

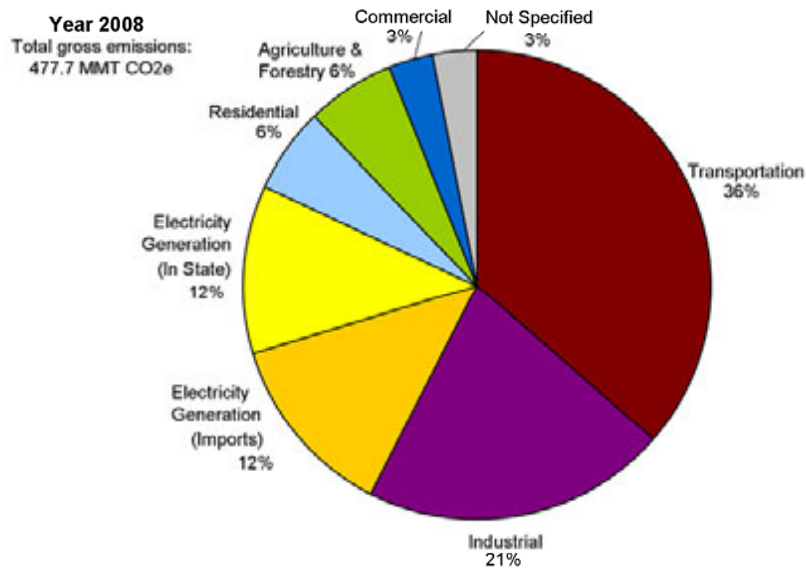
Impacts of AB 32 on California's electricity sector

Meredith Fowlie
UC Berkeley and NBER
fowlie@berkeley.edu

Focus on the following..

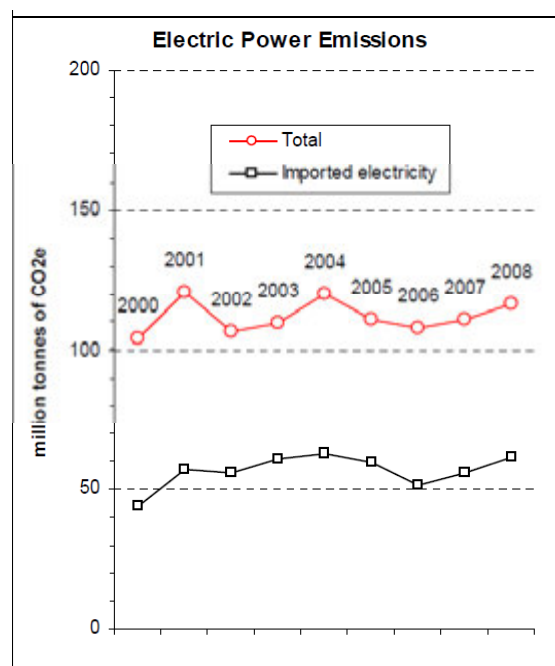
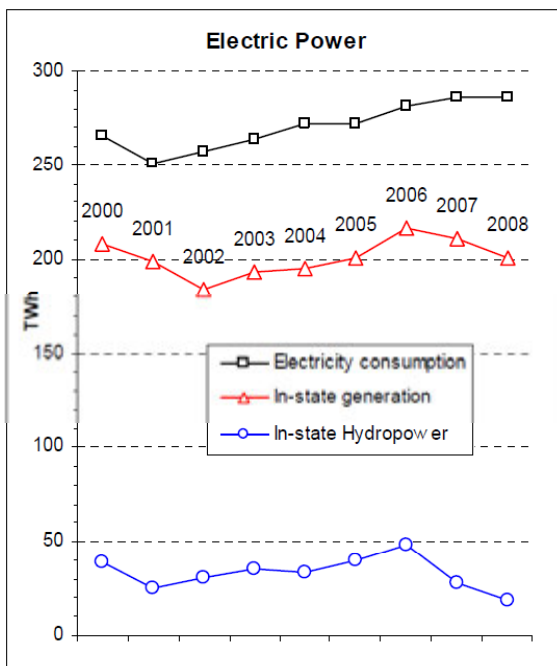
- What are modeling results telling us about *how much* of the emissions reductions mandated by AB32 will be achieved in the electricity sector.
- What are modeling results telling us about *how* these emissions reductions will be achieved in the electricity sector?
- How sensitive are answers to the above questions to key policy design features?
- In particular, how binding are complementary measures that affect the electricity sector?

