Policy scenario analysis with CA-TIMES

Alan Jenn, Saleh Zakerinia, Kalai Ramea, Christopher Yang
Institute of Transportation Studies, University of California, Davis - *June 2016*

Abstract

The CA-TIMES model allows for deep insights into how the state of California will meet its demands in electricity, transportation, residential, commercial, industrial, and agricultural sectors through 2050. This project examines how various policies implemented in California affects the different sectors. By enforcing restrictions on emissions, transportation fleet makeup, fuel requirements, and renewable use, the policy scenario analysis is able to examine the costs, emissions outcomes, and a number of other factors across the array of policies.

Methods

Using the CA-TIMES, we construct a framework that allows us to examine how future energy scenarios in California are affected under different policy regimes. The policies fall under five different categories: emissions caps, renewable portfolio standards (RPS), Zero Emission Vehicle (ZEV) mandates, Low Carbon Fuel Standards (LCFS), Corporate Average Fuel Efficiency (CAFE) standards, and petroleum reduction requirements. A total of 1512 scenarios representing all combinations across the five policies are generated.

Due to the scale of solving many instantiations of CA-TIMES (a large scale LP with 10^6 order variables), the full set of policy scenarios is run on the National Energy Research Scientific Computing Center. The results of each individual run are then parsed and organized, filtering for individual results, and finally collated across specific category.

Policies used for scenario analysis

Emissions Caps

- 2020 emissions cap
- 2030 emissions cap (50% below 1990 levels by 2030)
- 2050 emissions cap (80% below 1990 levels by 2050, step-wise)
- 2050 emissions cap (80% below 1990 levels by 2050, linear)
- 2030 and 2050 emissions cap (50% below 1990 by 2030 and 80% below 1990 by 2050, step-wise)

Renewable Portfolio Standards

- No RPS
- 50% RPS by 2030
- 80% RPS by 2050

Zero Emission Vehicle Mandate

- No ZEV mandate
- ZEV mandate through 2025
- ZEV mandate through 2050

Low Carbon Fuel Standard

- No LCFS
- LCFS through 2025
- LCFS through 2050

CAFE Standards

- No CAFE standards
- CAFE standards through 2025
- CAFE standards through 2050

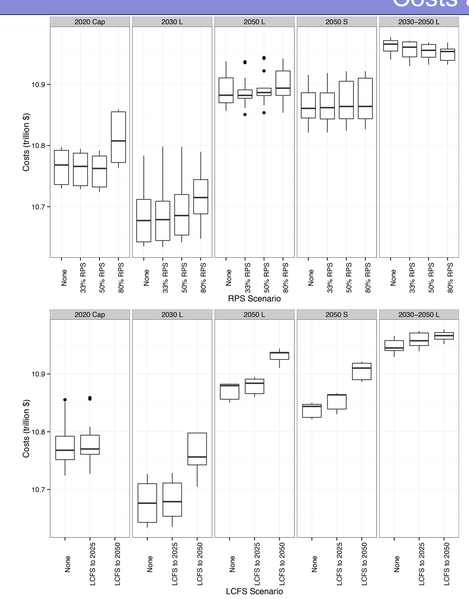
Petroleum Reduction

- No petroleum reduction
- 50% petroleum reduction by 2030
- 50% petroleum reduction by 2030 and 80% reduction by 2050

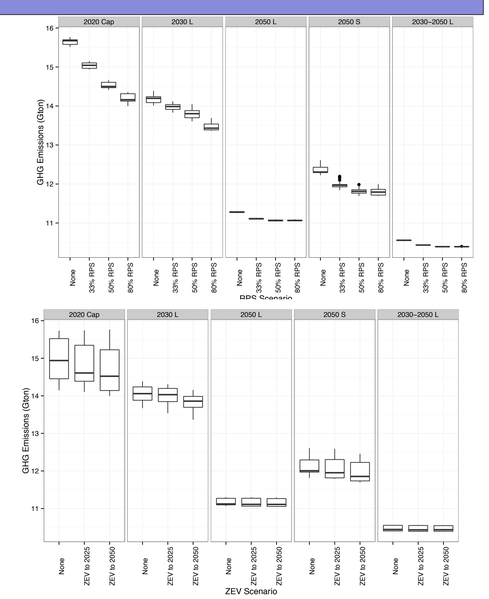
Results and Discussion

Costs and Emissions

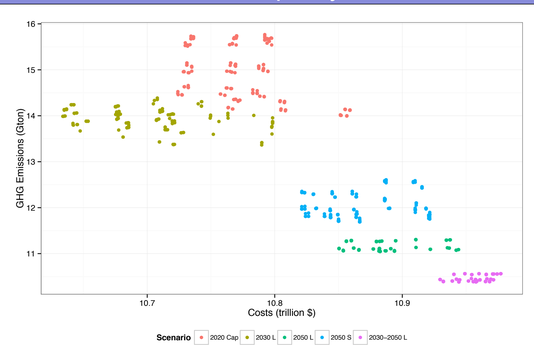
- In general, cap scenarios are the driving force between costs since they induce transformative changes across all sectors in order to comply with their respective requirements.
- Aggressive cap scenarios are already forced to implement measures seen in RPS. Renewable electricity is one of the first resources that cap scenarios turn to.
- Only the 80% RPS scenario leads to higher costs in the baseline cap scenario.
- Implementation of LCFS results in higher compliance costs, even in 2050 cap scenarios.



