Electricity & Natural Gas GHG Modeling

Results and Sensitivities

May 6th, 2008

Energy and Environmental Economics, Inc.

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Agenda

- 10 am – 12:30 pm
  - Key results and sensitivities
- Lunch: 12:30 – 1:30
- 1:30 – 2:30
  - Revised allocation scenarios
- 2:45 – 5pm
  - Webex: tutorial in using the GHG Calculator to create user-defined scenarios

Presentation Overview

- Background
- Model Overview and Key Results
- Benchmarking: why the tool works for its purpose
- Cost and Rate Impacts of Regulatory Policies
- Sensitivity Analysis
- Cost and Rate Impacts of CO2 Market: Allocation Scenarios
- GHG Calculator Walk-Through (Web-Ex)

Next Steps: Process

- Final model posted for comments
  - May 10th
- Comments on GHG Docket including Stage 2 model
  - May 27th
- Reply Comments on GHG Docket including Stage 2 model
  - June 10th

CPUC, CEC, ARB Project Team

- Energy and Environmental Economics, Inc.
  - Prime, Development of the non-proprietary tool, Integration, GHG Policy
- PLEXOS Solutions LLC
  - State-of-the-art production simulation model
- Schiller Associates, Steven Schiller Lead
  - Advisor on California GHG policy and energy efficiency
- Dr. Ben Hobbs, Johns Hopkins University
  - Academic advisor, World-renowned electricity simulation expert
- Dr. Yihsu Chen, UC Merced
  - Academic advisor, Emerging capability at UC Merced

Project Overview

- Joint CPUC, CEC, ARB effort to evaluate AB32 compliance options in California's electricity and natural gas sectors
- Model estimates the cost and rate impact of multiple scenarios relative to reference case
- Project timeline designed to fit into 2008 Scoping Plan process for AB32
- Deliverables
  - Non-proprietary, transparent, spreadsheet-based model using publicly available data
  - Report on results and sensitivities / scenarios
  - Stakeholder process leading to CPUC/CEC proposed decision
  - Model output to be used as an input to the ARB

Stage 1 Key Qs

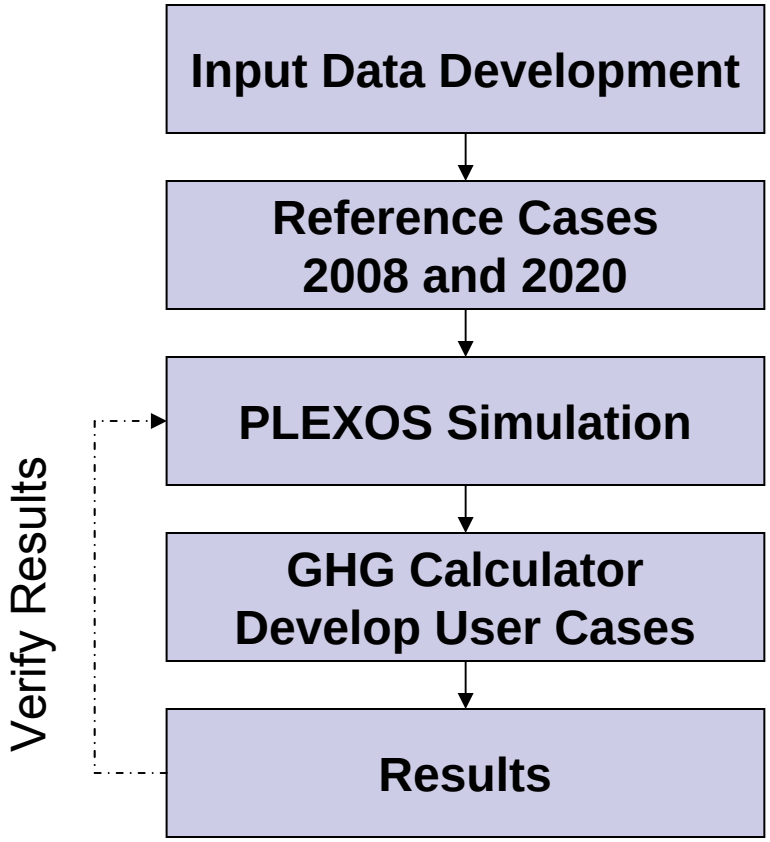
- How much will various policy options reduce CO2 emissions?
- How will these policy options affect electricity rates?
- *Underlying question: At what electricity sector target level do incremental improvements get expensive?*

Stage 2 Key Qs

- What is the cost to the electricity sector of complying with AB32 under different policy options for California?
- What is the cost to different LSEs and their customers of these options?
- *Underlying question: What option has the best combination of cost and fairness?*

Model Overview and Key Results

GHG Model Analysis Approach



EE & RE Supply, Costs, Load Forecasts

Loads & Resources for 2020
Reference Case: 20% RPS/BAU EE

WECC-wide Simulation
Summary Dispatch, Costs, Emissions

Select resources to add or remove from reference case, select among CO2 market policy choices

Δ Reference and User Case Emissions, Rates, and Costs

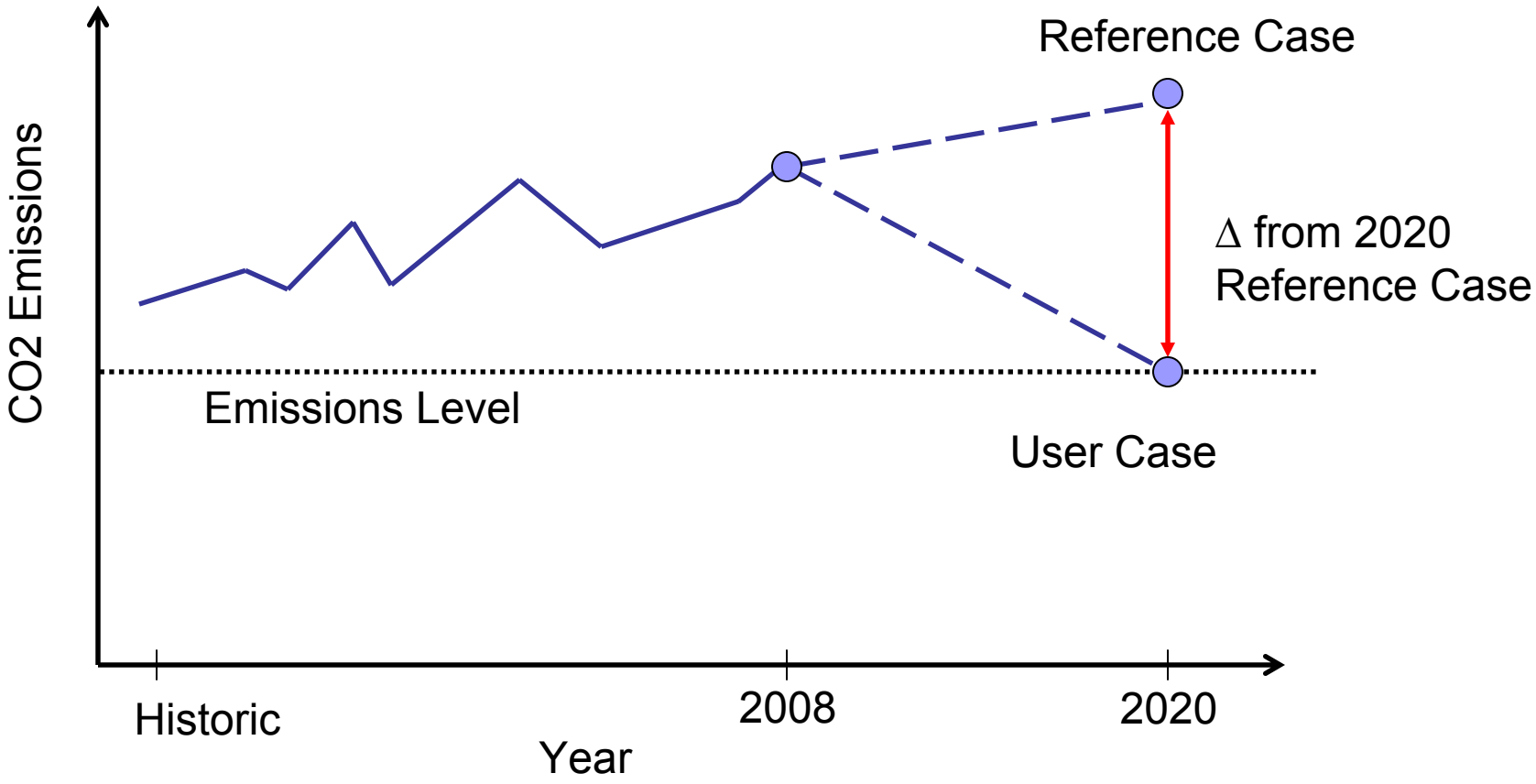
GHG Modeling Technology Cost Assumptions