California's electricity sector is responsible for approximately 1/4 of the state's anthropogenic greenhouse gas emissions



Source: California Air Resources Board: California Greenhouse Gas Inventory
<http://www.arb.ca.gov/cc/inventory/data/graph/graph.htm>

Electricity imports play an important role



Source: "California Air Resources Board: Trends in California Greenhouse Gas Emissions for 2000 to 2008."

http://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_trends_00-08_2010-05-12.pdf

The carbon intensity of California's electricity sector is relatively low

- CO2 emissions/kWh *consumed* in California (including imports): **0.9 lbs CO2/kWh¹**.
- CO2 emissions/kWh *produced* in California: **0.66 lbs CO2/kWh²**.
- National average emissions rate per kWh produced: **1.31 lbs CO2/kWh³**.

Sources: (1) "California Air Resources Board: Trends in California Greenhouse Gas Emissions for 2000 to 2008."; (2) EIA State Electricity Profiles, 2008; (3) EIA Electric Power Annual, 2008.

And getting lower..

Several initiatives already in place to reduce carbon intensity of California's electricity sector:

- CA Renewables Portfolio Standard (20% by 2010)
- Electricity Greenhouse Gas Performance Standard (SB1368)
- Energy-efficiency programs included in the 2007 Federal Energy Independence and Security Act (EISA)
- Phase out of OTC plants(?)

"BAU" emissions from the electricity sector in 2020 projected to be below 2008 levels, even without AB32.

Electricity sector is expected to contribute significantly to emissions reductions achieved under AB32

- In economic analysis conducted by CARB, approximately 40% of projected emissions reductions achieved under AB32 by 2020 come from the electricity sector.
- How these emissions reductions will be achieved depends to a significant extent on how the policy is designed and implemented.

How will these additional carbon emissions reductions be achieved?

- **Scale reductions ?** Reduce load.
- **Composition changes?** Reorder dispatch of existing generation so as to increase (reduce) capacity factors of low (high) emitting units.
- **New technology investment?** Build new, clean generation to displace relatively high-emitting generation on both the operating and build margins.

Projecting emissions trends in California's electricity sector (out to 2020)

- A variety scenarios have been analyzed.
- I will highlight results from three scenarios analyzed by ARB:
 - 2020 ARB Reference scenario
 - Full complementary measures and offsets (ARB Case 1)
 - Full complementary measures, no offsets (ARB Case 2)

Focus on the following..

- What are modeling results telling us about *how much* of the emissions reductions will be achieved in the electricity sector.
- What are modeling results telling us about *how* these emissions reductions will be achieved in the electricity sector?
- How sensitive are answers to the above questions to key policy design features?
- In particular, how binding are complementary measures that affect the electricity sector?

Approximately 40% of projected emissions reductions (32-37 MTCO₂e) achieved under AB32 by 2020 expected to come from the electricity sector

Sector	California 2020 GHG emissions (MT) under		
	BAU reference case	% Reduction under AB32	% Reduction under AB32- No offsets
Residential	29.7	-9%	-14%
Commercial	12.1	-7%	-10%
Industrial	102.8	-15%	-17%
Mining	12.2	-5%	-14%
Agriculture	31	-1%	-2%
Transportation	227.8	-12%	-13%
Electricity sector	100.0	-32%	-37%
Waste	12.4	0%	0%
Total	527.9	448.7	438.2

Source: Updated Economic Analysis of AB 32 Scoping Plan

Scale reductions?

