Synapse
Energy Economics, Inc.

Exploration of Costs for Load Side and Supply Side Carbon Caps for California

Joint En Banc Hearing of PUC and CEC on
Point of Regulation in the Electricity Sector (R.06-04-009)

August 21, 2007

Presented by Bruce Biewald

Conclusion and Recommendation

- Conclusion:

  Load side carbon cap is likely to cost California consumers significantly less than supply side cap. Potentially billions of dollars per year.

- Recommendation:

  Develop specific design for load side cap policy based on detailed analysis.

Assumptions: Test System

- Simplified electric system that resembles California
- Imports included, but not treated differently from generation
- LSE's and generators are separate
- Rough numbers for dispatch, costs, and prices

Assumptions: Test System

Category	Type	Capacity (MW)	Generation (GWh)	Capacity Factor	CO2 Rate (Tons/MWh)	CO2 Emis (kTons)	Marg Cost ($/MWh)	Gen Costs (M$)
Dispatchable	Nat Gas	36,700	93,562	29%	0.553	51,737	80.0	7,485
	Imp Hydro/Nuclear	4,000	19,016	54%	0	0	55.0	1,046
	Imp Gas	4,000	19,016	54%	0.555	10,547	80.0	1,521
	Imp Coal	8,000	38,033	54%	1.040	39,554	45.0	1,711
	Oil & Other	1,031	4,611	51%	1.230	5,672	125.2	577
	Coal	389	2,145	63%	1.560	3,346	30.0	64
Fixed	Renewables	5,479	23,648	49%	0	0	55.0	1,301
	Hydro	10,088	39,632	45%	0	0	30.0	1,189
	Nuclear	4,324	36,155	95%	0	0	40.0	1,446
		74,011	275,819			110,856		16,341

Simplified test system designed to resemble California electric mix.
Based on 2005 EIA data.

Supply Side Cap

- Carbon dioxide price at $30/ton of CO2
- Suppliers increase energy market bids based upon emission rates and carbon price
- Tested two different allowance allocations:
  - 100% to generators
  - 100% to load serving entities (LSEs)

Load Side Cap

- Load buys energy with associated CO2 emissions
- No auction needed – credits assigned to retail providers on behalf of their customers
- Load retires credits to match its portfolio
- Cap met through clean generation, energy efficiency, and (if need be) purchase of credits

