



The Los Angeles 100% Renewable Energy Study

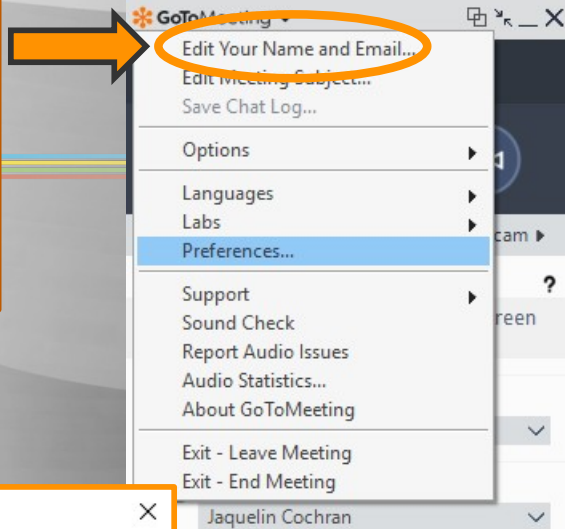
Advisory Group Meeting #12

Virtual Meeting #2





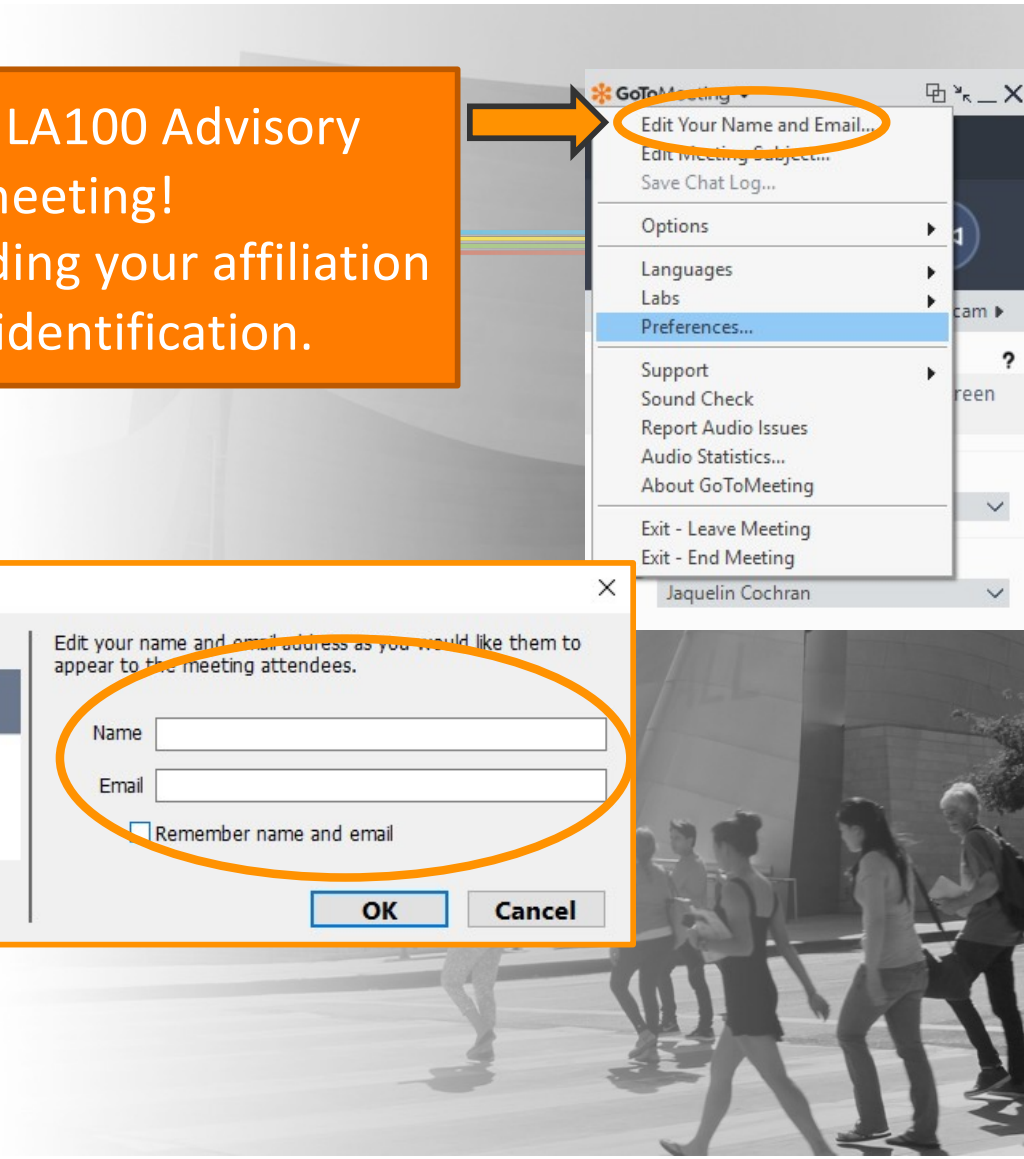
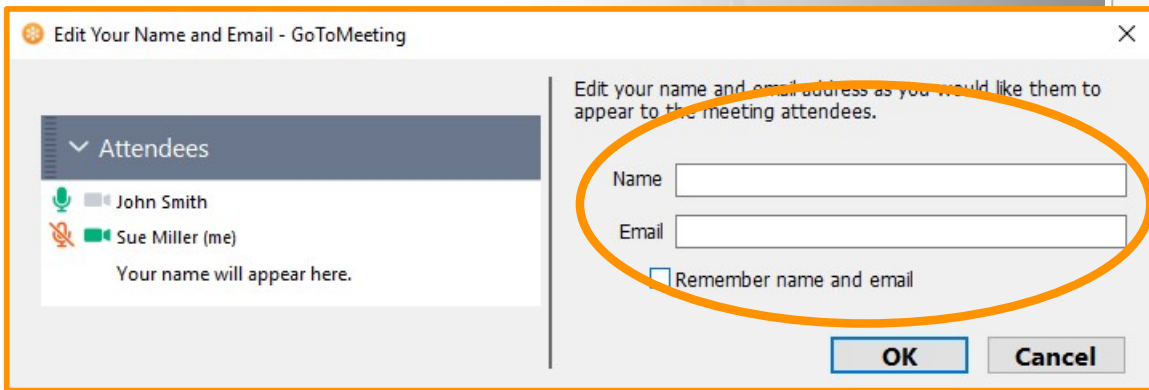
Welcome to the LA100 Advisory Group meeting!
Please consider adding your affiliation to your name identification.



