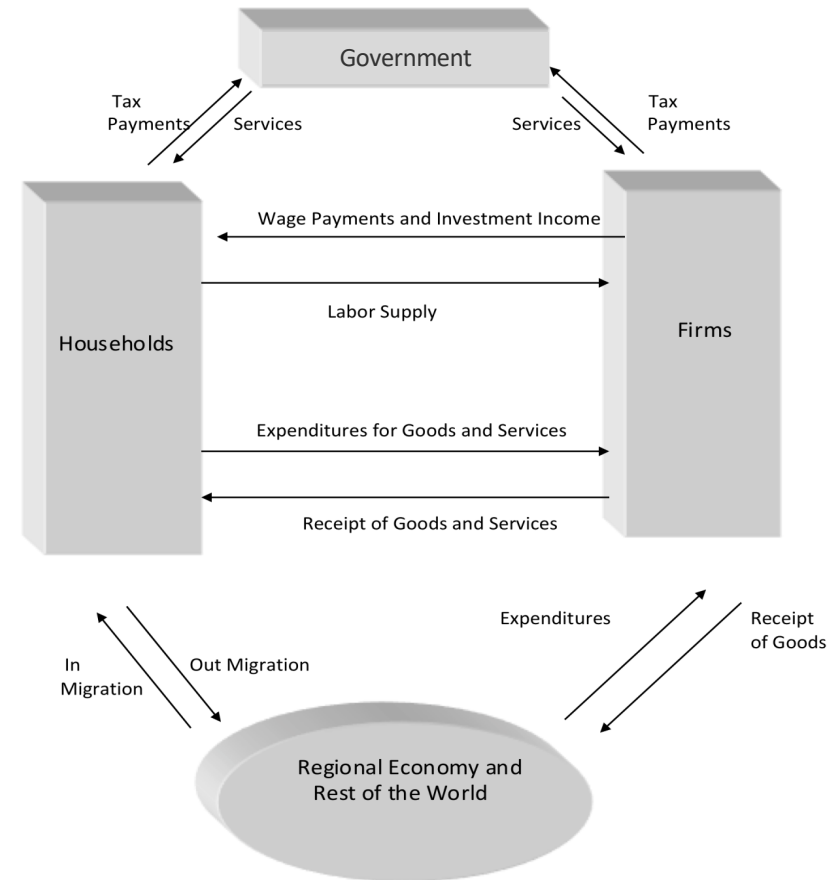
- Tasked with **model selection, development, and analysis**
- Collaboration among the University of Southern California, Colorado State University, and NREL
  - Professor Adam Rose, Professor Dan Wei from the University of Southern California
  - Professor Harvey Cutler, Professor Martin Shields from Colorado State University



# Model selection: City of LA

## CGE Model

- Selected a **computable general equilibrium (CGE)** model
- CGE models take a **comprehensive view** of an economy and how different sectors interact with one another
  - Industries/businesses, households, investors, the government, and the rest of the world outside of LA (imports, exports)



- The CGE model developed by Colorado State University **explicitly incorporates different energy technologies** such as wind and solar into its underlying data
- **Regional model** can be used for the City of LA
- Energy data is pulled from the **JEDI** suite of models



# Capturing net impacts of different scenarios **CGE Model**

- Model captures **both positive and negative** economic impacts of LA100 scenarios
- Example: Installing solar PV
  - **Increase** in activity from local purchases such as mounting hardware or profits to wholesalers
  - **Decrease** due to households spending money on solar instead of other goods and services
  - Positive or negative impact **depends heavily on electricity price (rate) changes**



Maintenance  
Operation of new plants  
Local development



Increased electricity cost to households in LA  
Decreased expenditures

- Model temporarily changes **theoretical electricity price changes over time** to illustrate potential impacts
- Actual price changes **could vary** for a number of reasons, including:
  - Capacity expansion and operations and maintenance (O&M)
  - Structure of rates
- Scenario has some hypothetical construction that is not tied to LA100 scenarios

# Future modeling to reflect LA100 study outputs and AG feedback

CGE Model

- Temporary price change example estimates are **not explicitly associated with expansion scenarios** because these changes are not yet estimated by NREL
- **LA100 outputs** will provide data on the mix of generation technologies. CGE model will reflect expenditures to develop this mix
- Future estimates will reflect a number of **potential price change scenarios** for each each LA100 scenario
- We will **incorporate AG and LADWP feedback**, particularly on electricity price changes due to factors other than the scenario-specific investments

# How price changes affect consumers

CGE Model

Households spend different amounts on electricity and will be affected differently by electricity price

Household (HH) Income	Annual Electricity Spending per HH	Monthly Electricity Spending per HH	Number of HHs	Total Expenditures
< \$10k	\$561	\$47	103,516	\$61,786,278
10k-25k	\$566	\$47	91,149	\$54,883,561
25k-30k	\$663	\$55	148,040	\$104,347,873
30k-40k	\$767	\$64	121,888	\$99,391,057
40k-60k	\$850	\$71	156,590	\$141,505,703
60k-80k	\$854	\$71	207,562	\$188,490,583
80k-125k	\$1,025	\$85	139,713	\$152,248,029
125k-150k	\$1,025	\$85	166,766	\$181,728,220
> \$150k	\$1,025	\$85	179,054	\$195,118,697

# What is (and is not) included in temporary estimates

CGE Model

## Estimated impacts **are**:

- Solely tied to theoretical electricity price changes
- For the City of LA as a whole
- Applied as a single percent change to all income groups
  - This can be changed in the future

## Estimated impacts **are not**:

- Tied to LA100 outputs
- Split out by neighborhood
- Directly tied to expenditures captured in the model – does not include quality of life or health impacts
  - Re: December 2018 AG question about economic impact of emissions reductions



- Positive and negative impacts are **across all industries** and do not indicate growth or decline in the energy workforce
- Results are **aggregate**, so different types of impacts could have different signs—some could be positive while others are negative
- Impacts **only include what is monetized** and do not show impacts that are not explicitly monetized in the CGE model, such as health

# Impacts show “pressure” on changes in the economy

CGE Model

- Results do not show absolute changes for the entire economy in LA
- Example: A 3,000-job impact does not indicate that employment will grow by 3,000 in LA
  - It would just show that employment would grow by 3,000 jobs **faster** than it would otherwise
- Example: A negative employment number does not necessarily mean that the economy would lose jobs
  - It just means that employment growth might not be **as high** as it otherwise would have been
    - i.e., a business may not hire a worker

# Example estimates of theoretical price changes: annual employment

CGE Model

- Results show **relatively low net changes** in employment

Electricity Price Change	10% Decrease	10% Increase
Example annual change in employment	3,369	-2,919
Example annual percent change	0.18%	-0.16%

- Estimates are **theoretical** and **do not include the expansion and associated expenditures** in LA100 scenarios
- Different expenditures on different technologies** will drive different results.
  - Expenditures for different components, industries
  - Expenditures within LA will drive more local economic activity

# Questions?

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