- Applies current technology cost assumptions
  - Does not project technology transformation or new technology development
- Physical costs, not market costs
  - Cost of new projects return on investment is just enough to provide equity return rates necessary for investment
  - Market price of energy set at variable costs of marginal unit

Building the Reference Case

- Forecast energy and loads to 2020 for all WECC Zones
- Adjust California load forecast for EE and distributed resources
  - Estimate embedded EE, behind-the-meter PV, CHP in California load forecast
  - Modify California load forecast for 5% demand response
- Add lowest cost renewable mix to hit RPS requirement
  - For all regions outside of California
  - To meet 20% RPS in California
- Add / subtract conventional resources to maintain existing reserve margins in each WECC zone
  - Add CCGT to balance energy
  - Add CT to balance capacity

Measuring CO2 Change from Reference to User Cases



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Inputs: 2020 Reference Case vs. 33%RPS/High goals EE*

Inputs	Reference Case	33% RPS/High goals EE*
Energy Efficiency (EE)	Assume 16,450 GWh EE embedded in CEC load forecast	'High goals' EE scenario based on CPUC Goals Update Study & POU AB 2021 filings: 36,559 GWh
Rooftop solar PV	847 MW nameplate of rooftop PV installed	3,000 MW nameplate of rooftop PV installed
Demand Response	5% demand response	5% of demand response
Combined heat and power (CHP)	292 MW nameplate behind-the-meter CHP No new large (>5MW) CHP	1,574 MW nameplate small CHP (< 5 MW) 2,804 MW nameplate larger CHP (>5 MW)
Renewable Energy	20% RPS (6,733 MW)	33% RPS (12,544 MW)

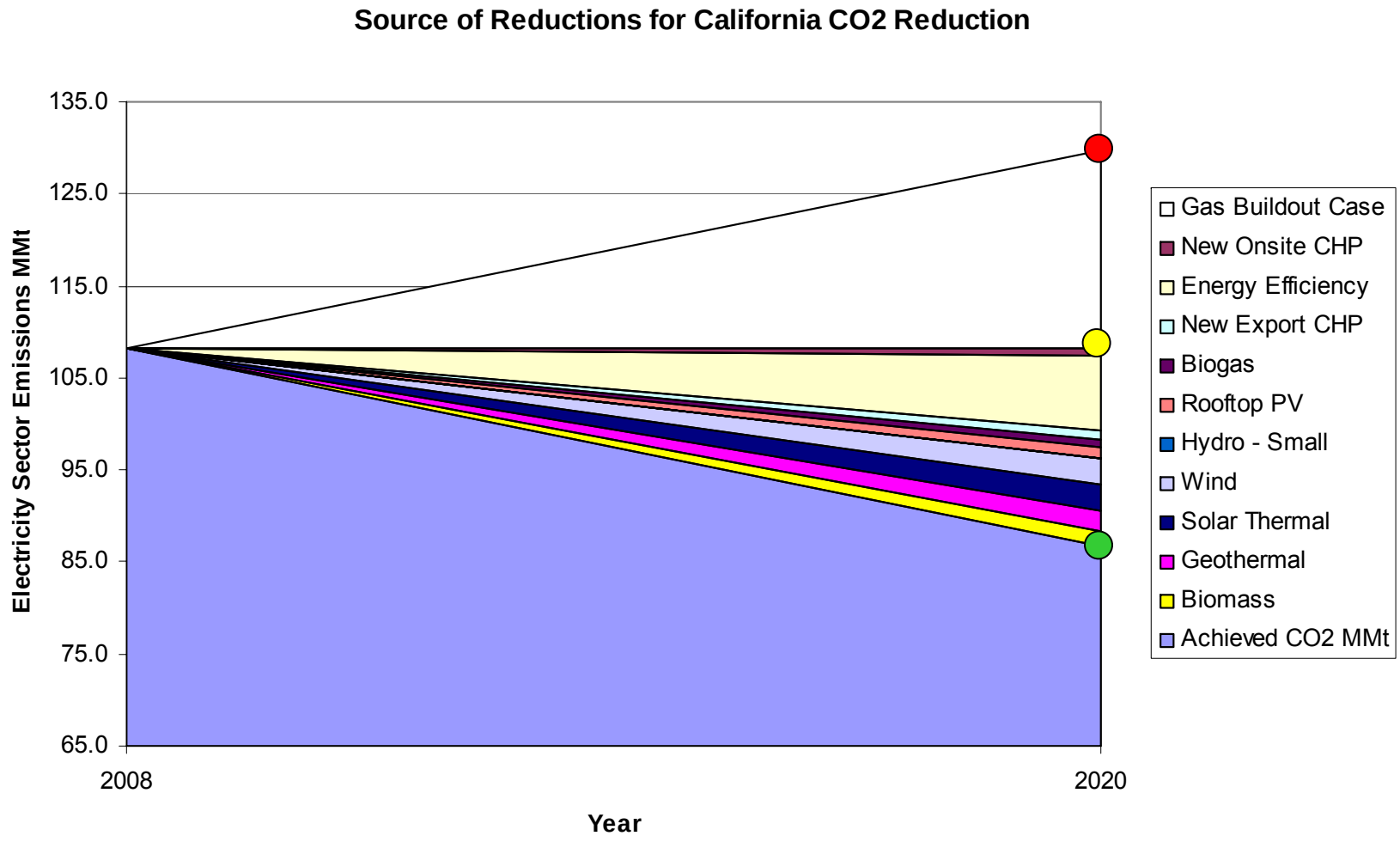
*33%RPS/High goals EE formerly called 'Aggressive Policy Case'

Results: 2020 Reference Case vs. 33%RPS/High goals EE*

Results	Reference Case	33% RPS/High goals EE*
2020 Emissions	108.2 MMTCO2e	78.6 MMT CO2e
% Δ in Utility Cost & Rates from 2008	Δ 2008 = 13%	Δ 2008 = 28%
% Δ in Rates from 2020 Reference Case	N/A	Δ 2020 Ref. = 13%
% Δ in Cost from 2020 Reference Case	N/A	Δ 2008 Ref. = -3%
2020 Average Rate	$0.149/kWh	$0.169/kWh
2020 Utility Cost	$47.6 billion/yr	$46.2 billion/yr
2020 Customer Cost	$1.2 billion/yr	$6.7 billion/yr
2020 Total: Customer & Utility Cost	$48.8 billion/yr	$52.8 billion/yr

*33%RPS/High goals EE formerly called 'Aggressive Policy Case'