Results: Near Term

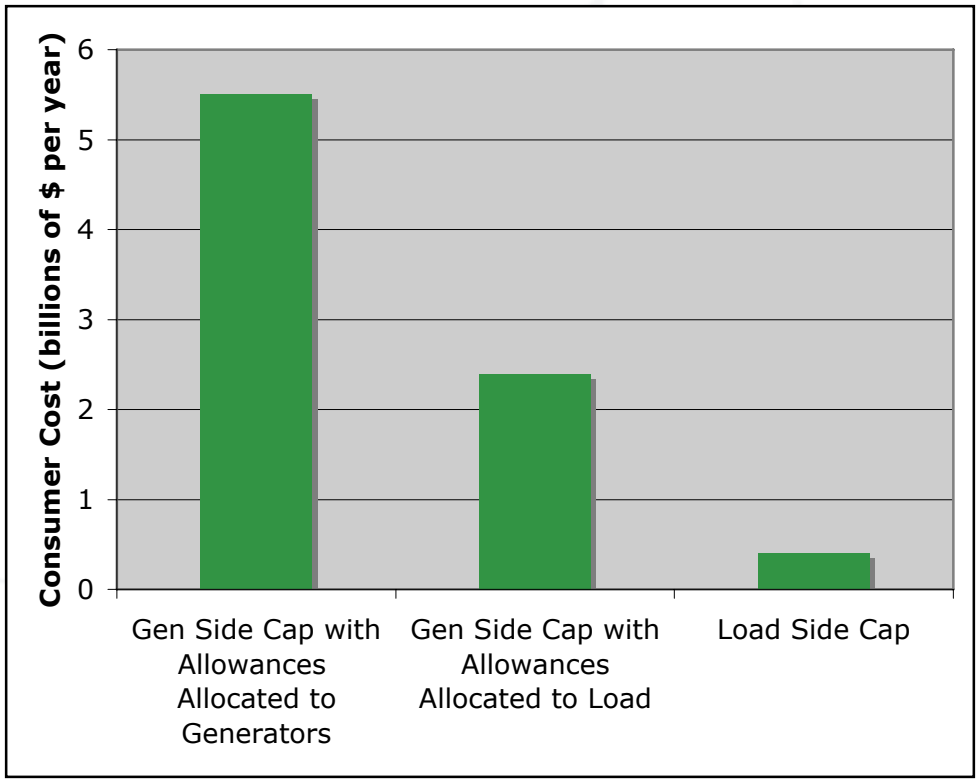
	Reference Case - No CO2 Policy	Generator Side Cap - Allowances to Generators	Generator Side Cap - Allowances to Loads	Load Side Cap - Payments to Selected Generators
CO2 Price ($/ton)	0	30	30	N/A
Weighted Market Price ($/MWh)	70.3	90.5	90.5	70.3
Total Market Costs (M$)	19,399	24,951	24,951	19,399
Generator Costs (M$)	16,341	19,892	19,892	16,766
CO2 Change (kTons)	0	-6,668	-6,668	-6,668
CO2 Allowance Costs (M$)	0	3,126	3,126	425
CO2 Control Cost ($/ton)		469	469	64
Customer Net Costs (M$)	19,399	24,951	21,825	19,824
Generator Net Costs (M$)	16,341	16,766	19,892	16,341
Generator Margin (M$)	3,058	8,185	5,059	3,058
Customer Cost Impacts (M$)		5,552	2,426	425

Results: Long Term

	Reference Case - No CO2 Policy	Generator Side Cap - Allowances to Generators	Generator Side Cap - Allowances to Loads	Load Side Cap - Targeted Resource Changes
CO2 Price	0	30	30	N/A
Weighted Market Price ($/MWh)	70.3	90.4	90.4	70.3
Total Market Costs (M$)	19,821	25,485	25,485	19,821
Generator Costs (M$)	16,841	20,394	20,394	17,086
CO2 Change (kTons)	0	-7,126	-7,126	-21,045
CO2 Allowance Costs (M$)	0	3,112	3,112	245
CO2 Control Cost ($/ton)		437	437	12
Customer Net Costs (M$)	19,821	25,485	22,373	20,066
Generator Net Costs (M$)	16,841	17,282	20,394	16,841
Generator Margin (M$)	2,980	8,203	5,091	2,980
Customer Cost Impacts (M$)		5,664	2,552	245

Consumer cost results

Load-side cap saves ratepayers between $2 billion and $5 billion annually (depending upon allowance allocation to load or generation).



Simple Carbon Cap Math: Assumptions and Calculations

Assumptions:

Total system electricity sales = 300 million MWh/year

Total system CO2 emissions = 100 million tons/year

Marginal system CO2 emissions = 0.6 tons/MWh

CO2 price = $30/ton

Target CO2 reduction = 10% or 10 million tons/year

Calculations:

CO2 reduction "cost" = 10 million tons/year x $30/ton = $0.3 billion/year

Electricity price effect = 0.6 tons/MWh x $30/ton = $18/MWh

or $18/MWh x 300 million MWh/year = $5.4 billion/year

Value of allowances = 100 million tons/year x $30/ton = $3.0 billion/year

Simple Carbon Cap Math: Policy Cost Comparison

	Supply Side Cap Allowances to Generators (billion $/year)	Supply Side Cap Allowances to Load (billion $/year)	Load Side Cap (billion $/year)
CO2 reduction cost	--	--	0.3
Electricity price effect	5.4	5.4	--
Value of allowances	--	-3.0	--
Cost to consumers	5.4	2.4	0.3