Advisory Group Meeting

#12

Virtual Meeting #1



Agenda

July 9

- LA100 Scenarios—Pathways to 100% RE
- Discussion/Q&A

Today (July 16)

- Welcome
- Continue Last Week's Discussion
- Jobs and Economic Analysis
- Discussion/Q&A

July 23

- Environmental Analyses
- Discussion/Q&A

July 30

- Distribution Grid Analysis
- Discussion/Q&A

August 6

- Follow-up Q&A

Tips for Productive Discussions



Let one person speak at a time

Keep phone/computer on mute until ready to speak



Help ensure everyone gets equal time to give input

Type "Hand" in Chat Function to raise hand



Keep input concise so others have time to participate

Also make use of Chat function



Actively listen to others, seek to understand perspectives



Offer ideas to address questions and concerns raised by others



Hold questions until after presentations

From Last Week: Three Examples to Reduce Costs, Improve Community Involvement

1. Truly revolutionary demand response (or responsive load) programs
 - Can we think creatively about options that maximize the value of price responsive demand while protecting lower income communities?
 - Can consumers be part of the solution with real-time pricing? Consumer choice on electricity products differentiated by reliability? Can we have customers bid in their willingness to pay and unleash the power of internet of things?
2. Cost optimal 100% decarbonization that extends beyond the electric sector?
 - Would it be acceptable to reach 95% RE and achieve additional emission reductions through direct air capture or in other parts of the economy?
3. Creative transmission
 - Can we think beyond traditional AC and DC power grids and deploy the latest steerable, dynamic transmission technologies to maximize use and value of existing difficult-to-site lines?



The Los Angeles 100% Renewable Energy Study

LA100: Jobs and Economic Impact Modeling

Advisory Group Meeting #12, Virtual Meeting #2

David Keyser

National Renewable Energy Laboratory

July 16, 2020



Today's presentation and discussion

Agenda:

- Review models used to estimate job and economic impacts, how they relate to one another, and how to interpret results
- Use earlier (outdated) capacity expansion results to demonstrate linkage between capacity expansion results and economic impacts

Requested feedback:

- What other information/types of results would you like to see?
- What about jobs and economic impact is important to communicate in this study?