CO2 Savings for Reference Case and 33%RPS/High EE goals Case



Gas Build-out Reference Case 33%RPS/High goals EE

Net of CO2 Reductions

- Comparison of Reference Case & 33%RPS/High EE Goals Cases

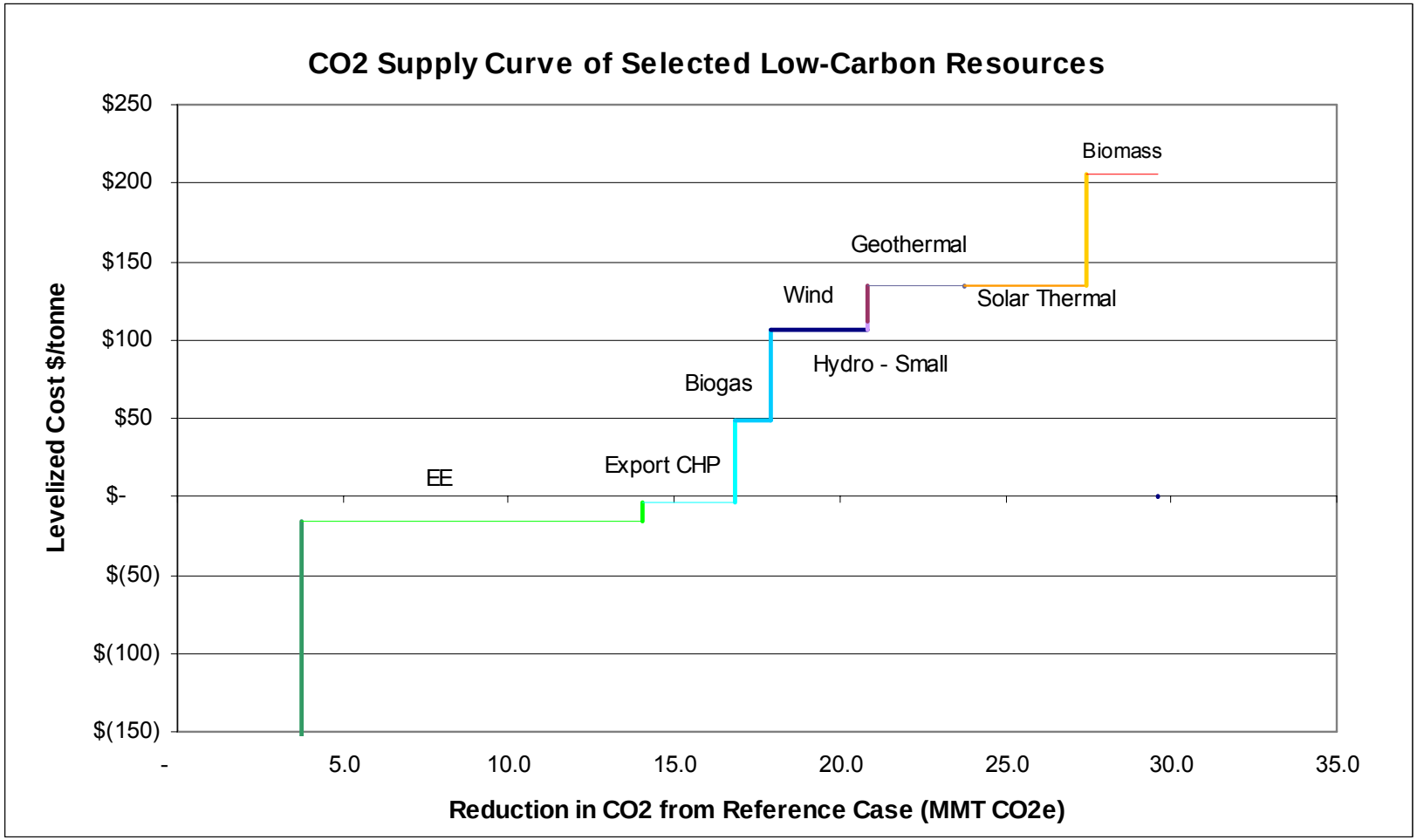
Summary of Costs of Reference Case ($/Tonne CO2e)

	Utility	Consumer	Total	MMt CO2e
Energy Efficiency	$ (140)	$ 42	$ (98)	8.2
Renewables	$ 79	$ -	$ 79	12.4
CSI	$ (25)	$ 837	$ 812	0.5
CHP	$ -	$ -	$ -	-
Weighted Average	$ (9)	$ 38	$ 29	21.1

Summary of Costs of High EE / 33% RPS ($/Tonne CO2e)

	Utility	Consumer	Total	MMt CO2e
Energy Efficiency	$ (16)	$ 78	$ 63	10.2
Renewables	$ 133	$ -	$ 133	12.8
CSI	$ (106)	$ 1,007	$ 902	1.7
CHP	$ (158)	$ 161	$ 4	4.9
Weighted Average	$ 20	$ 111	$ 131	29.6

Net Utility CO2 Cost of Resources:
33%RPS/High EE Goals Case



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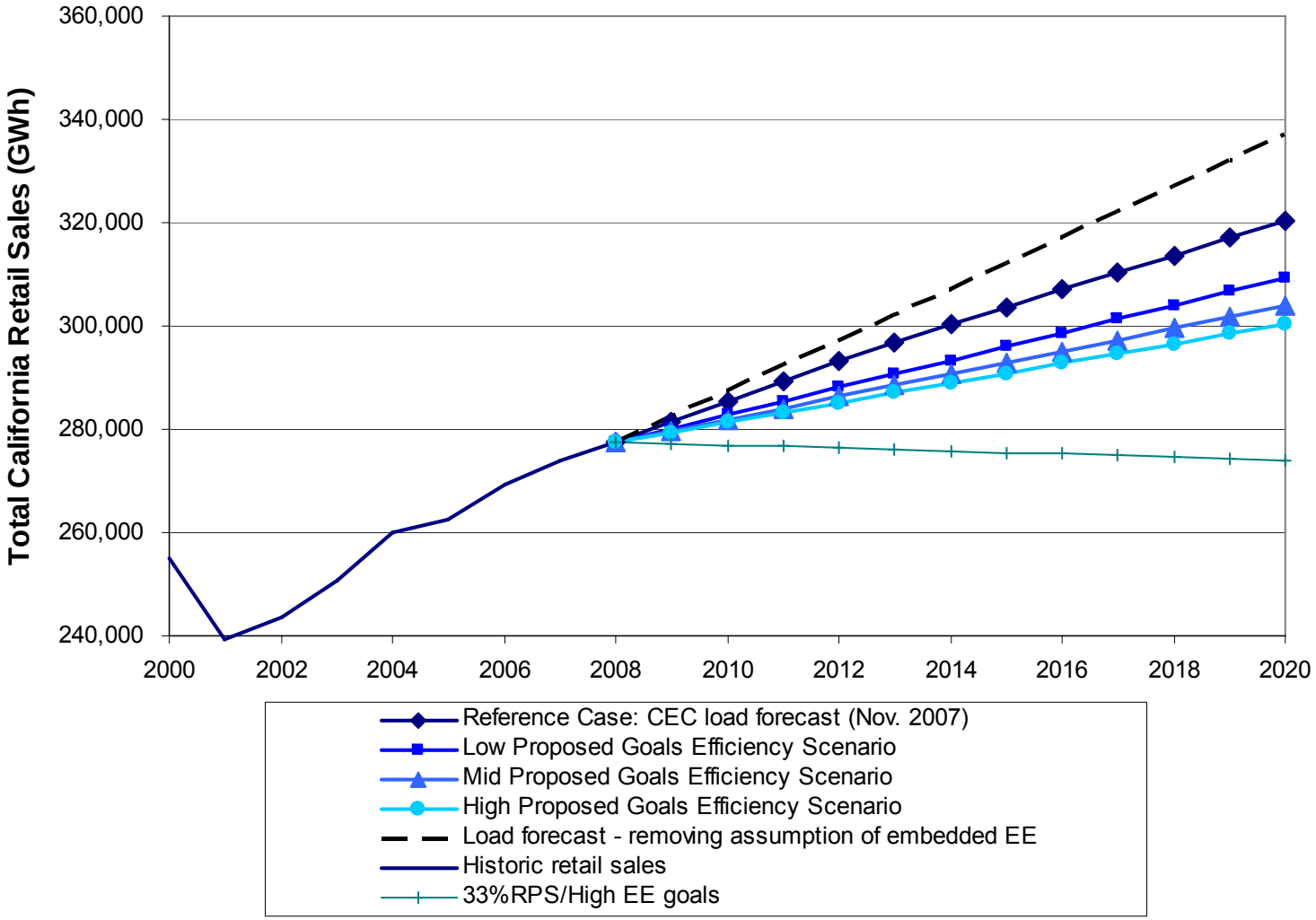
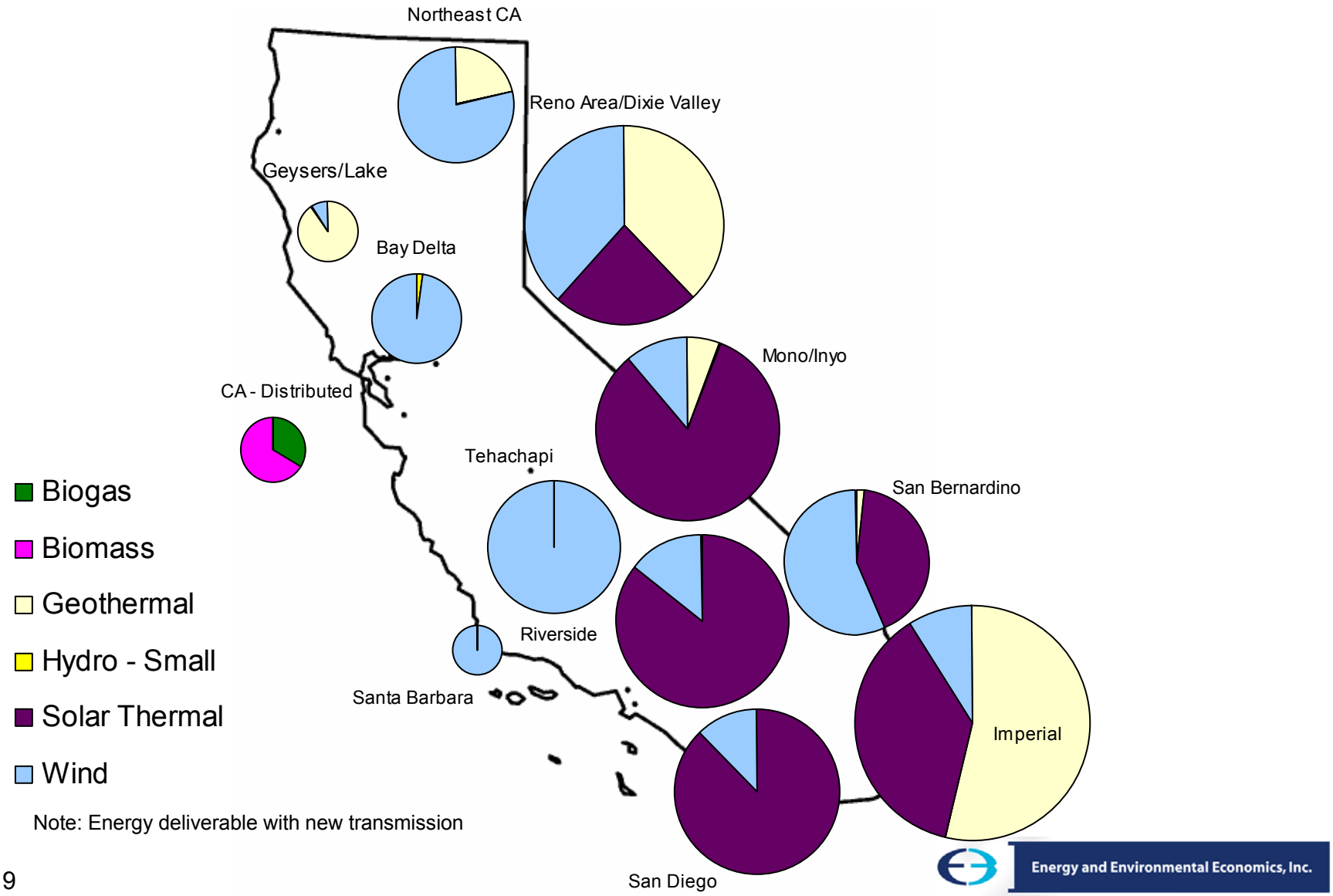
Energy Efficiency Scenario Impacts on California Load Growth



