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Filer:	Stephanie Bailey
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Economic Impacts in Long-Term California Energy Scenarios

David Roland-Holst
Sam Evans, Sam Heft-Neal, Drew Behnke,
Thomas Brooks, Lucy Shim - UC Berkeley

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Economic Benefits and Costs

Four main economic drivers in the scenarios:

1. Energy system investment
2. Large scale adoption of new energy using durable goods, including vehicles, HVAC, and appliances
3. Income/expenditure effects of energy savings
4. Public health benefits of emission reductions

Salient Macroeconomic Impacts

- Energy system investments are a potent catalyst for income and job growth.
- Technology adoption benefits can (e.g. medium cost scenario) far exceed their direct costs.
- Energy savings are substantial and induce broad based job creation.
- Savings from averted mortality and morbidity are comparable to the direct costs of mitigation policy.

Macroeconomic Impacts: 2050

Percent change from Reference* in 2050

	Mit_Med	Mit_High	Mit_Low
Gross State Product ($B)	8.92%	2.37%	3.68%
Real Output	8.23%	1.70%	3.02%
Employment (,000)	7.32%	1.78%	2.78%
Real Income	5.61%	1.86%	2.47%
State Revenue	8.13%	1.72%	2.79%

Scenarios

Mit2050: Base cost (E3) mitigation scenario
Mit_High: Higher cost alternative
Mit_Low: Lower cost alternative
References: Reflects pre-SB 350 policies (e.g. 33% RPS, historical energy efficiency goals)

*Differences in both tables are estimated with respect to a reference scenario assuming no additional RPS investment ("Build-out") from 2020.

Difference* from Reference in 2050

(2015 $ Billions unless noted)

	Mit_Med	Mit_High	Mit_Low
Gross State Product ($B)	1,109.995	294.886	457.451
Real Output	1,531.660	316.714	562.394
Employment (,000)	3,299.247	801.416	1,252.795
Real Income	1,094.382	310.110	446.733
State Revenue	127.168	42.231	56.046

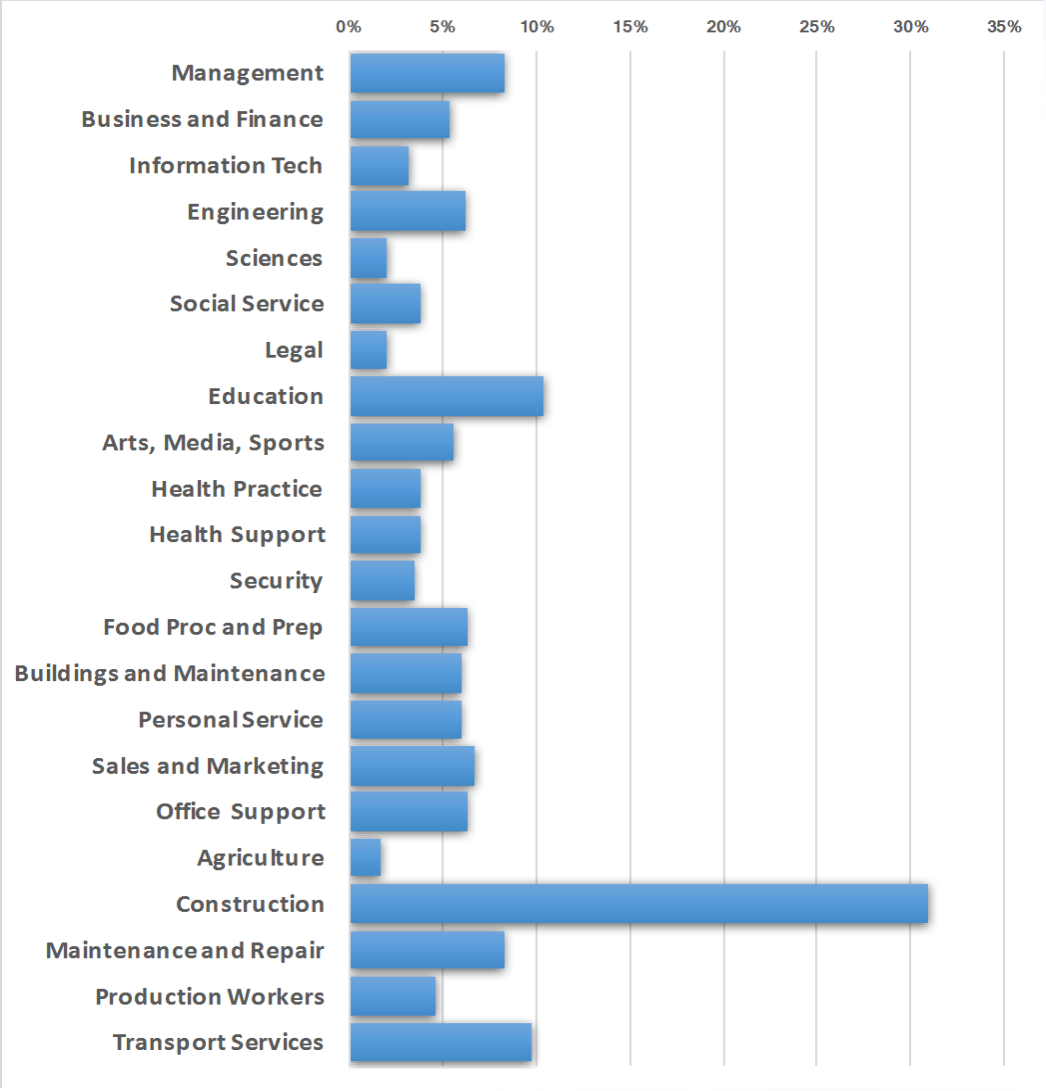
Household Real Income Impact by Tax Bracket

