

NextSTEPS (Sustainable Transportation Energy Pathways)

CA-TIMES Greenhouse Gas Reduction Scenarios for California in 2030

Christopher Yang

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Research Team and Talk Overview

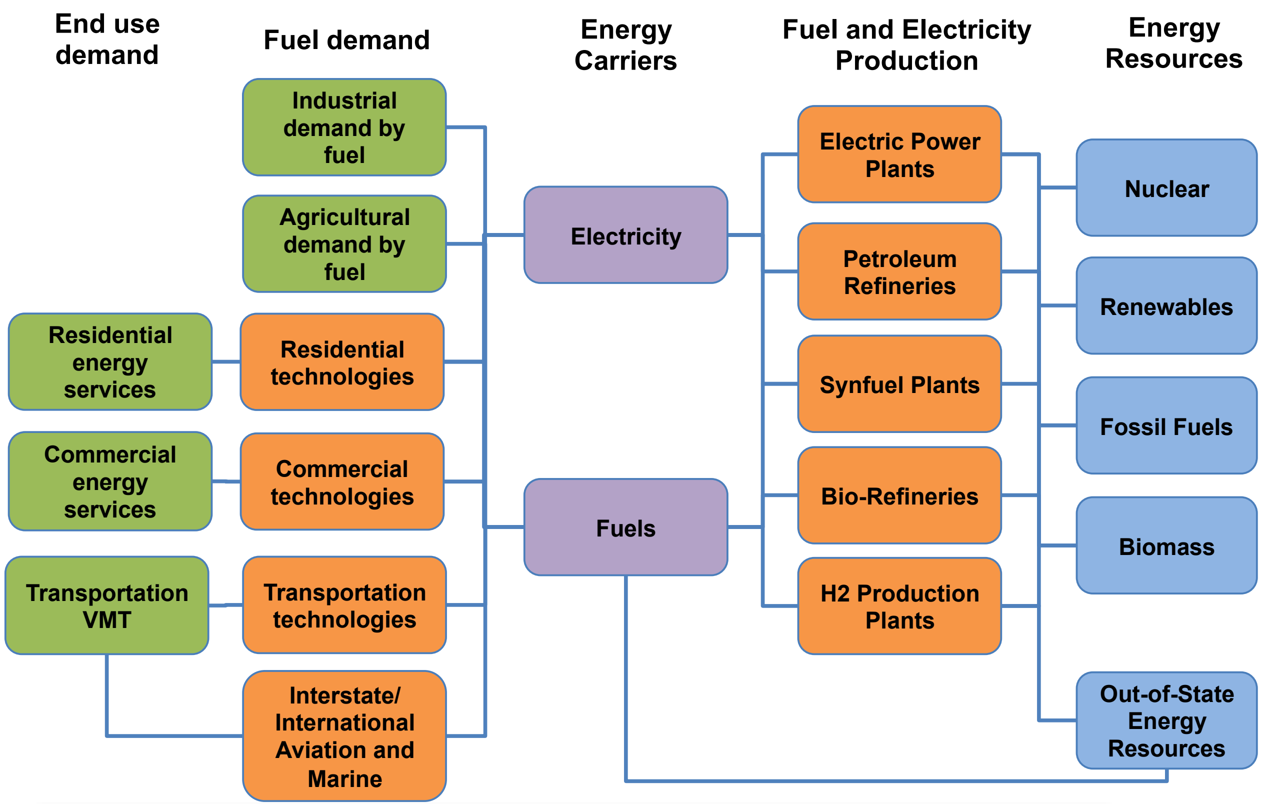
- Research Team
  - Saleh Zakerinia
  - Kalai Ramea
  - Alan Jenn, Ph.D
  - Prof. David Bunch
  - Sonia Yeh, Ph.D
- CA-TIMES description
- New policies
- Scenario results

What is CA-TIMES?

- An integrated model of California's energy system that tracks energy flows, economic costs and environmental emissions
  - Projections of energy service demands to 2050
  - Energy demand sectors (transportation, buildings, industry)
  - Energy supply sectors (resource extraction, fuel production, electricity generation)
  - Integration of demand and supply sectors
- It is used to **design** the state's future energy systems to meet the demand for energy services
  - Outputs include technology investments, and operational decisions
  - Constrain these decisions based upon policy considerations
    - Emissions, technology or sector specific policies
  - Key metrics:
    - End-use and supply technology mix, technology costs, resource utilization, emissions, mitigation costs, etc. . .