Note: 1990 – 2000 average annual CA retail sales growth rate: ~1.5%

CA Renewable Resource Zones



Note: Energy deliverable with new transmission

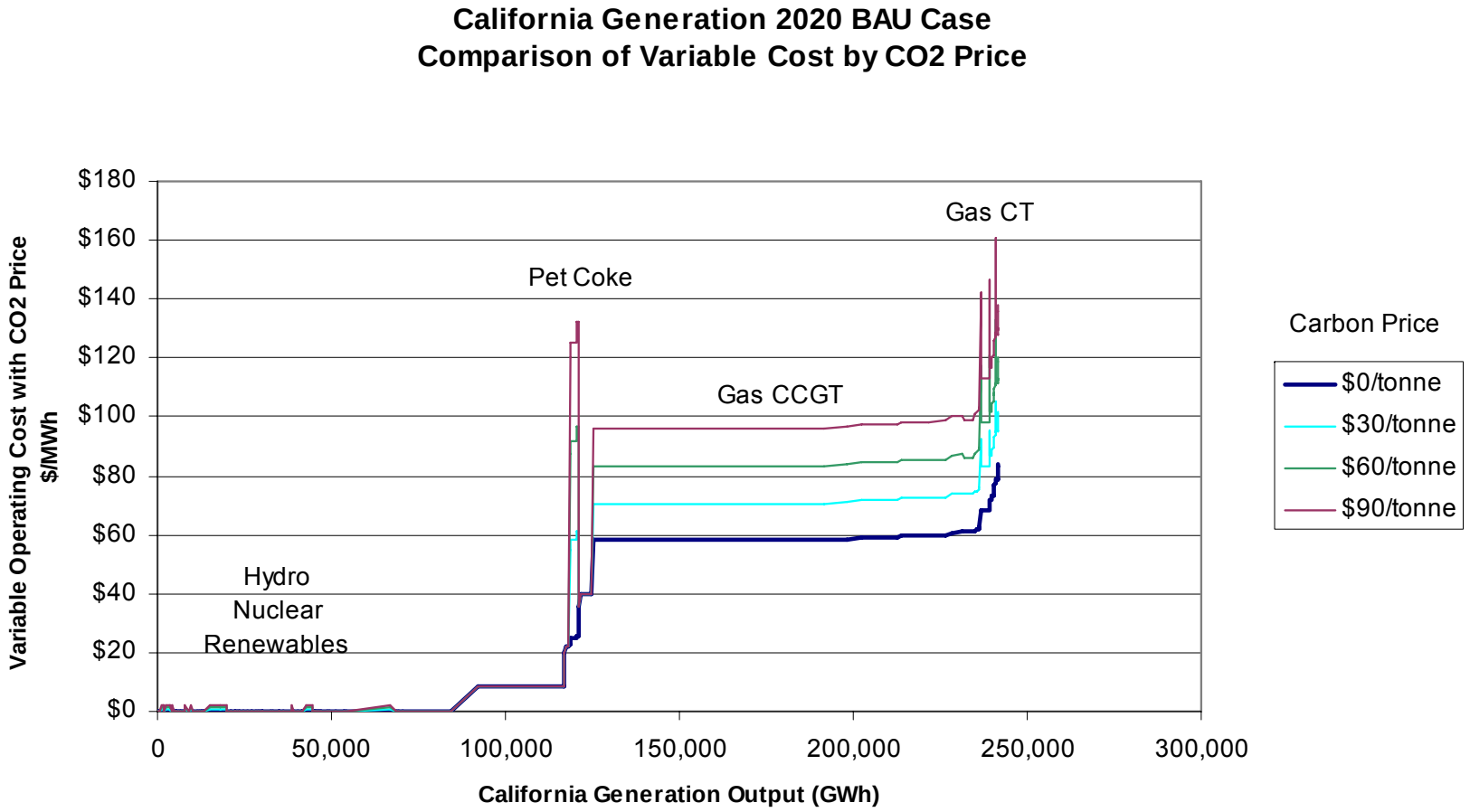
CO2 Cap and Trade Framework

- Energy deliverer, multi-sector cap and trade
- California-only carbon price
- Hybrid model structure (regulation & market)
  - CO2 market
    - Input market clearing price of GHG emission permits
      - No 'electricity-sector' emissions cap, just multi-sector
      - Electricity sector is assumed to be a 'price-taker' for emission permits
    - Adjust allocation, auction and offsets controls
  - Regulatory requirements
    - Input LSE policy requirements (RPS, EE)
- **Model does NOT determine the CO2 market price!**

Impacts of a California-only GHG Market on the Electricity Sector

	Results
Change in operation of existing CA plants - Cost of CO2 could change the relative economics of plant dispatch	No – CA plants are dispatched in emissions order already
Reduction of emissions intensity of imports - Increase in low-carbon specified imports and/or reduction in high-carbon specified imports	Yes – with risk of shuffling. Out-of-state coal imports become uneconomic ~$60/tonne CO2
New capital investment - Cost of CO2 could make all-in costs of low-carbon resources less expensive than fossil-fuel resources	No – Not at existing technology & gas cost and CO2 price below ~$100/t CO2
Technology innovation (not directly modeled) - A higher market price for power and a CO2 price could drive new technology innovation, resulting in new sources of emission reductions	? – Lots of clean technology investment could spur big changes
Distributional impacts - Distributional impacts due to emission allocation policy choices and impacts due to impact of CO2 market on electricity prices	Yes – there are winners and losers Discussion on allocation later

Operational changes of CA generation with carbon prices



CO2 price does not change the economic dispatch order in California (much)