(Mit2050, percent change from Reference case in 2050)

- Average household income rises in every tax bracket.
- The Middle Class has the largest percentage increase.
- These results do not guarantee direct gains to every household.
- They measure the effects of new jobs for some and rising wages that will benefit the majority of households.

Employment Impact by Occupation

(MIT2050 Scenario, percent change from Reference case in 2050)



- All non-agricultural occupations experience better employment prospects.
- Construction dominates because of the energy buildout and building standard compliance.

Economics of Health Benefits

- Emissions mitigation policy will make significant contributions to public health across California
- In 2030 alone, our (conservative) exploratory estimate of the economic value health benefits from GHG reductions in the energy sector is $6.0 billion, of which:
  - $2.4B is due to averted mortality
  - $3.6B is due to averted medical (morbidity) costs
- These benefits compare to about $8 billion in average annual direct costs of mitigation policy
- Our exploratory estimates represent health benefits associated with reductions in GHG emissions in the energy sector alone but do not quantify many of the other expected benefits that are known to be substantial (see next slide for details)

Socioeconomic Impacts

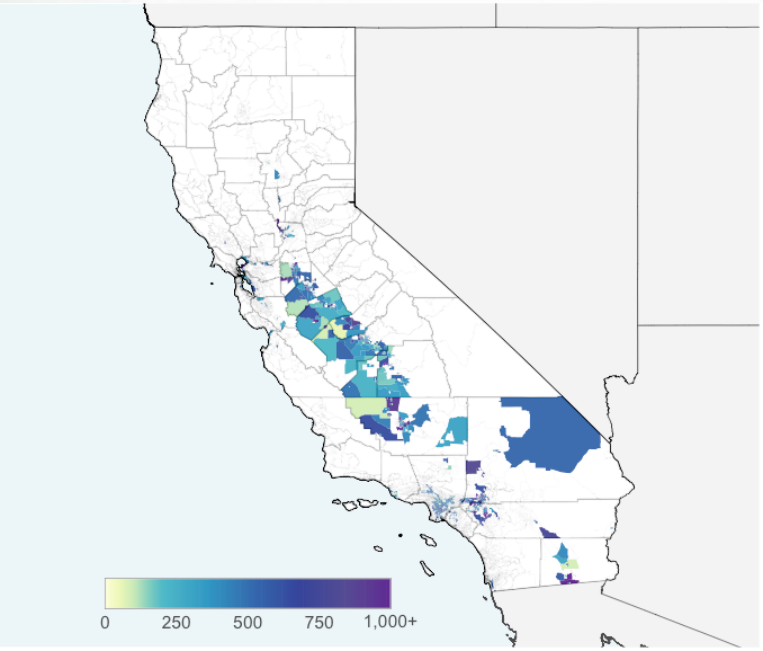
If the recommended LTES are implemented, Disadvantaged Communities (DACs) will experience