- The clustering of emissions are grouped by cap scenarios. No selection of policies are able to induce the level of change from the cap requirements
- The cumulative emissions decrease due to the RPS is most noticeable in the 2020 cap scenario. In more aggressive scenarios, changes to RPS are blunted by the fact that renewables are already integrated.
- A similar story can be seen in the ZEV mandate, but the decrease in emissions from the ZEV policy is substantially smaller than from RPS.
- In addition to emissions decreases, the ZEV mandate shifts vehicle fleet technology.

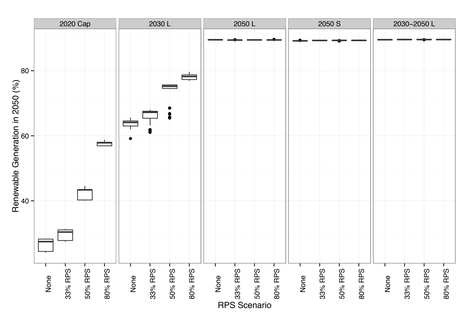


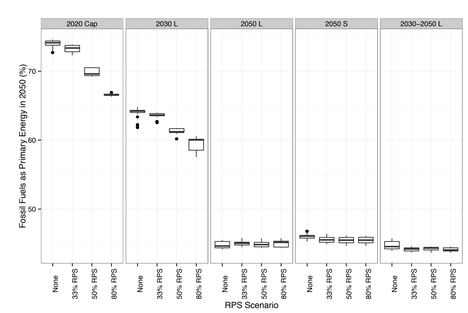
Overview of policy results



- The landscape of results for emissions can be grouped by emission cap scenarios.
- No combination of policies can be implemented to achieve lower emissions than the next tier of emission caps.

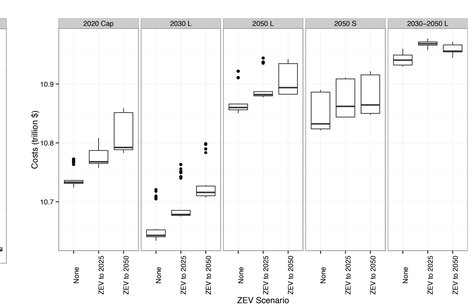
Renewable Generation

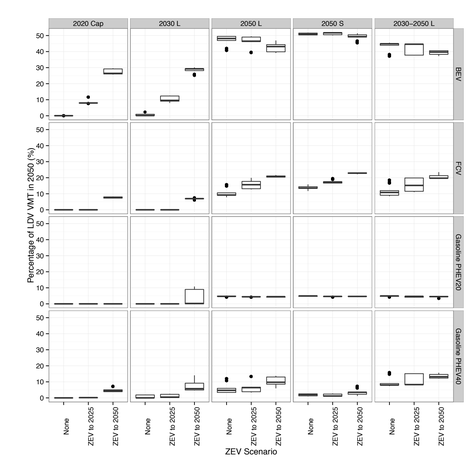




- The percentage of renewable generation in 2050 is drastically increased with the implementation of RPS in the 2020 and 2030 cap scenarios.
- Renewable generation is maxed out in 2050 cap scenarios since their integration is required to meet the cap requirements regardless of the presence of RPS.
- There is a corresponding decrease in fossil fuel usage as the RPS scenarios become more stringent.

Alternative Fuel Vehicles





- The costs of ZEV are on the order of $50 billion per tier, though this decreases slightly as cap scenarios increase in stringency.
- The pattern of technology adoption is directly affected by ZEV implementation with the policy slightly favoring FCVs over BEVs.

Acknowledgements
Thanks to the Sustainable Transportation Energy Pathways group and PG&E for providing funding and support for this research project. This research used resources of the National Energy Research Scientific Computing Center, a DOE Office of Science User Facility supported by the Office of Science of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

Contacting the Authors:
Alan Jenn (*ajenn@ucdavis.edu*)

UC DAVIS
SUSTAINABLE TRANSPORTATION ENERGY PATHWAYS
An Institute of Transportation Studies Program