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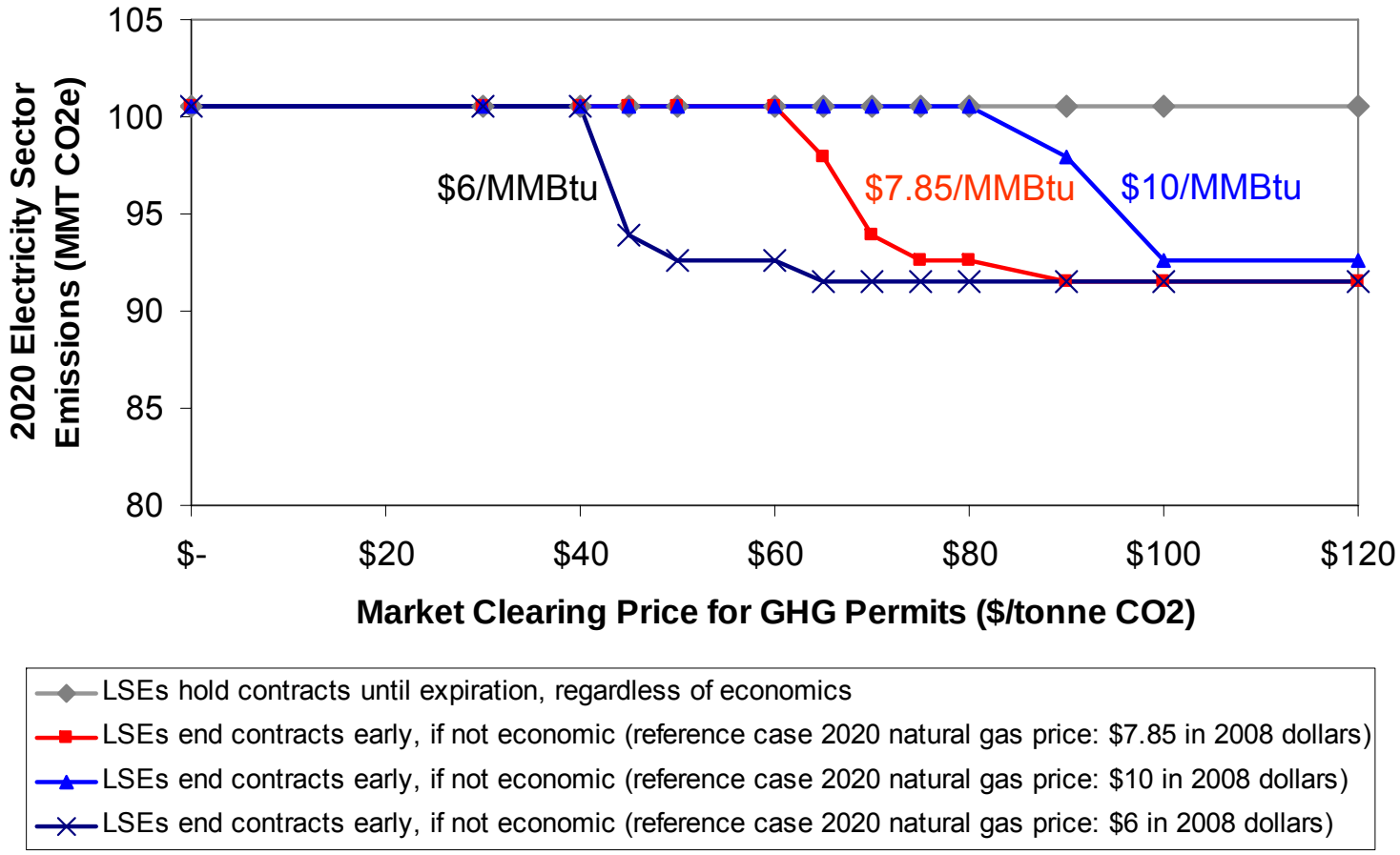
Change in imports of out-of-state fossil generation with different natural gas and carbon prices



Scenario: 20% RPS, 'Mid goals' of EE

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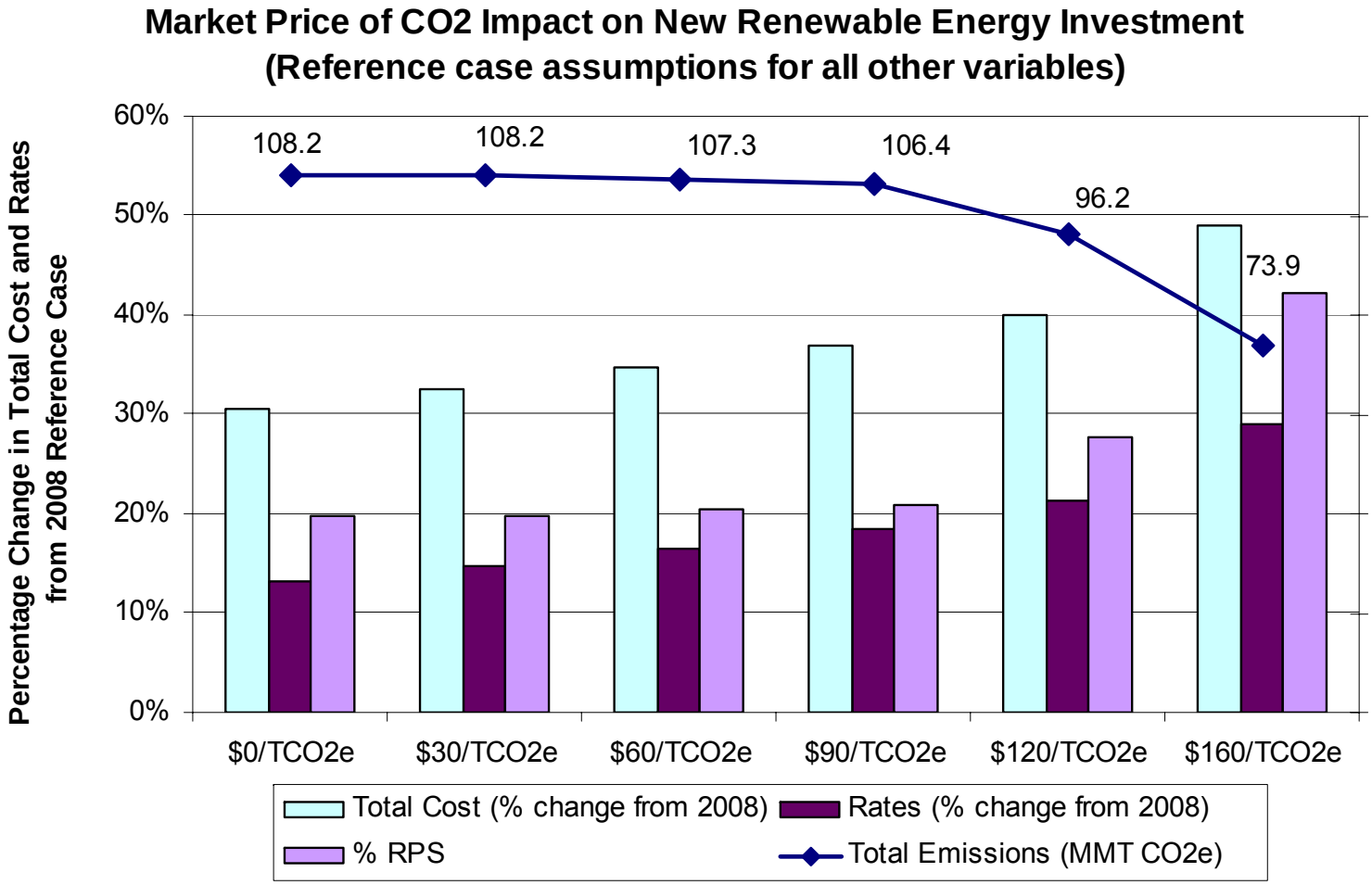
In-State Renewable Investment



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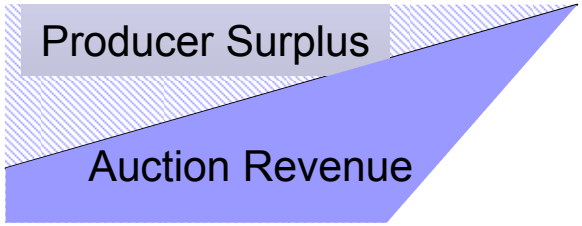
Profits for Clean Generation through Electricity Market Clearing Price (MCP)

- MCP with CO2 leads to increased profits for producers and importers with low carbon generation
- At $30/t CO2: State pays approximately $700 million to producers due to higher market clearing price for power
- Assumes utility-owned generation and long-term contracts do not capture the windfall since they are compensated at cost for CO2

~$700 M per year



Analysis affected significantly by contract assignment assumptions

Emissions Benchmarking

GHG Calculator is a Policy Tool

- Capability to model many different policy-level choices
- Should not be used for resource planning decisions!
- Requirements for reasonable accuracy for CO2 policy decisions
  - Reasonable statewide electricity sector emissions level
  - Approximately correct emissions intensity by LSE
  - Approximately correct generation or purchases from 3 categories of generators
    - Utility-owned generation by fuel type
    - Long term contracts
    - Imports
  - Approximately correct changes in above for different resource mixes