Simple Renewable Standard Math: Assumptions and Calculations

Assumptions:

Total system electricity sales = 300 million MWh/year

Renewable energy credit price = $30/MWh

Renewable energy target = 10% or 30 million MWh/year

Calculations:

Renewable "cost" = 30 million MWh/year x $30/MWh = $0.9 billion/year

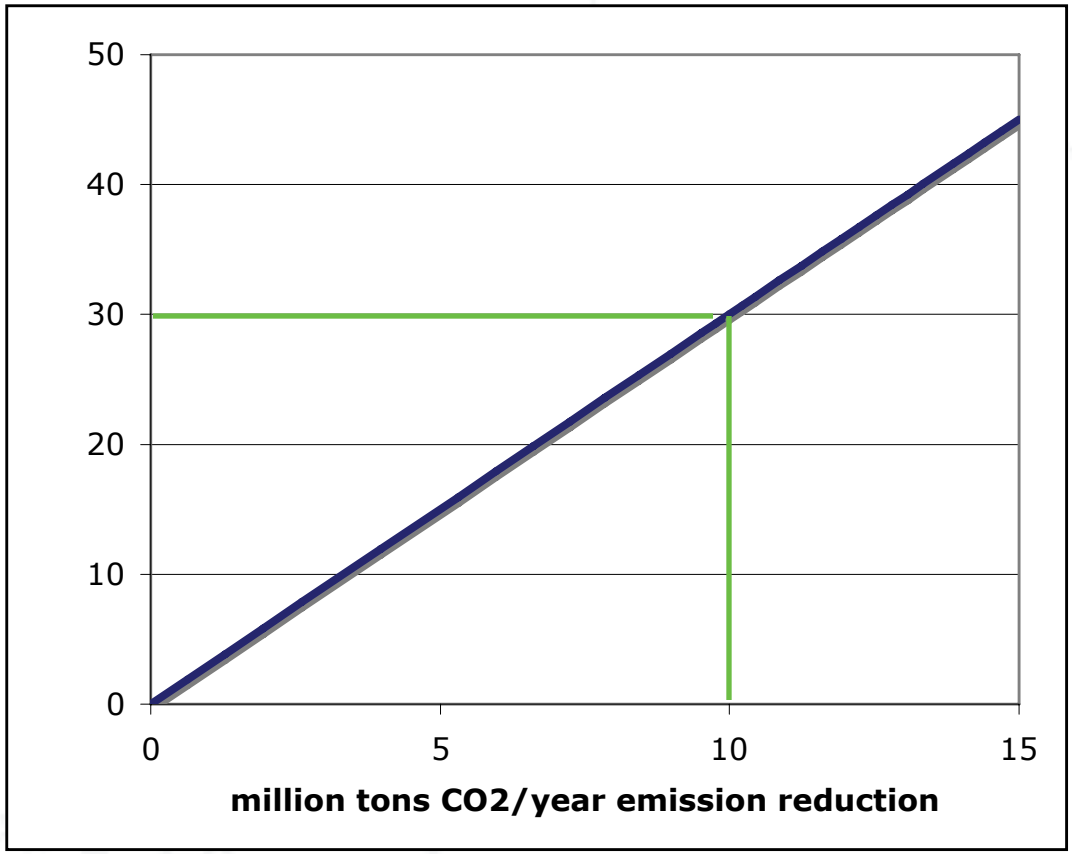
Electricity price effect = $30/MWh x 10% = $3/MWh

or $3/MWh x 300 million MWh/year = $0.9 billion/year

Conclusion:

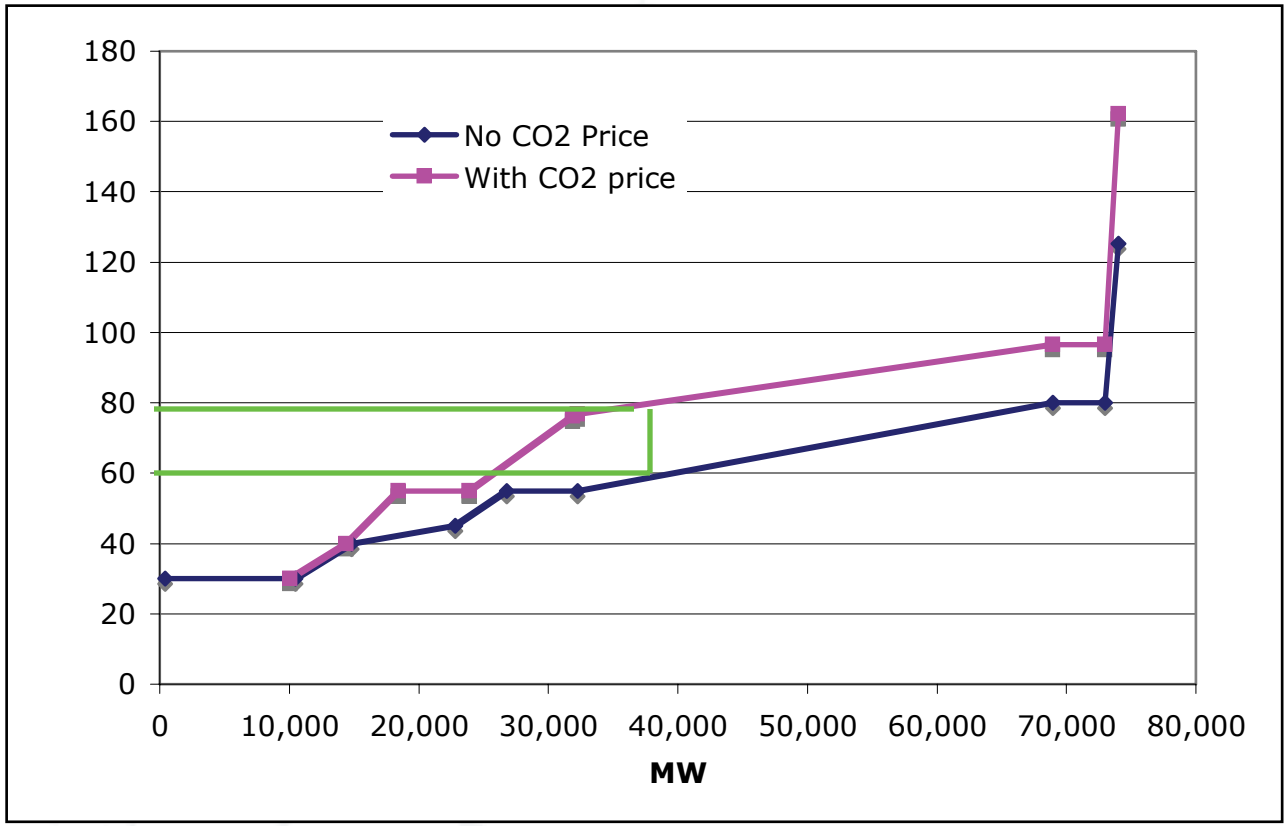
RPS is like load side carbon cap. Because the compliance is with the load side consumers pay for the desired outcome (more renewables) without create a large electricity market price increase.