Modeling objectives and where this fits in the LA100 study



Assess net employment, GDP, and **distributional household income impacts** within the City of LA for different LA100 scenarios



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



Estimate **workforce needs** within the LADWP basin

Models used

- Two types of models: Computable General Equilibrium (CGE) and the NREL Jobs and Economic Development Impacts (JEDI) suite of input-output models
- Both share sets of underlying data
- Both needed: **CGE** to estimate a broad set of overall impacts within LA and **JEDI** to estimate detailed impacts that are solely associated with the power sector

CGE Model

- Used to estimate **net** impacts
- **Net** impacts look at additional potentially negative impacts driven by how this activity is funded and displacement elsewhere in the economy

JEDI Model

- Used to estimate **gross** impacts
- **Gross** impacts only account for positive changes such as jobs created and supported by LA 100 scenarios
- Captures workforce needs and associated economic activity

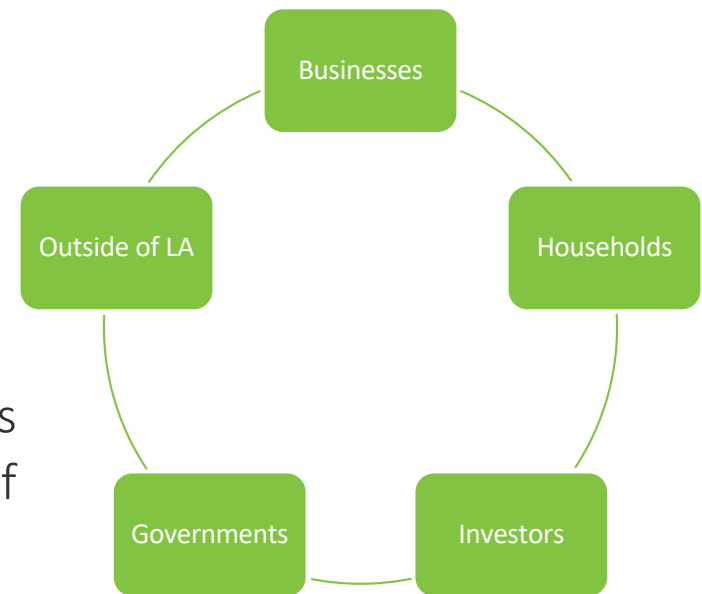
- Tasked with **model development and analysis**
- Collaboration among the University of Southern California, Colorado State University, and NREL
 - Professor Adam Rose, Professor Dan Wei from the University of Southern California
 - Professor Harvey Cutler, Professor Martin Shields from Colorado State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



How JEDI and CGE models represent the economy

Similar underlying data and structure: Both represent how different sectors and the population interact with one another

- Industries/businesses, households, investors, the government, and the rest of the world outside of LA (imports, exports)
- Relationships represented in input-output data
- **JEDI** contains detailed information about relationships between different **energy technologies** and the rest of the economy
- This information incorporated into the **CGE** model to provide detail about these technologies



CGE shows net impacts and JEDI provides gross estimates

- **CGE** models use JEDI technology-specific data along with additional demographic and labor data
- **JEDI** only uses additional labor data, and relationships do not change over time
- **Fixed** relationships in **JEDI** only show LA100 impacts while flexible CGE relationships show an overall aggregated impact

JEDI Model

LA 100 Scenarios

CGE Model

LA 100 Scenarios

+

Additional Negative Impacts

Types of impacts included in both sets of results

Onsite

- Occur solely within immediately impacted industries
- Most specific workforce needs
- Tend to be physically at a location
 - Example: rooftop solar installers, electricians

Supply Chain

- Occur throughout the supply chain
 - 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 direct and indirect impacts
 - For example, if a ratepayer pays more for electricity, they may reduce expenditures on leisure activities

CGE model results are **aggregate** and combine all of these impacts and JEDI separates them

- 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's monetized in capacity expansion modeling** and do not show impacts that are not explicitly monetized in the CGE model, such as health
- Health and environmental impacts are forthcoming in a separate analysis