Key Drivers in Utility Cost and Rate Impacts to CO2 Policy Choices

- Existing revenue requirement
- Existing sales levels
- Utility-owned generation
- Existing long-term contracts (RPS, coal, other)
- Market purchases and imports to California

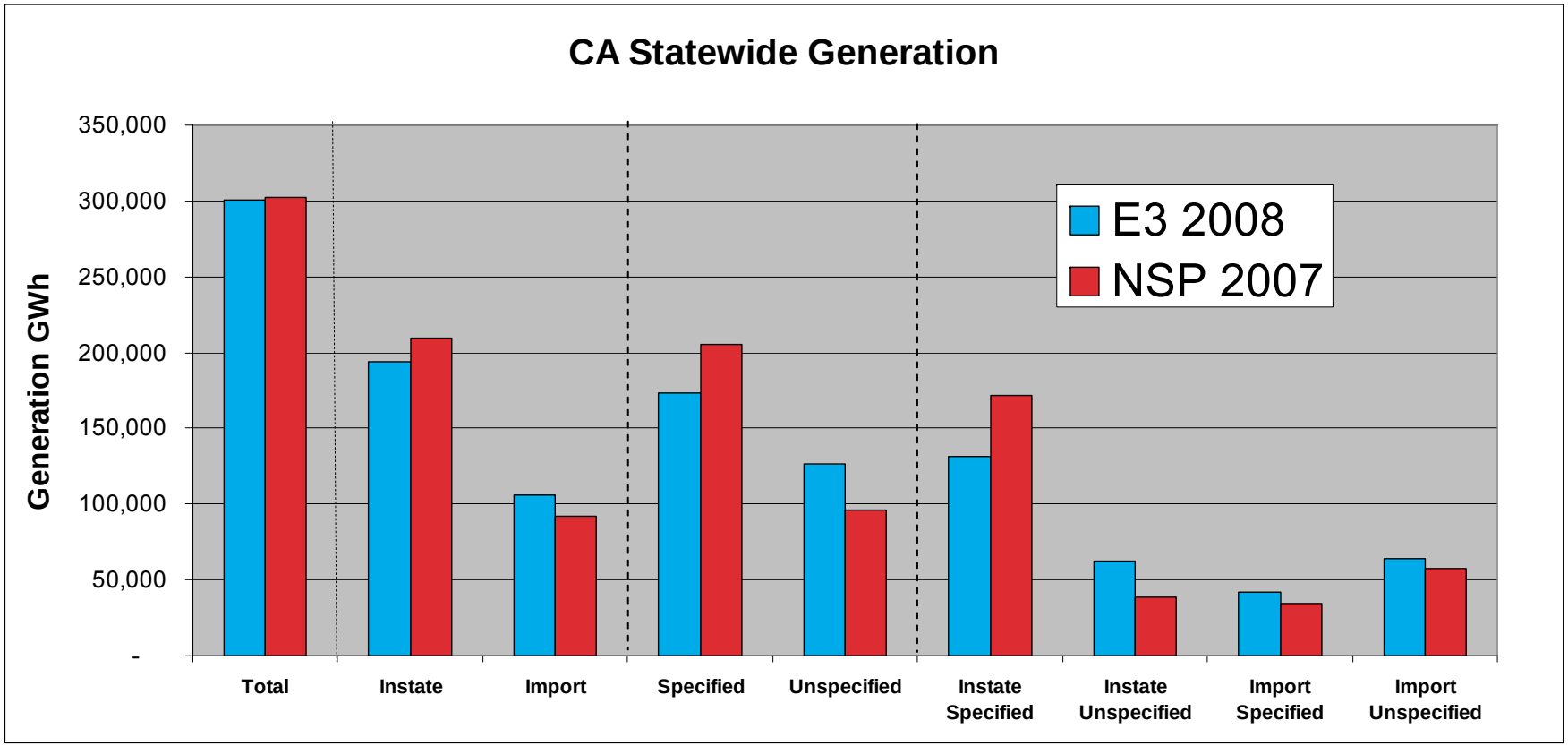
Significant changes in the last week

- Growth rates through 2020
- Allocation mechanisms/choices

Utility-owned Generation & Contracts

- Updated since the last workshop
  - Responses received from many parties:
    - SMUD, LADWP, SCPPA, Calpine, City of Redding, SDG&E, PG&E, SCE, PacifiCorp, Mountain Utilities
- Changes incorporated into results
  - Utility-owned generation assignment
  - Long term contracts for utility generation
  - Imports adjusted based on net requirements
- Retail providers suggested additional changes that were not incorporated into model, which could improve future versions of the TEPPC database
  - Heat rate, capacity, fuel type, missing and new generators

Benchmarking E3 Calculator Statewide Generation to Public Data



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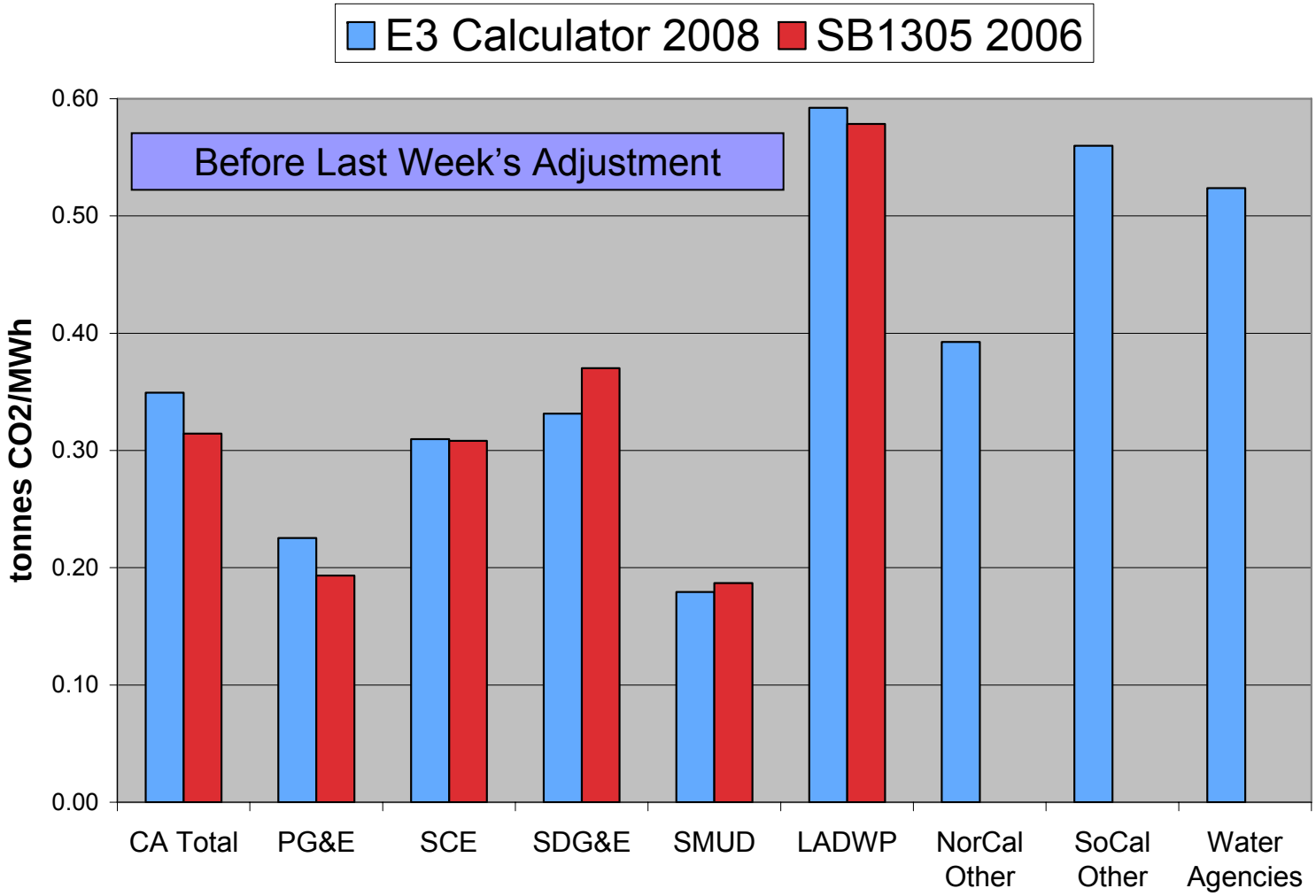
Benchmarking E3 Calculator Emissions Intensity to Public Data