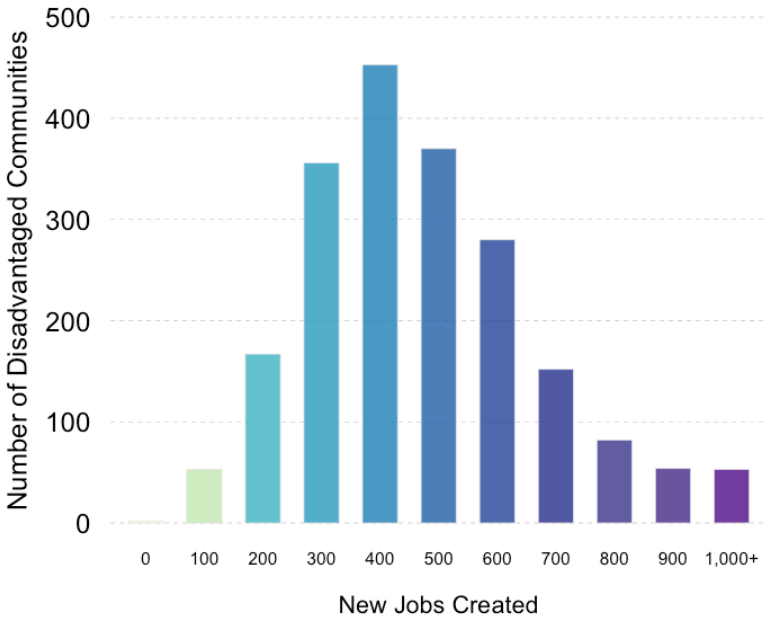
- higher job growth
- proportionately greater income growth
- larger per capita absolute benefits from reduced mortality and morbidity

compared to the rest of the state's population.