Data used in preliminary CGE and JEDI analysis

- Results in this presentation are out of date but key themes and insights are still consistent and relevant
- Due to time required to set up and run models, these results are not the same as those presented last week
- Results are solely based changes to electricity supply and demand and do not include impacts from the implementation of energy efficiency (e.g., construction activity related to efficiency upgrades). Impacts from reductions in electricity demand are implicit due to decreased need for electricity and electricity infrastructure
- The presentation contains a subset of results to show how the final analysis will look
- Results presented this fall will use final capacity expansion modeling data and be consistent with analysis across LA100 topics

- CGE model relies on changes in prices; these are assumed to be how projects are funded
- Prices include existing debt, which is determined by taking the difference between the 2017 IRP, which includes debt, and LA100's results using 2017 IRP, which does not
- Debt is added to costs from the capacity expansion model to determine necessary changes in prices to fund different scenarios
- It is assumed that ratepayers pay for scenarios
- If taxpayers paid for scenarios, results would be the same or at least extremely similar
- LA100 does not assume policy changes associated with rates or low-income programs, which could affect how impact of rate changes are experienced at different income levels

CGE Model CGE analysis: what to expect

- **Net** changes in jobs, household income, and GDP within LA
- Changes are in **aggregate** and do not show detail about impacts specific to the power sector, which include hospitality, professional services, construction
- Changes by household income cohorts
- **Draft** results are not from the most recent capacity expansion modeling estimates

- Overall, minimal net negative changes
- Most significant initially but decline over time

	Net Employment Change (person years)	Household Income (\$2017 million)	Domestic Supply (\$2017 million)
2026 – 2030	-300	-\$10	-\$60
2031 – 2035	-300	-\$10	-\$40
2036 – 2040	-300	-\$10	-\$40
2041 – 2045	-300	-\$10	-\$40

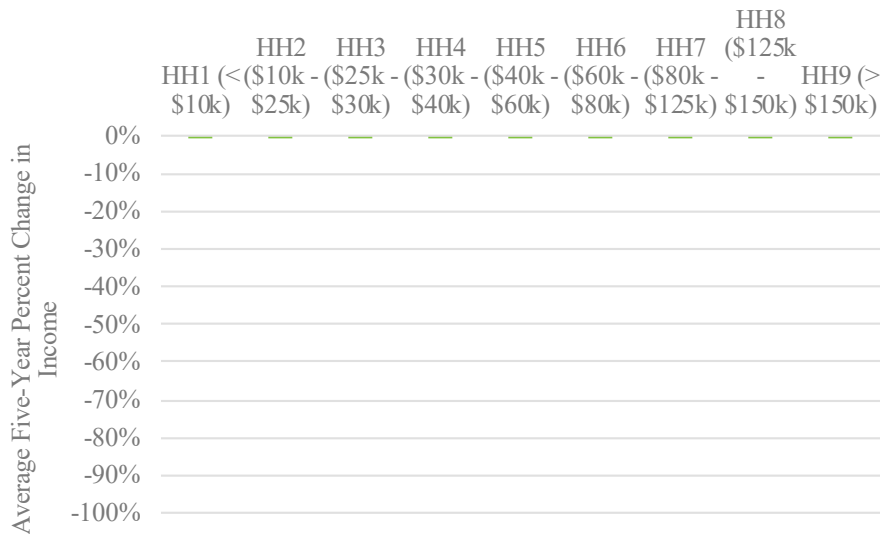
Estimates do not use the most recent capacity expansion modeling outputs and are only for demonstration

CGE Model

Draft household income percent change from SB100 – Moderate

- Households (HH) impacted differently by income cohort
- Average percent changes in income are close to zero, but still more significant for lower income households than higher income households
- More significant percent change for lower income households is due to electricity expenditures as a portion of income

HH income change at 0 – 100% scale



HH Income change at 0 – 0.05% scale



Estimates do not use the most recent capacity expansion modeling outputs and are only for demonstration