CA-TIMES Energy Sectors

- Value of integrated model of California's energy system
  - Resource supplies – used across many sectors
  - Electricity – used across many sectors, timing
  - Understanding tradeoffs and minimizing mitigation costs
  - Economy wide policies



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Understanding modeling approach and key caveats

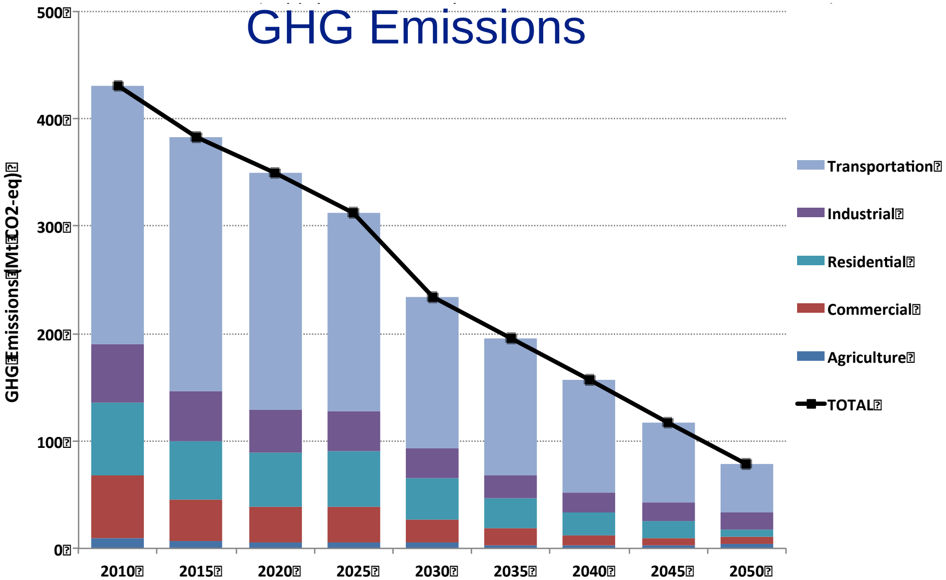
- Linear economic optimization (minimize system costs) to 2050
- Model requires specification of all service demands, technology and resource options to 2050
  - Quantity, availability, cost, efficiency, lifetime
- Optimization and adoption of technologies is based primarily on a life-cycle economic analysis of various alternatives
- Policies are modeled as system constraints
- Markets are not represented
  - Decisions are made on providing fuels/electricity/services at lowest cost
- Single, global decision-maker with perfect foresight
  - Tradeoffs are made across sectors

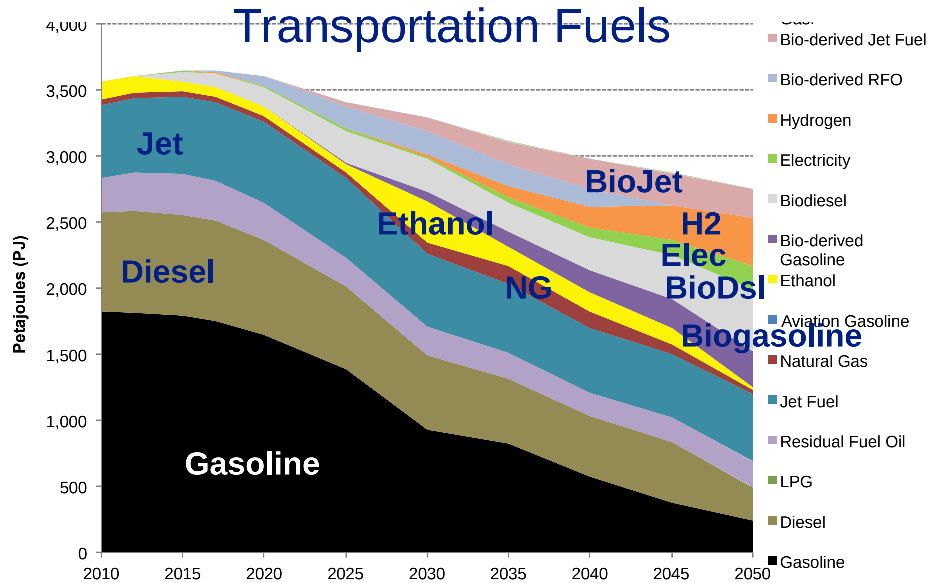
Model scenarios and results are illustrative of important trends and can highlight insights into which technologies and options could be used to mitigate GHG emissions