SB1305 = Power Content Label Reporting to CEC

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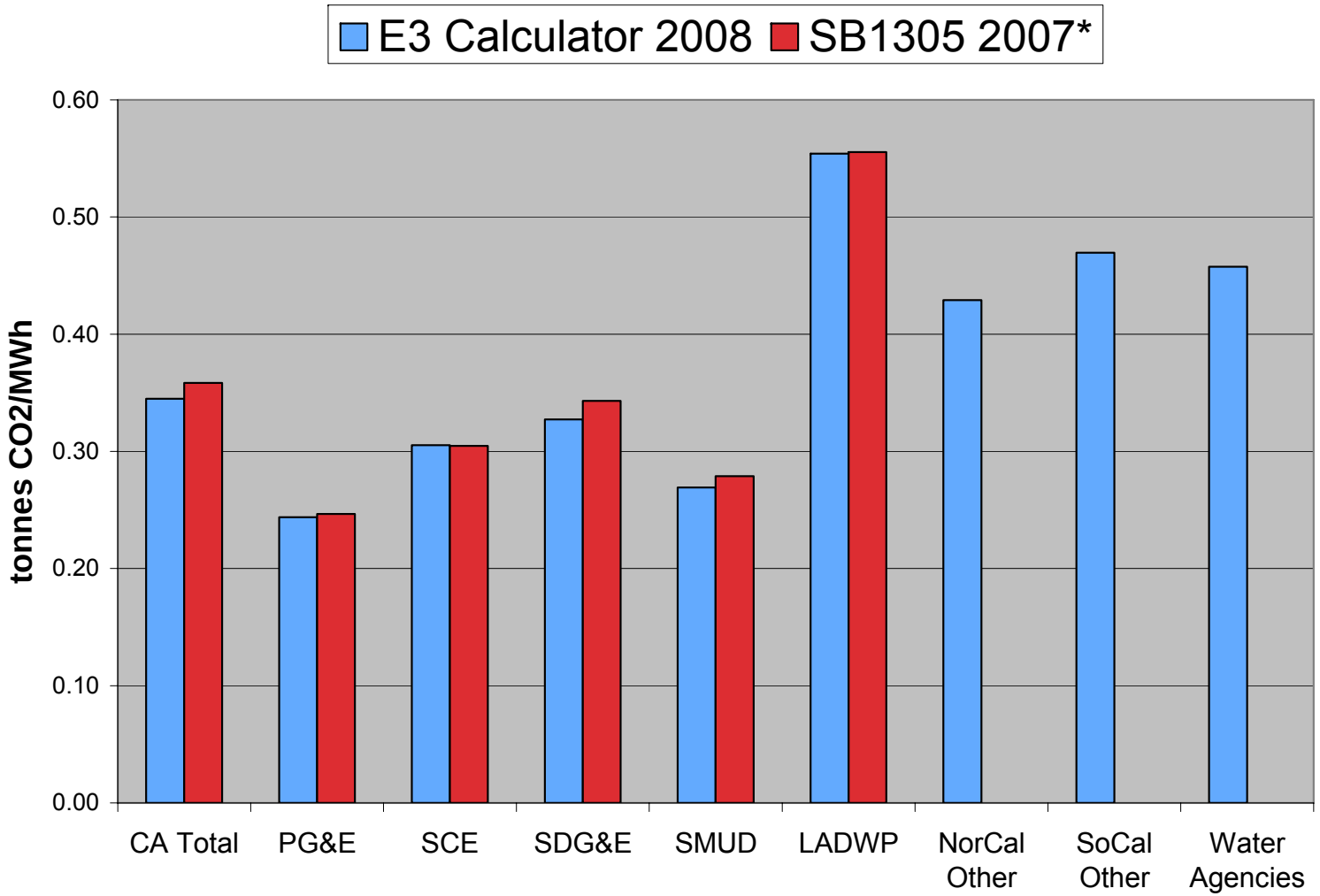
Benchmarking E3 Calculator Emissions Intensity to Public Data



*Normalized for average hydro year

SB1305 = Power Content Label Reporting to CEC

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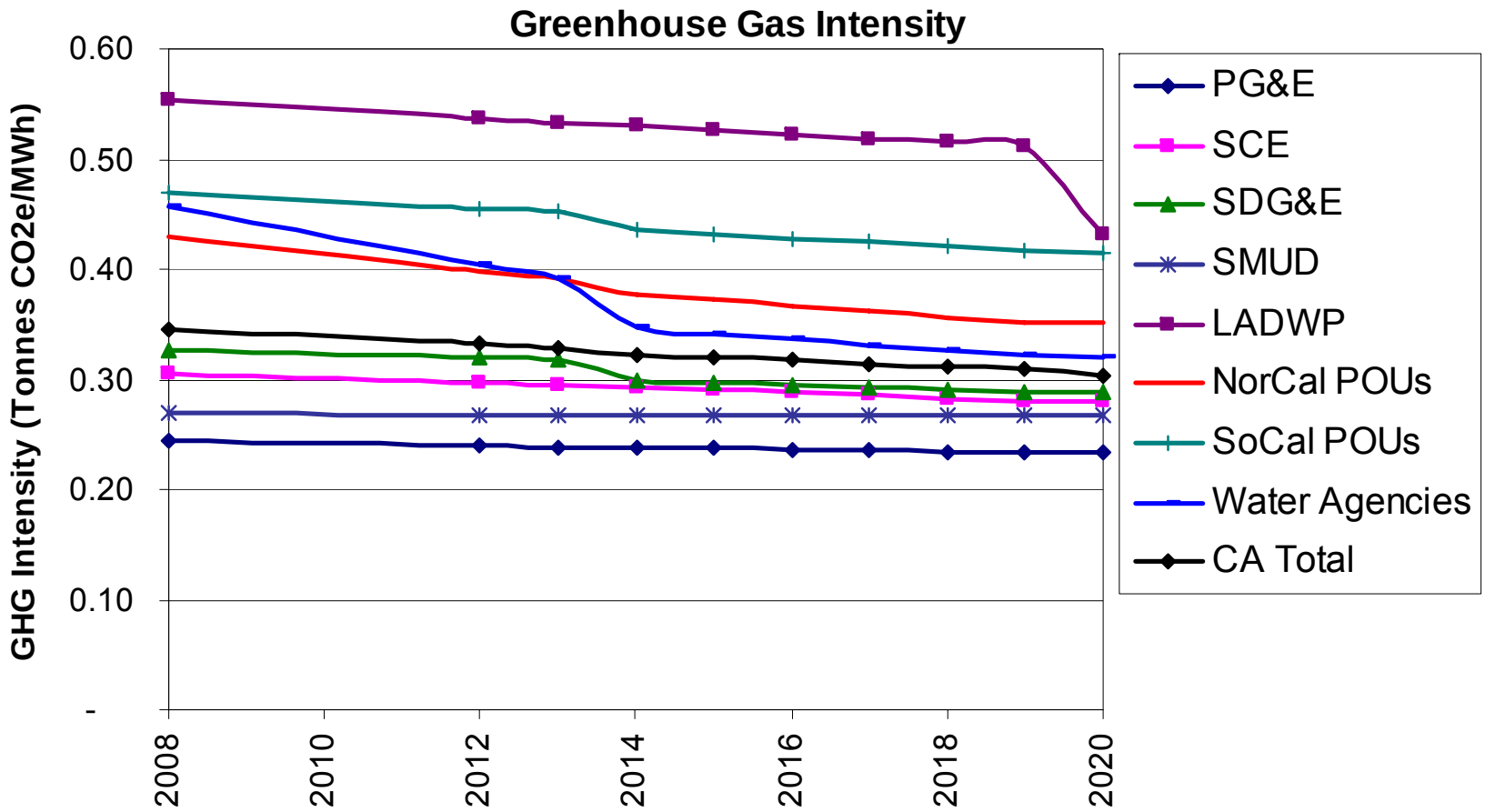
Emissions Intensity by Retail Provider