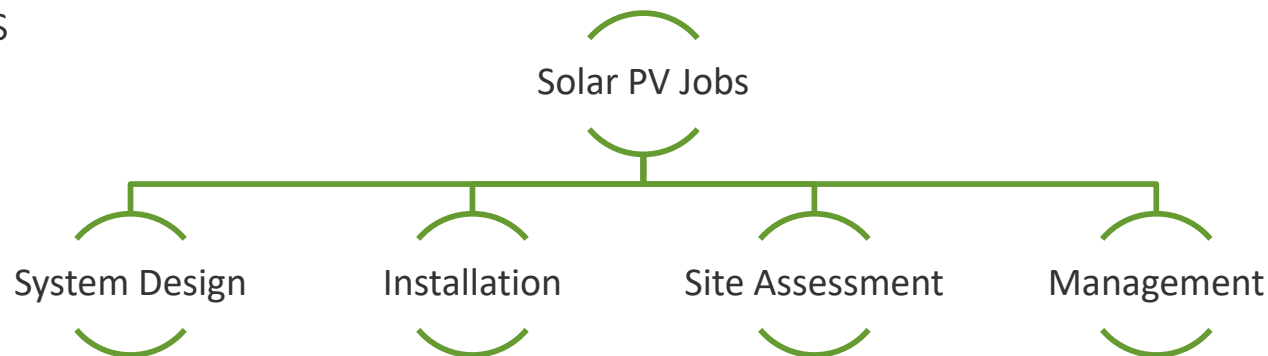
- Revise modeling to use final capacity expansion modeling numbers in August
- Refine construction, O&M job estimates by incorporating estimates from JEDI modeling to better represent renewable technologies
 - This refinement could make results larger in one direction or another

- Estimates are in basin and specific to LADWP; out-of-basin impacts are not included
- Results are from older model runs. For example, more recent runs moved significant levels of generation in-basin under LA Leads—a change that is not reflected in these results but will be in the future
- Highest impacts tend to be associated with highest in-basin expenditures
- Estimates can vary from technology to technology due to labor intensity, linkages of local supply chains, and availability of developers and operators to source goods and services locally
- Levels of impacts among all metrics tend to follow one another (i.e., higher job numbers drive higher GDP) so for the sake of brevity this will focus on jobs

JEDI Model

Workforce needs can inform businesses, future workers

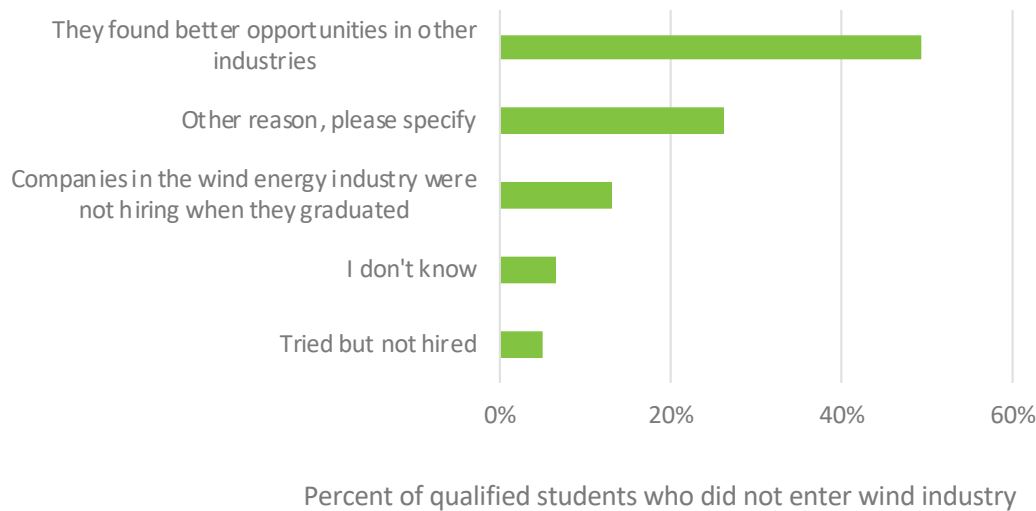
- Workforce needs are significant because on the employer side they mean workers need to be available
- On the worker side it means that jobs are available but necessary education, training, and experience needs are met
- Analysis of workforce needs informs education institutions, training programs
- LADWP Utility Pre-Craft Trainee program already helps make these connections; other utilities such as the New York Power Authority have similar programs