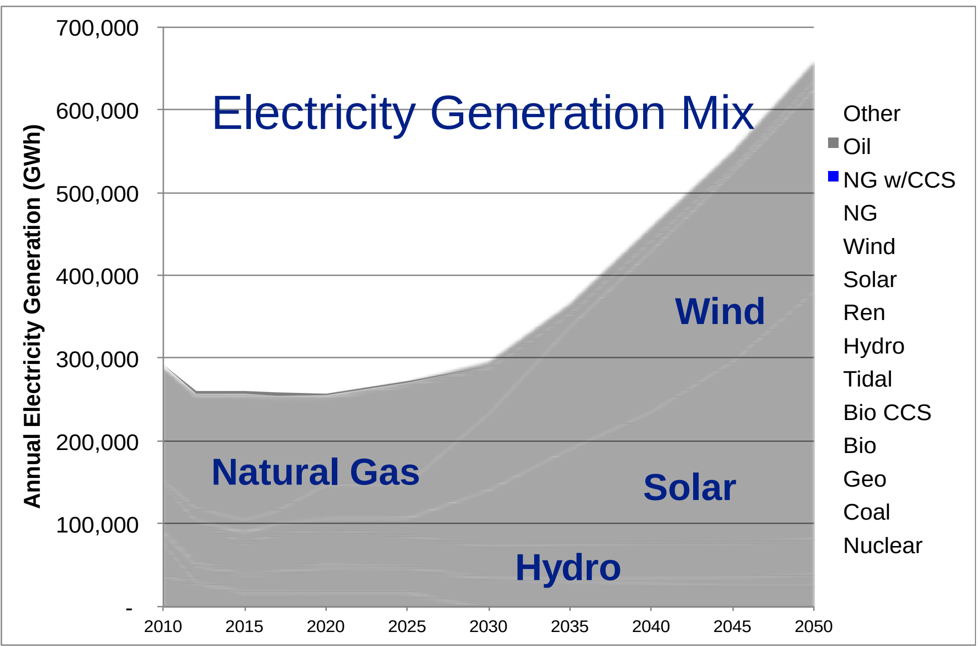
California Policy Targets

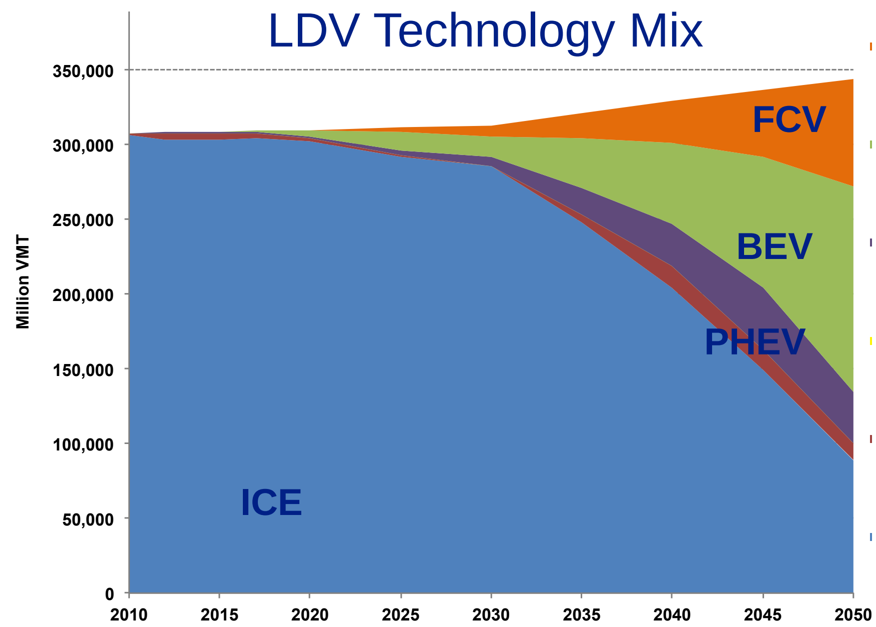
- 2005-2006 – Gov. Schwarzenegger sets 80% reduction target for 2050 and AB32 passed (2020 target)
  - Other important policies include Pavley/CAFE, RPS, LCFS, ZEV
- Recent Policy Targets for 2030 (2015)
  - Gov. Brown: 40% below 1990 levels
  - 50% petroleum reduction target
  - 50% renewable portfolio standard (RPS)
  - Doubling of building efficiency
- Focus of modeling is to understand how California can achieve long-term GHG reduction targets and implications of near-term policies on technology adoption and costs
- Modeling work is still ongoing so results shown are not finalized or published yet and are meant to be illustrative