Simplified Carbon Reduction Supply Curve



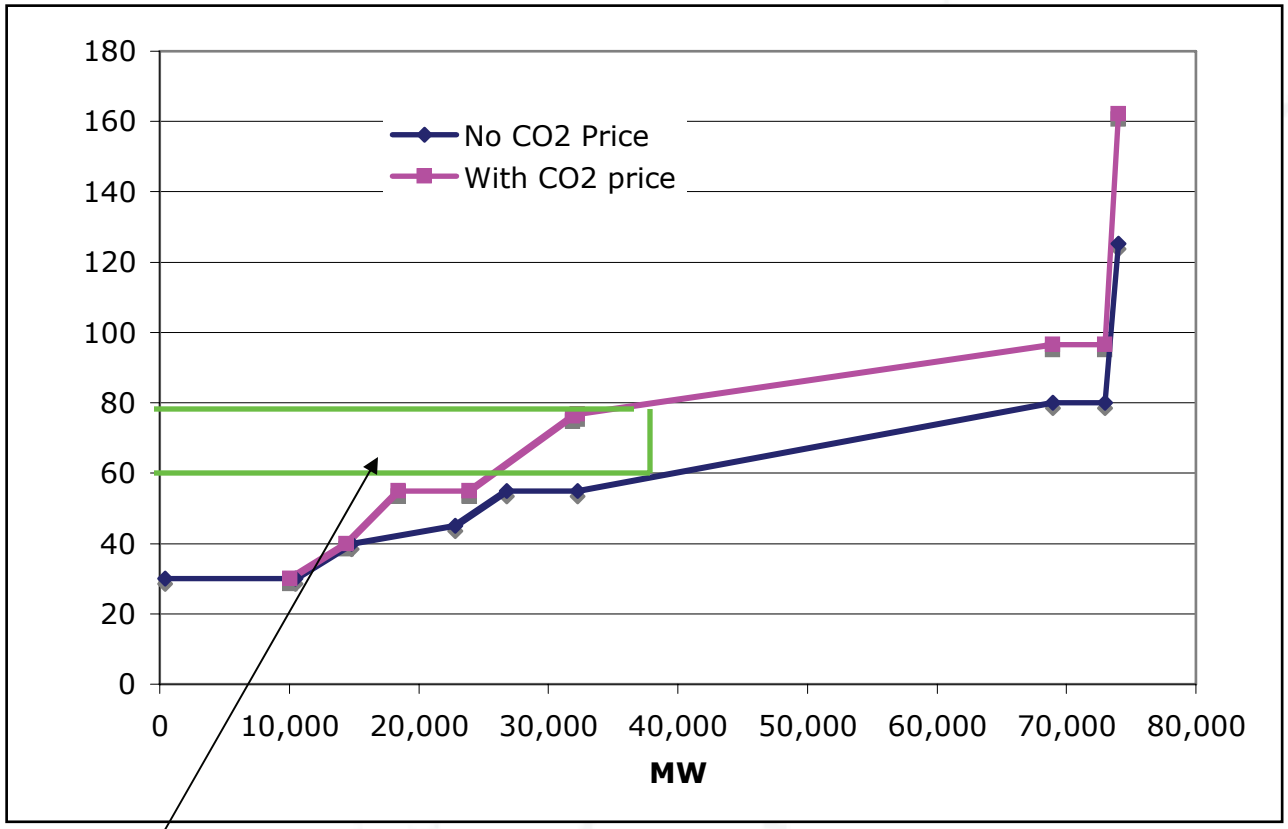
CO2 reduction “cost” = 10 million tons/year x $30/ton = $0.3 billion/year

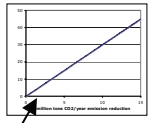
Simplified Electricity Market Supply Curve



Electricity price effect = $18/MWh x 34,000 MW x 8760 hours/year = $5.4 billion/year

Relative Market Scale





Electricity market price effect is an order of magnitude larger than carbon reduction cost.

Key Drivers of Cost Results

- With load side cap customers pay just for carbon emission reductions, but avoid the across-the-board increase in wholesale market prices for electricity ($5.5 billion for our sample year calculation)
- Why? Difference between system marginal and average emission rate
- Why? Carbon market is big, but electricity market is bigger!
  - Less “inframarginal rent” or “windfall” paid to low-emitting producers
- In the short run, the measures to reduce electric system CO2 emissions are limited and expensive (shifting dispatch mix)
- Analogy: RPS does not drive up the cost of coal, gas, nuclear – consumers just pay for the renewables

Questions, Comments, and Extensions

- Download the excel workbook:
  www.synapse-energy.com
- Let me know what you think:
  bbiewald@synapse-energy.com
- Please share improvements and extensions to the model.