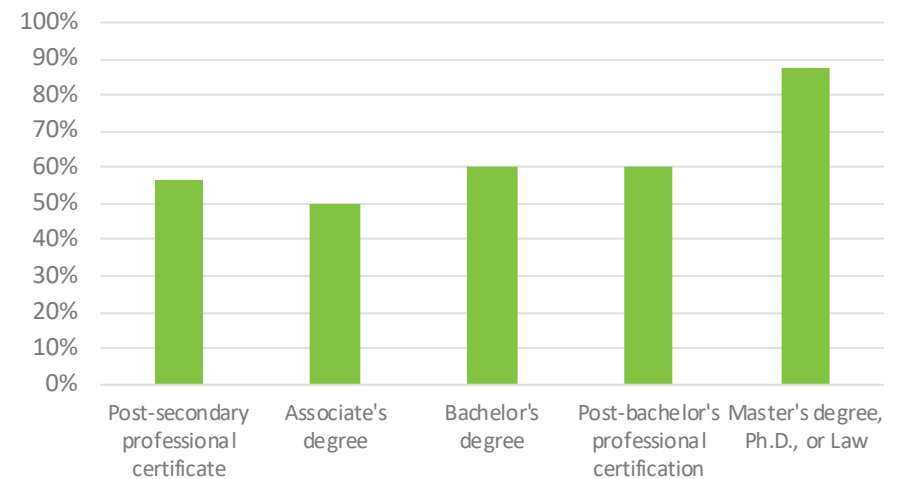
Example: Qualified students not entering wind industry

- More than 67% of students who took renewable energy or wind courses do not enter the wind industry
- This is most common in degree programs that take a long time to complete

Reason for not entering wind industry



Percentage of types of degree programs in which fewer than half of students enter the wind industry



Source: Keyser et al. (2019)

...Wind employers having difficulty finding employees

- 68% of wind employers report difficulty hiring across all occupations
- 25% look internationally due to this difficulty
- Most difficult to recruit are scientists and trade workers
- Trade workers are the largest portion of the wind workforce across all occupations



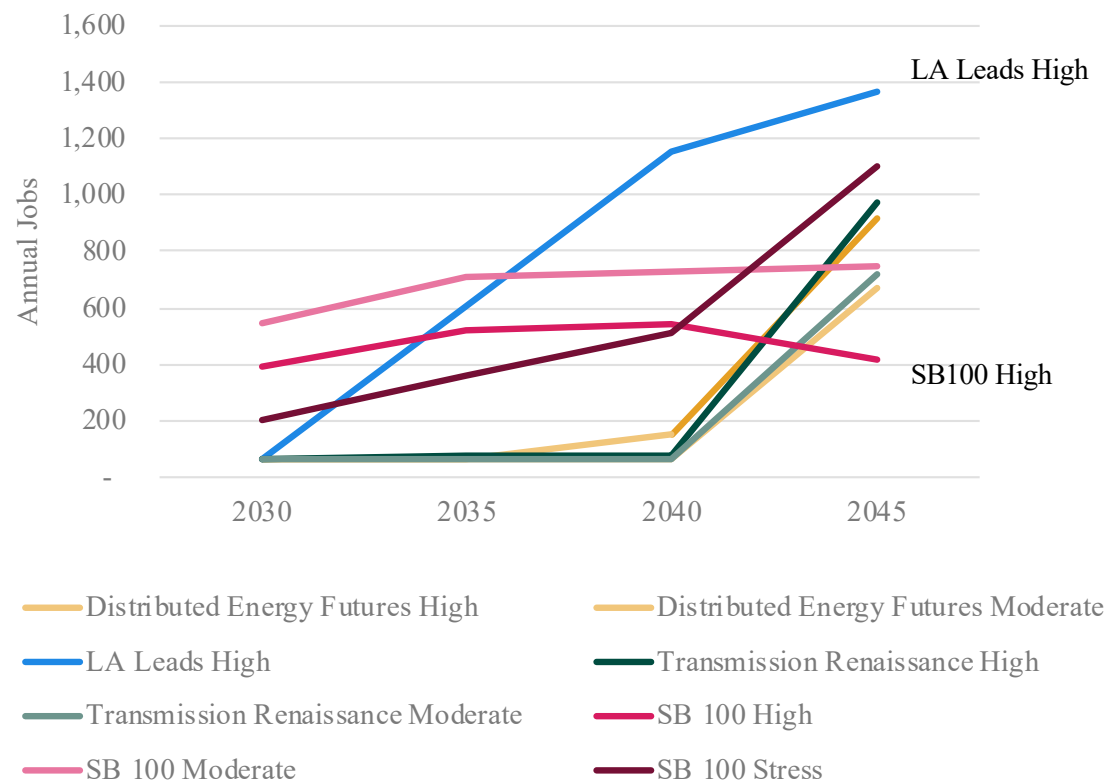
Source: Keyser et al. (2019)