Scenario Outputs



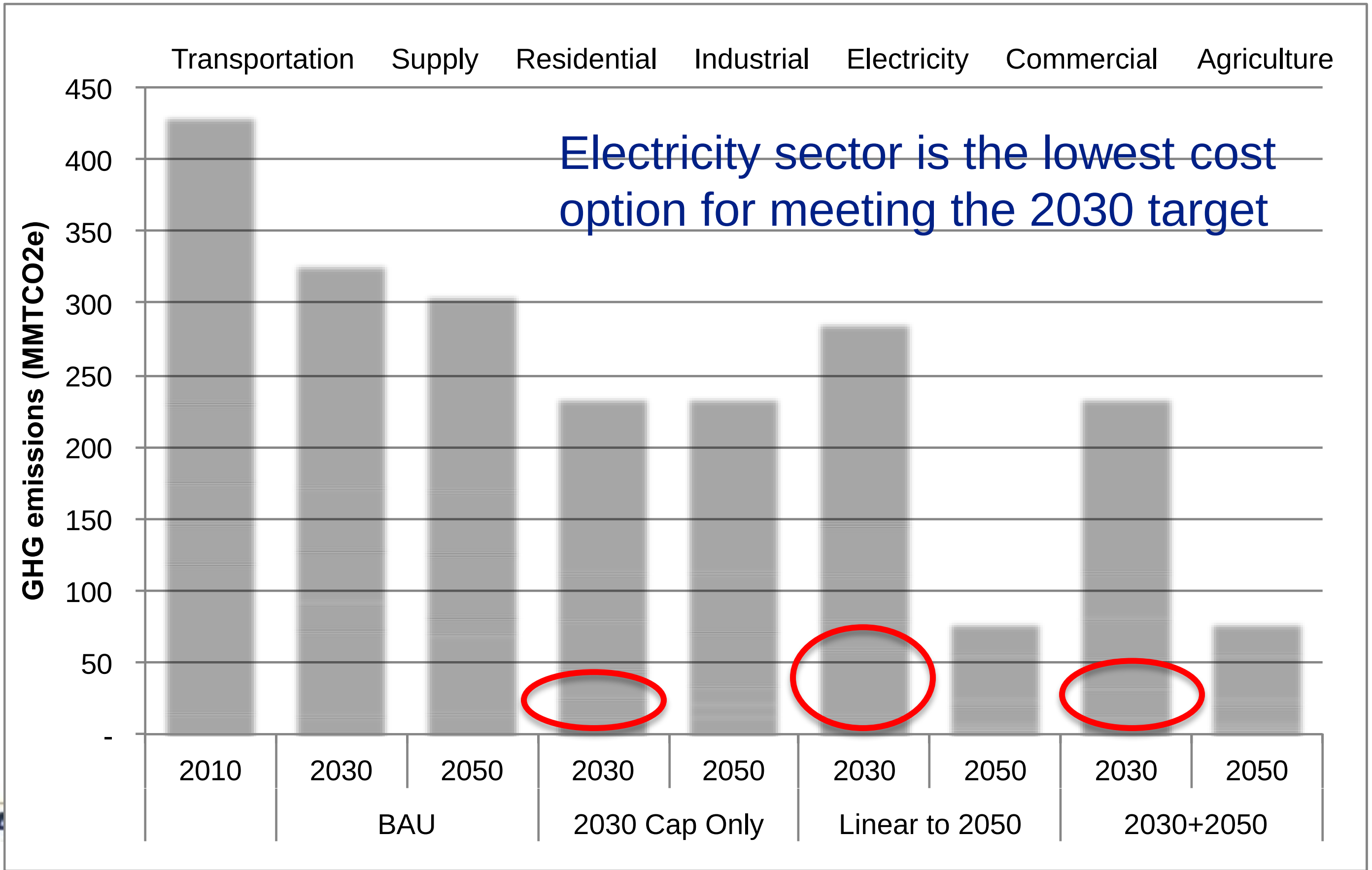






40% Reduction in GHG emissions by 2030

CA Energy System Emissions (MtCO2e)		
		% below 1990
1990	390	
2030 Target	234	40%
2030 BAU	327	16%
2050 BAU	305	22%
Linear trajectory (2020-2050) in 2030	287	26%



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2030 GHG Target

- Significant change in cumulative emissions vs linear reduction
  - 10.2 vs 10.9 $GtCO_2$ is 700 MMTCo2 or ~2x current annual emissions
  - vs 13.8 $GtCO_2$ in BAU (2010-2050)
- Electricity sector contributes significantly to meeting 2030 goal
  - Significant increase in wind and solar by 2030 vs BAU (60% vs 34%) and double the renewable generation
  - Carbon intensity of electricity is 44 g/kWh vs 206 in BAU
- Transportation sector also contributes significant reductions
  - Primarily through biofuels usage (2.5 billion gge additional biofuels)
  - Small changes in H2 and electricity use
- Increases mitigation costs

	2050 Linear	2030 and 2050 Cap
Discounted Incremental cost vs BAU ($Billion)		
cumulative to 2030	19.5	35
cumulative to 2050	323	382
Cost/HH/yr ($/yr)		
cumulative to 2030	87	155
cumulative to 2050	574	678

Petroleum Reduction Target

- Petroleum reduction target (2030) is binding without 2030 cap
  - The target is met primarily via biofuels (additional 2.3 billion gge)
  - Natural gas contributes as well (~1 billion gge)
  - Electricity and hydrogen do not play a large additional role in 2030
  - Petroleum target induces additional 20 $MtCO_2$ emissions reduction in 2030
  - Reduces cumulative emissions to 2050 by 162 $MtCO_2$ vs BAU
  - $8B total or $35/HH/yr cumulative cost to 2030 (PV)
