

# Impact of Electric Vehicle Adoption on Electricity Consumption and Generation: Evidence from California

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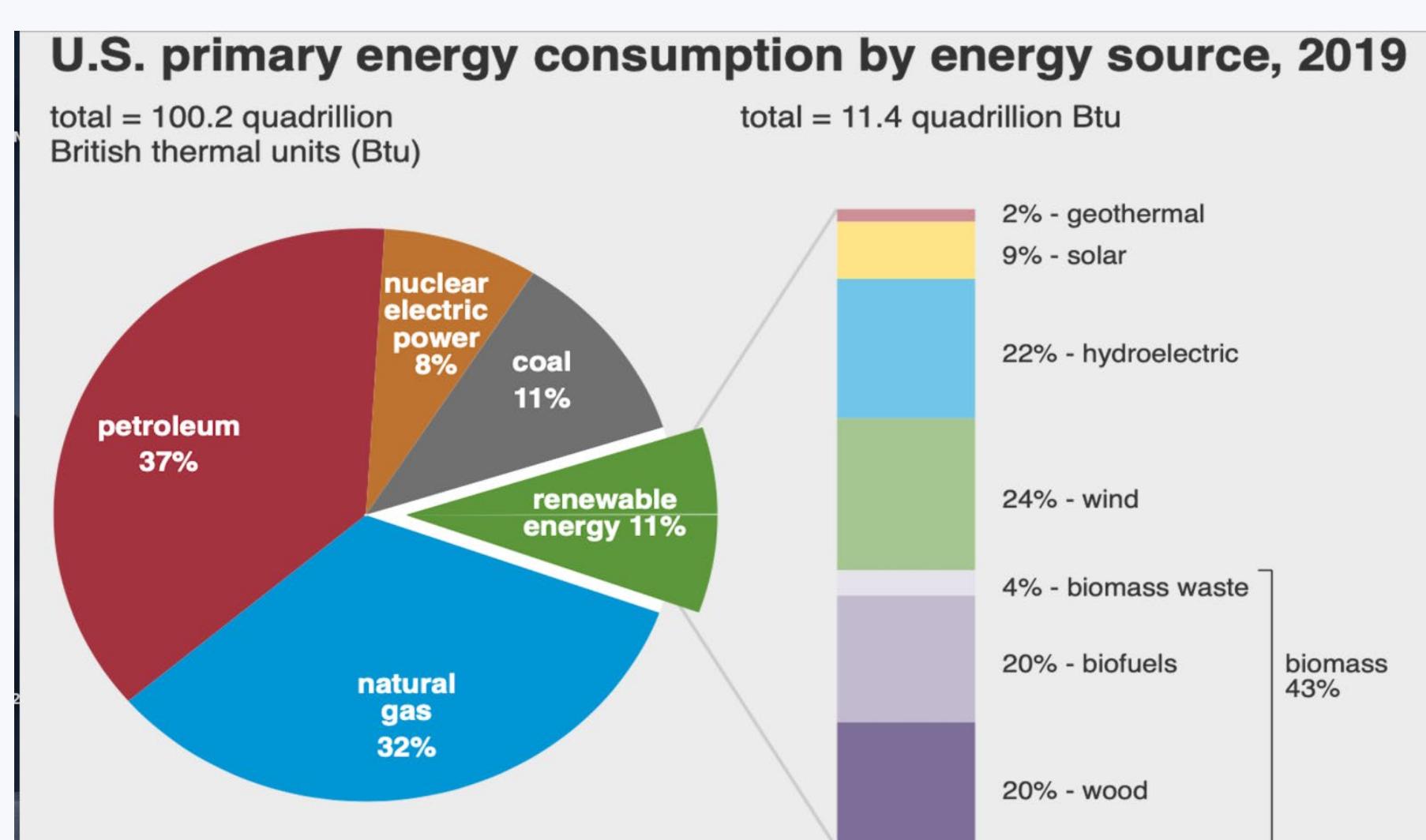
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## BACKGROUND

The market share of electric vehicles (EV) is growing in the USA, and there are substantial incentives for EV consumers. These incentives are in place, primarily, due to environmental concerns. This study explores two interrelated aspects of EV adoption.