JEDI Model

Draft construction and installation jobs from all scenarios

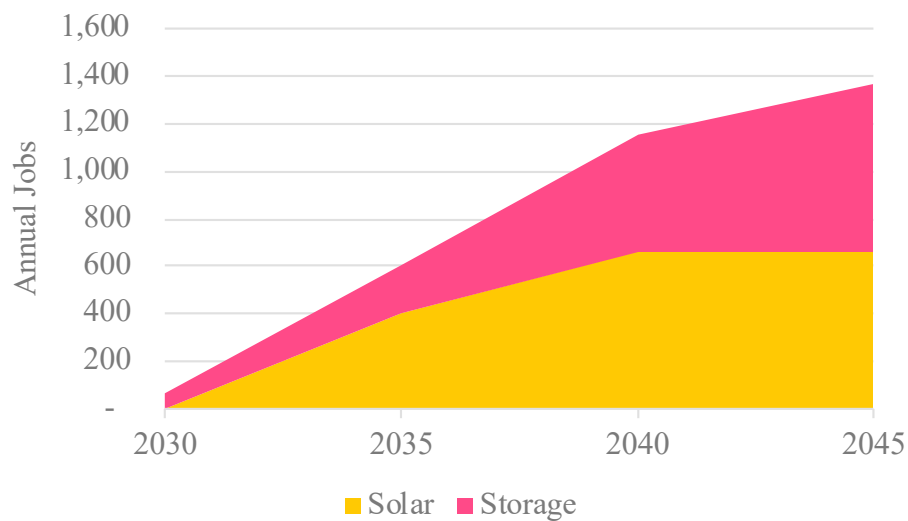
- Jobs driven by capacity growth
- In these outdated results, most significant annual increase is in LA Leads – High Load
- Lowest jobs are under SB100 – High Load, as in-basin capital expenditures slightly decrease from 2040 to 2045
- Results will change with updated capacity expansion modeling data

Jobs by Scenario



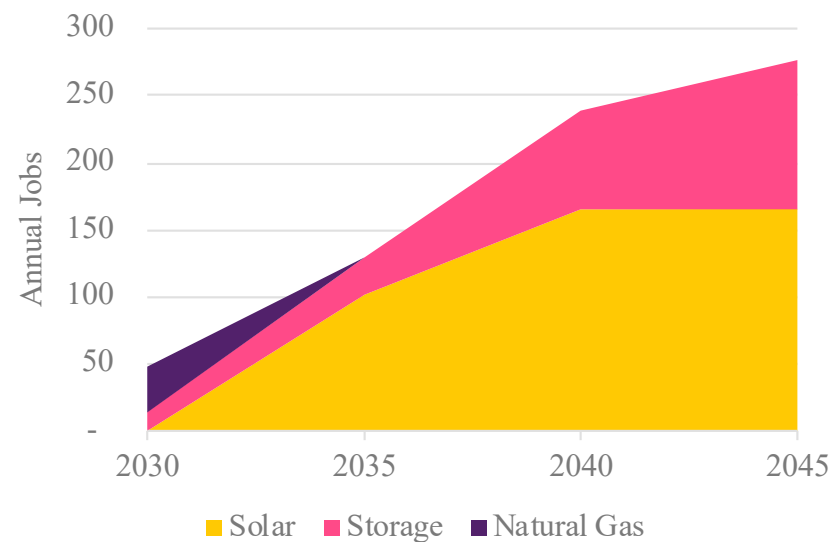
Estimates do not use the most recent capacity expansion outputs and are only for demonstration

Construction/Installation Jobs



Annual construction and installation jobs primarily driven by solar, but similar numbers in storage