Job Creation: Disadvantaged Communities

Mit2050 (Base Cost) Mitigation Scenario

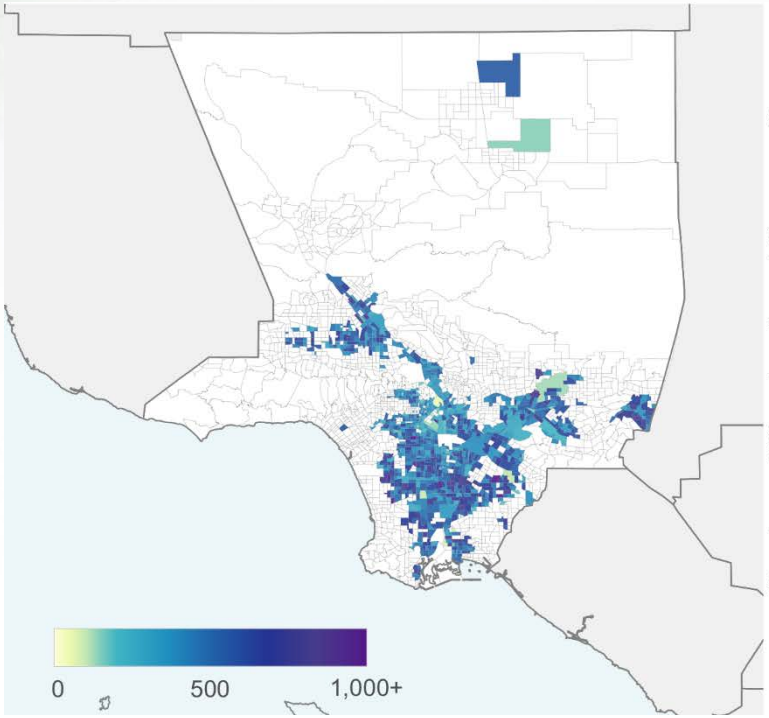


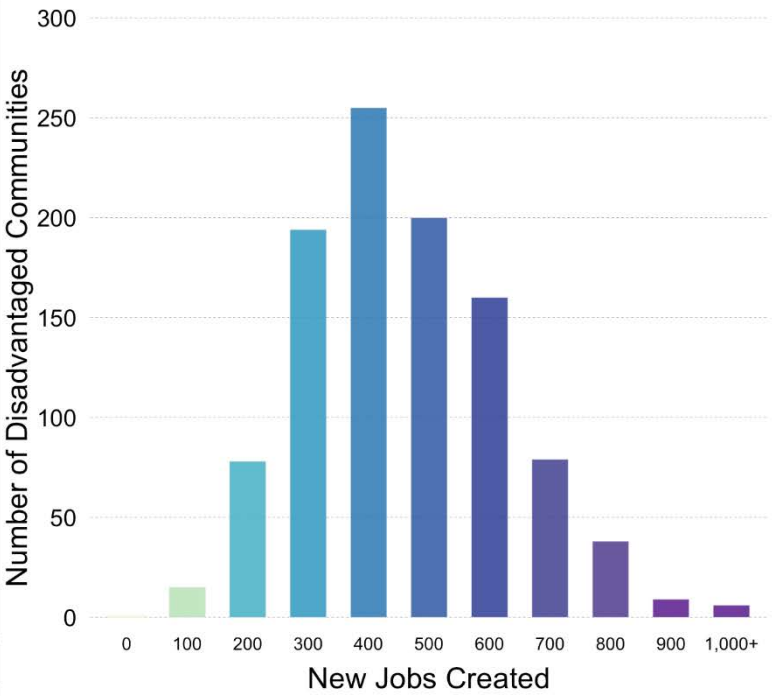


- 3.3M jobs generated across the state by 2050 with 964,000 generated in DACs (29%).
- Strong job growth in DACs across the state, particularly in the Central Valley.

Job Creation: Disadvantaged Communities

Mit2050 (Base Cost) Mitigation Scenario – Los Angeles

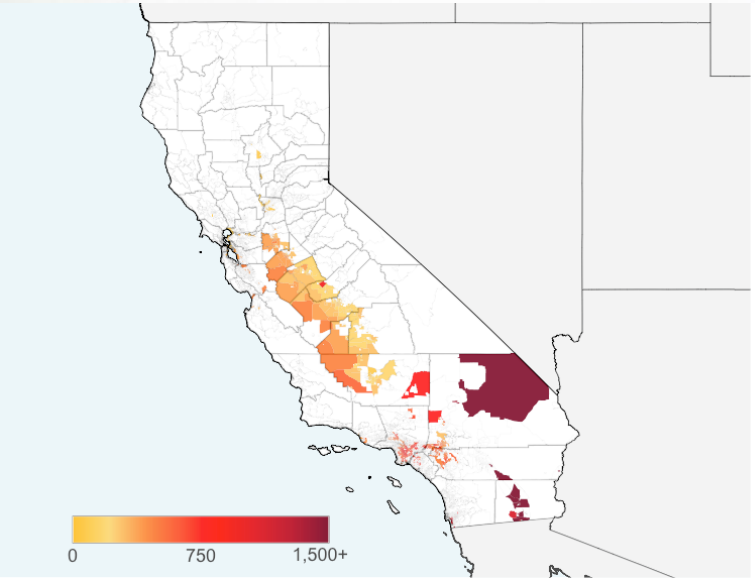


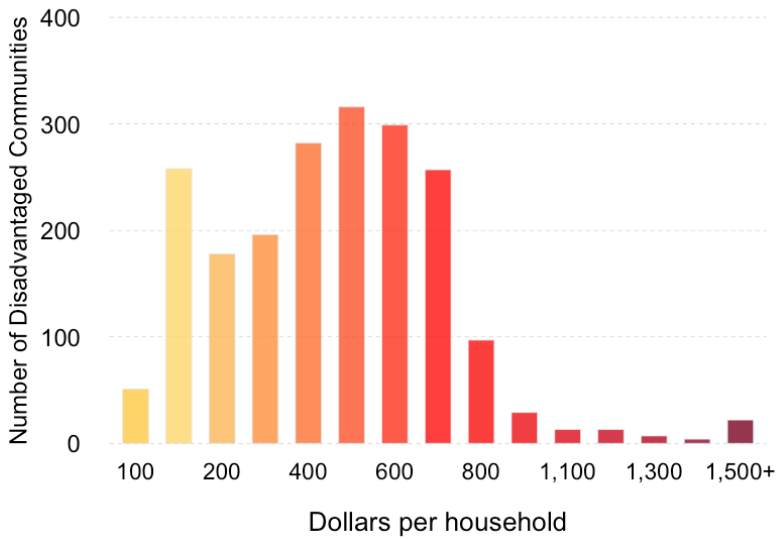


- Because workers in DACs are disproportionately employed in service and construction industries, 475,000 of the 940,000 jobs created are in Los Angeles are in DACs (50%).
- On average, 500 jobs created per DAC and more than 1,000 jobs created in five DACs.