- First, how electric vehicles and their supportive infrastructures, such as charging stations, are affecting electricity consumption?
- Second, If there is a positive relation between EV adoption and electricity consumption, where this excess electricity is coming from? Is this coming from renewable or non-renewable sources?

If the electricity generation does not involve renewable or cleaner sources, public spending on EV adoption may not contribute to a cleaner environment as much as expected.



## OBJECTIVE

- To quantify the electricity usage due to EV adoption.
- To investigate the relationship between electricity usage and the renewable energy share.
- Analysis of electricity consumption due to the adoption of electric vehicles is absent in the economics literature so far. This study tries to shed light on this missing discussion.

## DATA & METHOD

### Data

This study uses California's county-level monthly data from the year 2010 to 2019, which sums up to 6960 data points. I Collected these data mostly from California Energy Commission, U.S. Department of Energy and National Renewable Energy Laboratory, Bureau of Economic Analysis (BEA).

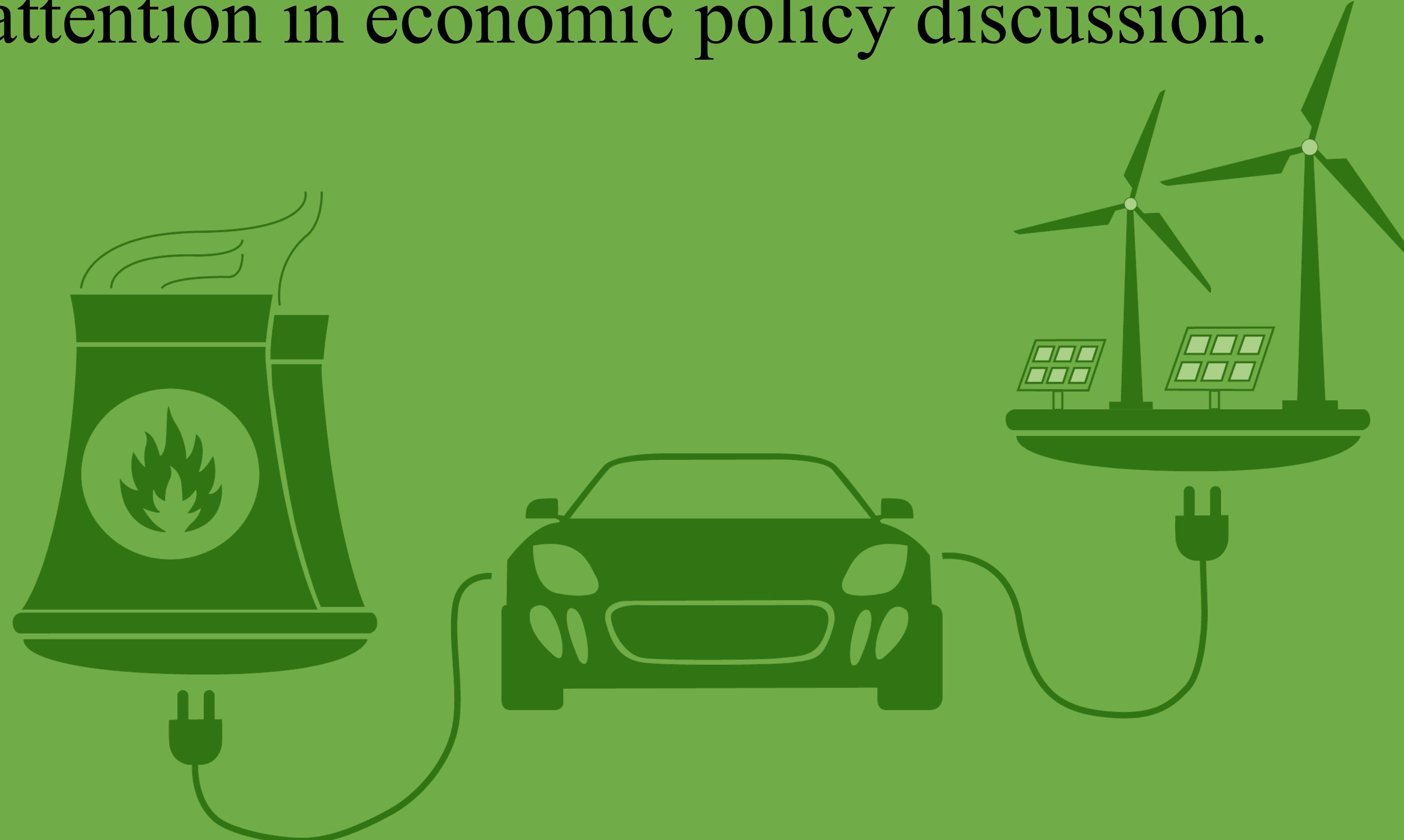
### Method

Two-way fixed-effect panel regression.