	Total sales in 2020 (GWh/year)	Reductions in 2020 emissions relative to BAU (MMTCO ₂ e)
Reference case	297,021 GWh/year	--
CASE 1 : AB 32	17% reduction	12 MMTCO ₂ e
CASE 2 : AB 32 without offsets	17% reduction	12 MMTCO ₂ e

- Less than half of the emissions reductions in the electricity sector come from reductions in consumption.
- Complementary measures appear to bind.

Source: Updated Economic Analysis of AB 32 Scoping Plan

Composition changes?

	Reference case 2010 Generation	AB32 Case 2010 Generation	AB32 without offsets 2010 Generation
Gas/oil	73,296 GWh	-30%	-62%
Coal	2,925 GWh	-79%	-92%
Nuclear	31,560 GWh	0%	0%
Hydro	48,199 GWh	0%	0%
Biomass	6,312 GWh	+38%	+38%
Wind	8,979 GWh	+125%	+125%
Other renewable	18,247 GWh	+100%	+100%
Imports		-47%	-26%

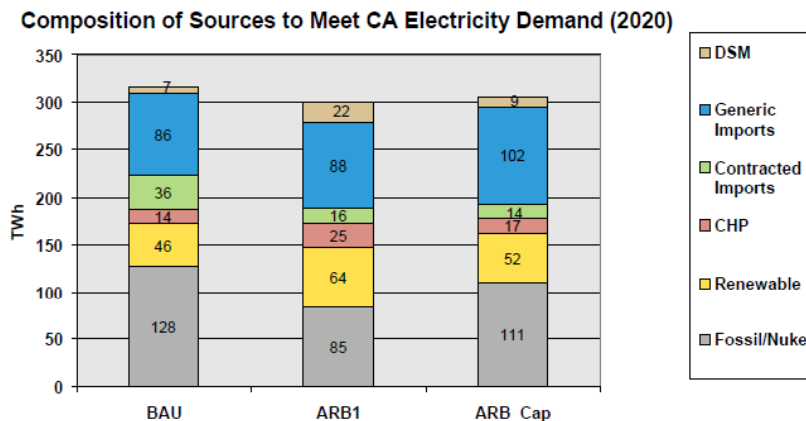
Source: **Updated Economic Analysis of AB 32 Scoping Plan**

Technology investment?

	Reference case 2010 Capacity	AB32 Case	AB32 without offsets
Gas/oil	41,984 MW	0%	0%
Coal	552 MW	0%	0%
Nuclear	4,324 MW	0%	0%
Hydro	13,788 MW	0%	0%
Biomass	1,100 MW	31% + 341 MW	31% + 341 MW
Wind	3,577 MW	101% +3613 MW	101% +3613 MW
Other renewable	3,510 MW	185% +6,494 MW	185% +6,494 MW

Source: **Updated Economic Analysis of AB 32 Scoping Plan**

CRA findings further highlight the effects of complementary measures



Under our assumptions, the cost-effective levels of new CHP and DSM/EE (those achieved under pure cap and trade, ARB_Cap) are below the levels required by the complementary measures:

- Cost-effective CHP 17 TWh vs. Complementary measure's 30 TWh
- Cost-effective DSM 9 TWh vs. Complementary measure's 22 TWh

Given the great uncertainty in DSM/EE and CHP costs, further analysis should be conducted to estimate the likely range of cost-effective levels of DSM/EE and CHP.

Conclusions

- California's electricity sector is expected to play an important role in meeting emissions reduction targets mandated by AB32.
- Emissions reductions achieved via multiple channels: scale reductions, changes in operating fuel mix, new investment.
- Complementary measures (RES, EE standards, etc) do bind; all models agree that they influence how emissions reductions are achieved.
- Begs the question...is this fruit worth picking?