Avoided Mortality and Morbidity Costs ($/hh)

Mit2030 (Base Cost) Mitigation Scenario

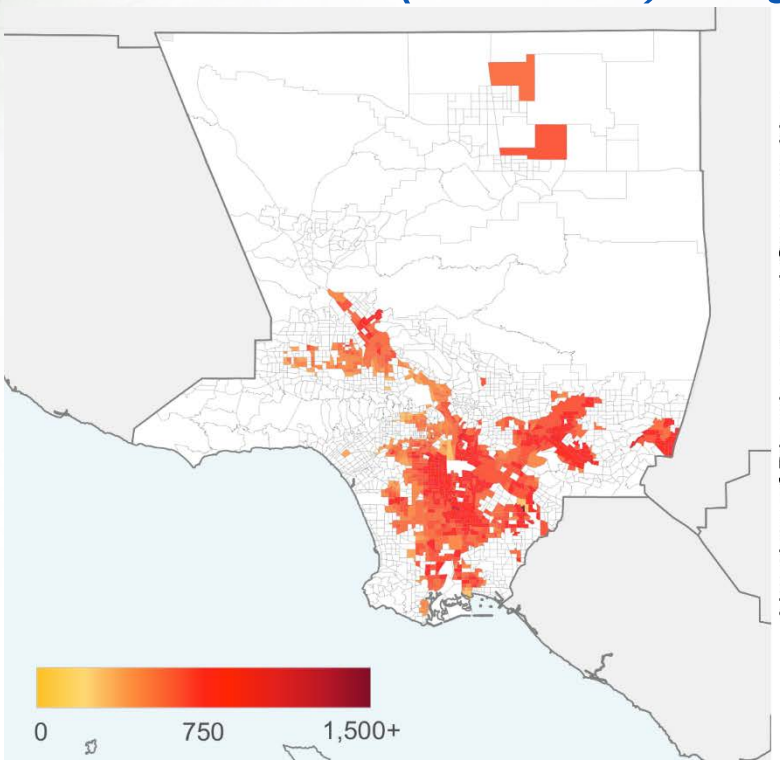


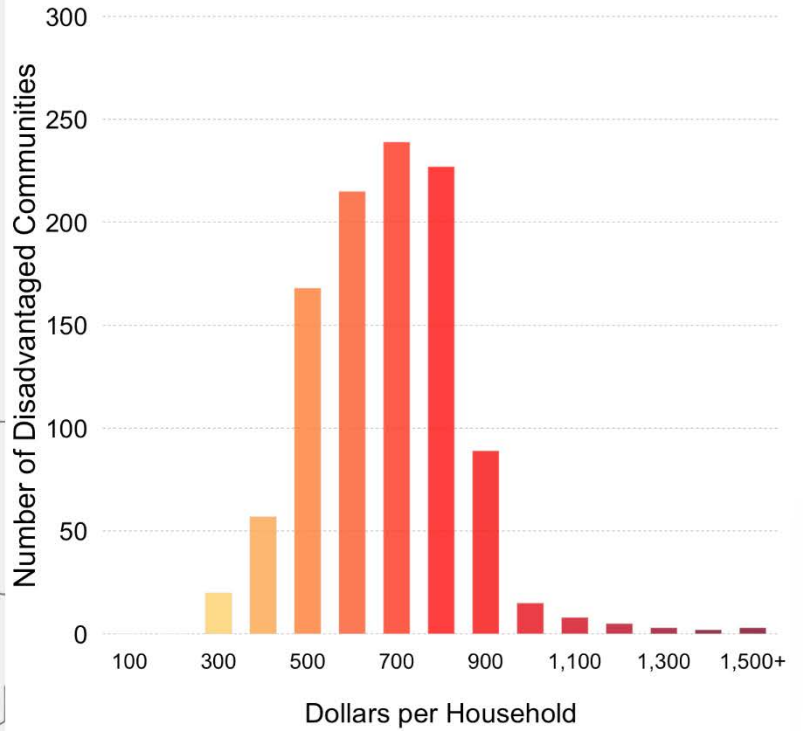


- On average, DAC households are
  - exposed to higher pollutant concentrations
  - have higher burdens of pollution-associated disease (e.g. asthma, cvd) and mortality.
- DACs thus can benefit disproportionately from improvements in air quality.
- DACs (25% of state population) receive $1.7B (30%) of the total economic benefit from averted health costs.