O&M Jobs



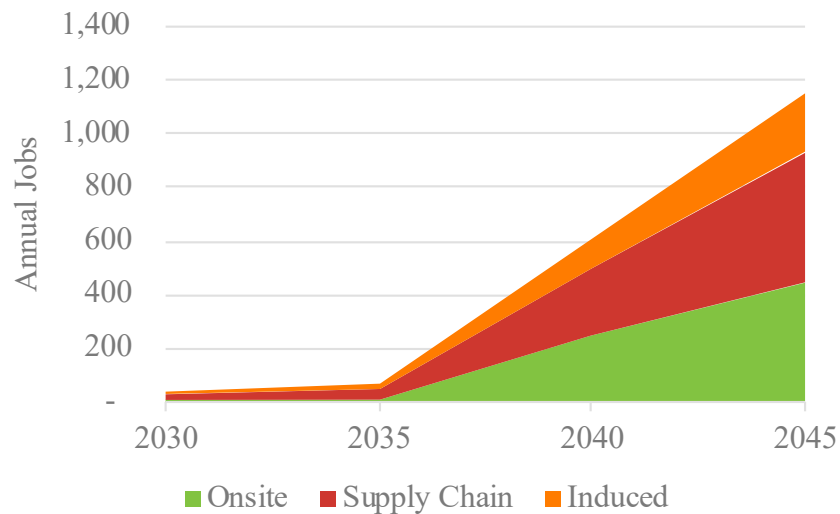
Phase-out of natural gas O&M replaced by solar and storage between 2030 and 2035

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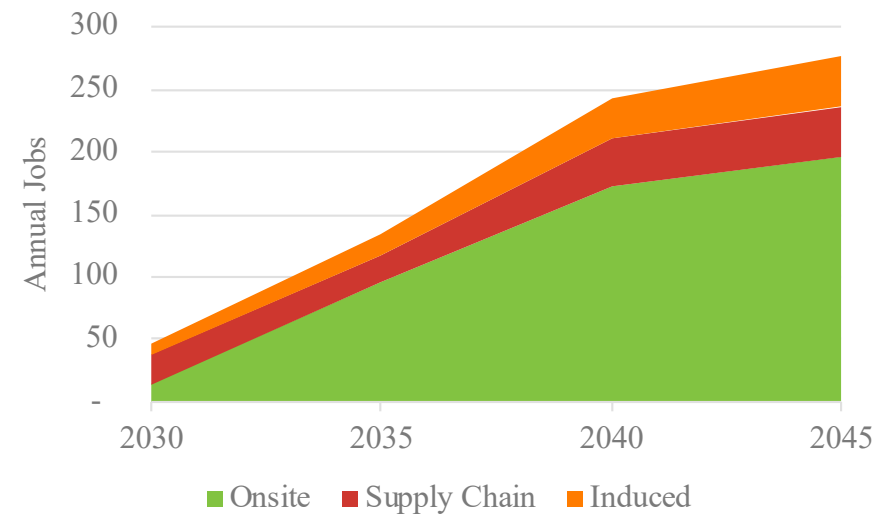
JEDI Model

Draft estimates by type of job from LA Leads – High Load

Construction/Installation Jobs



O&M Jobs



- Similar levels between onsite and supply chain with lower induced figures

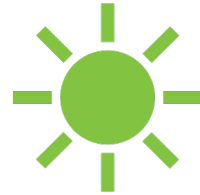
- O&M results show higher onsite figures with similar supply chain, induced job numbers

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Annual 2018 earnings per worker are above average

Construction and Installation

- Solar: \$63,000
- Storage: \$97,000



O&M

- Solar: \$71,000
- Storage: \$102,000

LA Average: \$59,000

Source: Bureau of Economic Analysis

Key takeaways: CGE and JEDI

CGE Model

- Shows ability to meet SB100 – Moderate Load scenario with minimal (albeit negative) impact
- Percent changes in household income are close to zero but tend to negatively impact lower-income households the most in terms of percent

JEDI Model

- Increases in both construction and O&M workforce over time
- Most significant portion of workforce is onsite, followed by supply chain
- Largest installation and O&M workforce needs are in solar with some jobs in storage

Economic estimates and COVID-19

- **JEDI** does not assume changes in the structure of the economy, so results are as if scenarios occurred **in the year of the economic data**, which in this case is 2017 (most recent available)
- The **CGE model** has the ability to change over time, but COVID-19 is **not explicitly incorporated**
- Estimates are **long term through 2045**, and the impacts from COVID-19 are expected by the university team to be short to medium term
- Terrie Walmsley, Adam Rose, and Dan Wei of USC just published a CGE economic analysis of COVID-19: *“Impacts on the U.S. Macroeconomy of Mandatory Business Closures in Response to the COVID-19 Pandemic”*
- The authors anticipate **electricity demand** to follow changes in **GDP**, but for these to be **short to medium term** rather than long-term impacts

Thank You



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