➤ In the first model, the outcome variable is electricity consumption. The key explanatory variables are the numbers of EV and charging stations. Other control variables are the type of housing units, population, average income, electricity price, employment, temperature.

➤ In the second model, the outcome variable is the percentage of electricity that comes from renewable sources. The key explanatory variables are electricity usage.

The government is spending public money as an incentive for electric vehicle (EV) adoption due to environmental concerns. This study finds increased EV adoption significantly raises electricity consumption. Besides, this excess electricity is coming from primarily non-renewable sources! This unintended consequence requires closer attention in economic policy discussion.



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## RESULT

TABLE 1: EFFECT OF EV ADOPTION ON RESIDENTIAL & COMMERCIAL CONSUMPTION				
EV	0.695 (0.447)	×	0.318 (0.701)	
Charging Station		×	29.71*** (7.49)	27.16*** (9.93)
Income	0.231 (0.310)		0.819** (0.401)	0.772* (0.412)
Population	0.418*** (0.074)		0.613*** (0.097)	0.608*** (0.098)
Weighted Price	134.74** (55.16)		174.97** (78.68)	171.91** (79.72)
Single HH	7,885.49 (720.71)		9,493.09 (7176.01)	10,160.81 (7358.46)
Employment	-0.123*** (0.043)		-0.297*** (0.056)	-0.308*** (0.059)
Hot Months	169,478.93*** (11725.16)		192,259.71 (13742.45)	191,572.84*** (13843.41)
Cold Months	17,198.96 (12,556.87)		24,458.90 (15,029.43)	25,233.86 (16,430.62)
County Fixed effect	✓		✓	✓
Time Fixed effect	✓		✓	✓

				(logged)	(Unlogged)
Electric Vehicle	0.3217 (1.55)	×	-2.40 (2.89)	×	×
Charging Station	×	0.5540 (1.51)	0.8954 (1.60)	×	×
Electricity	×	×		-34.78 (21.05) *	-0.0000085** (0.0000036)
Population	-20.12 (61.50)	5.23 (82.50)	-21.30 (85.44)	-9.08 (54.31)	0.000016*** (0.0000036)
Income	-36.15 (25.35)	-59.65* (32.63)	-68.78** (33.79)	-4.51 (22.66)	0.000022 (0.000015)
Weighted Price	-1.87 (6.66)	0.9975** (9.81)	0.0235 (9.85)	-0.0906 (5.94)	-0.0055 (0.0039)
Employment	120.97*** (42.60)	121.81 (51.00)	144.80** (56.02)	139.65 (39.85)	-0.0000024* (0.0000012)
Single HH	-43.18 (151.93)	-34.87 (178.57)	0.2921 (181.66)	125.79 (148.02)	2.55 (3.01)
County Fixed effect	✓	✓	✓	✓	✓
Year fixed effect	✓	✓	✓	✓	✓

## KEY FINDINGS

Each charging station in California significantly increases the monthly electricity consumption per county by 27.16 Mega Watt, which is 0.12% of total electricity usage.

A one percent increase in electricity consumption is associated with a decrease of 0.34% of the renewable electricity share.

## DISCUSSION

- Although electric vehicles emit lower greenhouse gases than conventional vehicles, they require significant electricity for charging. Evaluating the true environmental impact of government EV incentives should weigh the reduced gasoline engine emissions against the increased fossil fuel consumption during electricity generation.
- California already spent a total of \$2.46 billion in ten years period for its EV incentive programs. Unless California adopts cleaner sources of power plants, billions of dollars of public spending on EV adoption will not be as effective as it would be if accompanied by increased adoption of renewable energy sources.

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