Avoided Mortality and Morbidity Costs ($/hh)

Mit2030 (Base Cost) Mitigation Scenario – Los Angeles





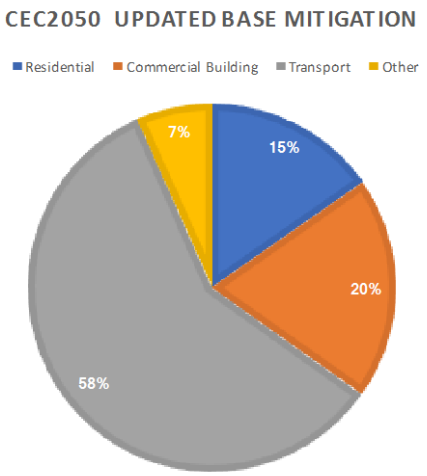
- In 2030, average DAC households avoid $677/hh in costs while non-DACS avoid $511/hh.
- Los Angeles includes DACs with some of the highest PM 2.5 exposure (~90th percentile), Ozone exposure (~93rd percentile) and disease incidence (~99th percentile in asthma).
- Avoided health costs due to predicted reduction in both PM2.5 and Ozone concentrations in the region.

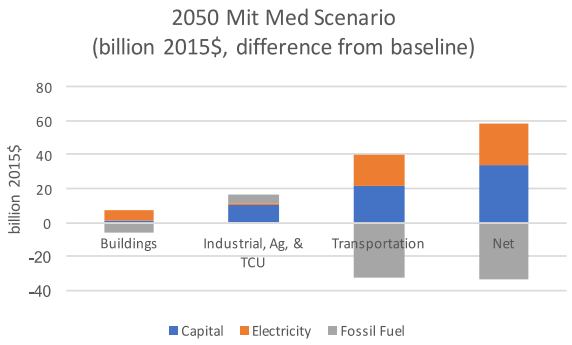
Contributions of the Building Sector

- LTES calls for the building sector to increase spending on:
  - electric power (from renewable sources)
  - technology

  while reducing spending on
  - fossil fuels

  The former will promote skilled employment, while the latter promotes public health.
- Relative magnitudes of these effects are an empirical question.





Conclusions: Statewide

- The state is committed to an ambitious long term program for emissions reductions, but the economic benefits for Californians can be much greater than its direct costs.
- Conservative estimates, based on investment and detailed technology cost analysis, indicate that California's proposed energy buildout and technology adoption programs will be potent catalysts for income and job growth across the state.
- Determined commitments to a new generation of lower carbon energy infrastructure and use technology has the potential to:
  - Increase California real GSP 2% by 2030 and 9% by 2050
  - Create over 500K additional FTE jobs by 2030 and 3.3M by 2050
- Expected additional gains from higher productivity and induced innovation will further amplify these net benefits
- Economic benefits from improved public health alone are comparable to the direct costs of the Base cost mitigation policy scenario.

Conclusions: Disadvantaged Communities

- New job creation is largely in sectors and occupations that disproportionately employ people from Disadvantaged Community households, including construction, transportation and services. This group (25% of state population) captures 30% of annual new jobs by 2030 and 29% by 2050.
- Electric Vehicle adoption remains concentrated among wealthy households and, while the EV fleet is expected to grow substantially, in the absence of targeted policies, most new purchases are likely be by non-DAC households (~90% in 2030).
- DAC households are currently burdened by high levels of criteria pollutant exposure (25% higher PM2.5 levels on average) and suffer from higher than average rates of associated diseases (55% higher asthma rates).
- DACs therefore benefit disproportionately from improvements in air quality that can reduce the mortality and morbidity costs they bear (30% of avoided deaths and costs in DACs, 25% of state population).
- However, these benefits among DACs are unevenly distributed across the state with DACs in Los Angeles benefitting more than DACs in the Central Valley, for example, because the sources of pollution in the Central Valley are less likely to be impacted by the policies considered here.

Priorities for Further Work

- Identify more detailed benefits and costs by LTES component (i.e. Energy Efficiency, Electrification, Low Carbon Fuels, and Non-energy Non-CO2 GHGs).
- Disaggregate building costs and benefits by sector, enterprise scale, and location.
- Evaluate opportunities for adjustment assistance and incentives to accelerate adoption.

Thank you