- Combined with GHG emissions caps
  - With 2030 GHG target, petroleum reduction target is not binding
  - No change between these model runs with and without petroleum target
  - With relaxed 2030 target (linear 26% reduction), we see 1.5 billion gge additional biofuels and 0.6 billion gge additional natural gas usage

Main Takeaways

- The CA-TIMES model is used to analyze future scenarios of decarbonization and the impacts of broader policy targets, technology/resource costs and constraints
- Provides insights into the broader context for the transportation sector as well as tradeoffs and synergies in mitigation options across sectors
- 40% 2030 GHG target is met through decarbonization in the electricity sector and biofuels in transportation sector
  - 40% in 2030 does not appear to be necessary to achieve the 2050 goal, nor the lowest cost trajectory, but will lower cumulative emissions
  - Costs are reasonable (PV \$382B or ~\$700/HH/yr to 2050)
- Impact of petroleum reduction target
  - Binding without 40% GHG target in 2030 (BAU or Linear GHG cap)
  - Mostly met through biofuels and natural gas rather than significant increases in hydrogen or electricity

Ongoing work to be completed in 2016

- Incorporating learning-by-doing
- Understanding the interactions between different policies and targets
- GHG reductions from increasing stringency of existing policies (RPS, CAFE, ZEV, LCFS, Petroleum, etc) vs emissions caps
- Incorporation of consumer heterogeneity and choice into the model
- Parameter uncertainty for model inputs
- More detailed analysis of interactions between electric sector and transportation fuels production

Thank you!

ccyang@ucdavis.edu