Scenario: 20% RPS, reference case energy efficiency, no carbon market

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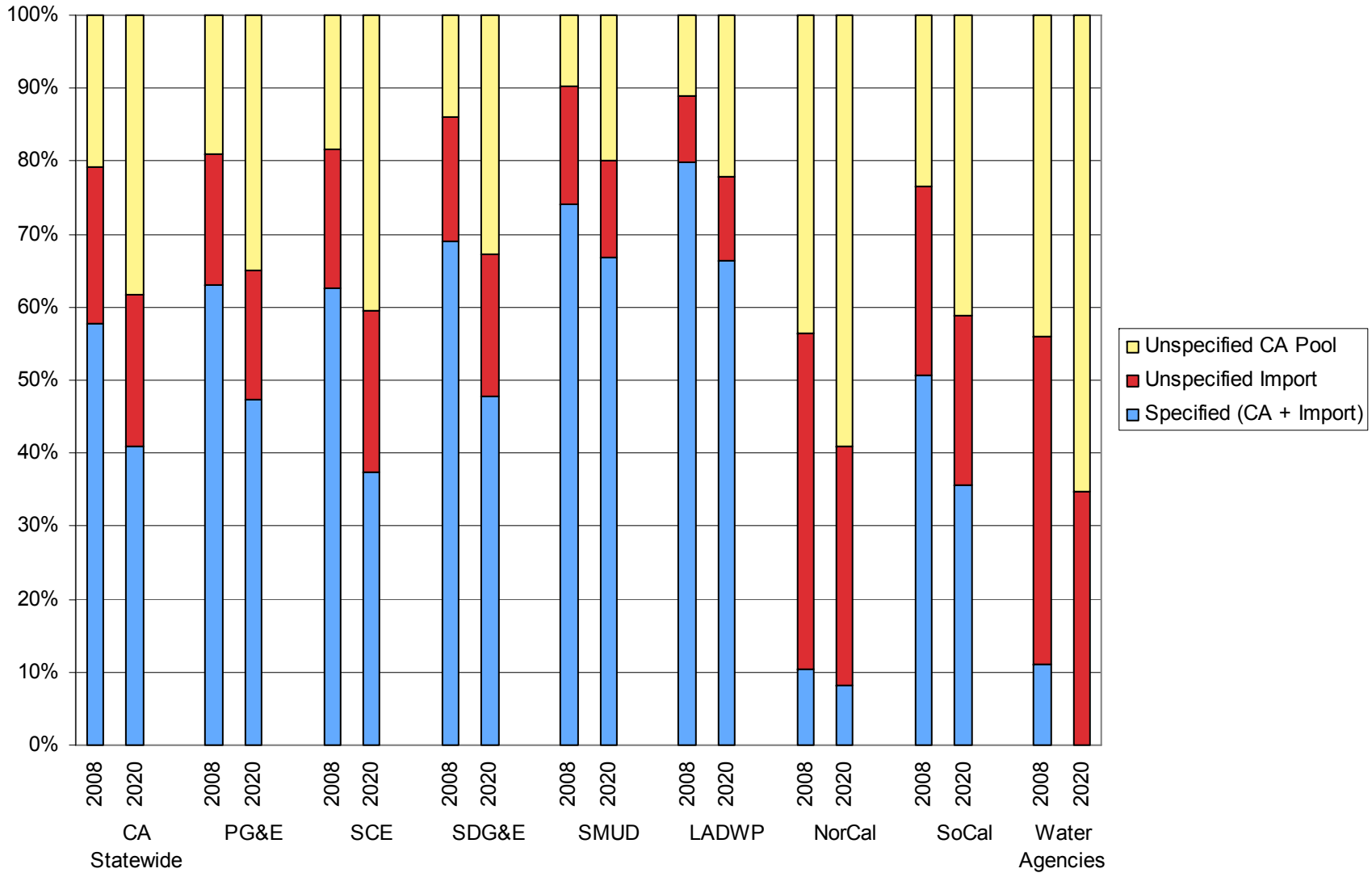
SB1305 Data Availability for NorCal, SoCal

6 Northern - Other		
	Alameda	PG&E Direct Access
	Biggs	Plumas-Sierra Rural Electric Cooperation
	Calaveras Public Power Agency	Port of Stockton
	Gridley	Power and Water Resource Purchasing Agency
	Healdsburg	Redding
	Lassen Municipal Utility District	Roseville
	Lodi	Shasta Dam Area Public Utility District
	Lompoc	Silicon Valley Power
	Merced Irrigation District	Tuolumne County Public Power Agency
	Modesto Irrigation District	Turlock Irrigation District
	Palo Alto	Ukiah
	Mountain Utilities	Pacificorp
	Trinity Public Utility District	Sierra Pacific Power Company
	Truckee-Donner Public Utility District	Surprise Valley Electrical Corporation
7 Southern - Other		
	Anaheim	Rancho Cucamonga
	Anza Electric Cooperative, Inc.	Riverside
	Azusa	SCE Direct access
	Banning	Valley Electric Association, Inc.
	Bear Valley Electric Service	Vernon
	Boulder City/Parker Davis	Victorville Municipal
	Colton	Needles
	Burbank	SDG&E Direct Access
	Glendale	Imperial Irrigation District
	Pasadena	

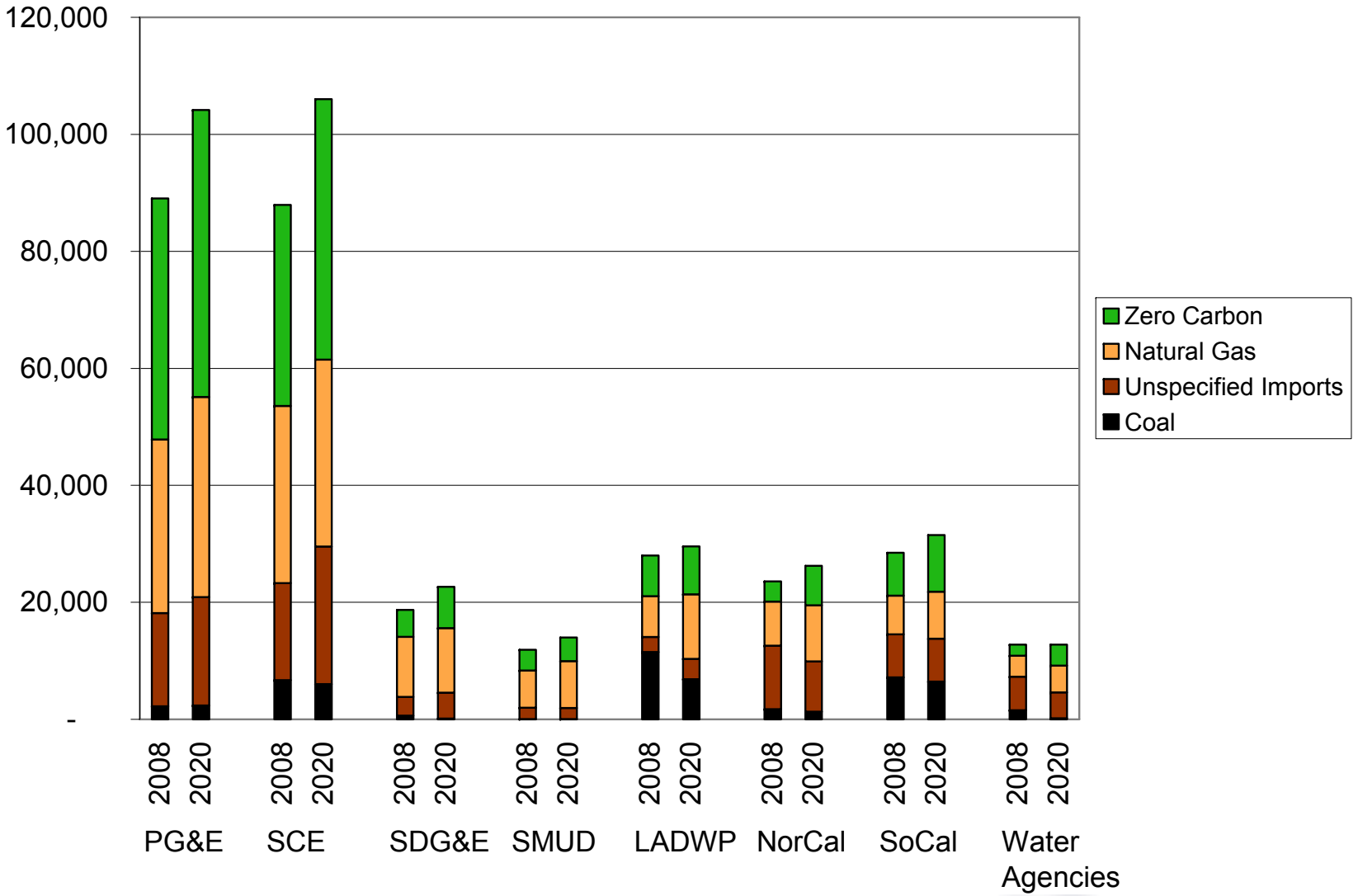
Highlighted LSEs data included in E3 dataset

SB1305 = Power Content Label Reporting to CEC

Generation Assignment Shares in 2008 and 2020 Reference Case by LSE



Resource Mix in 2008 and 2020 Ref. Case by LSE



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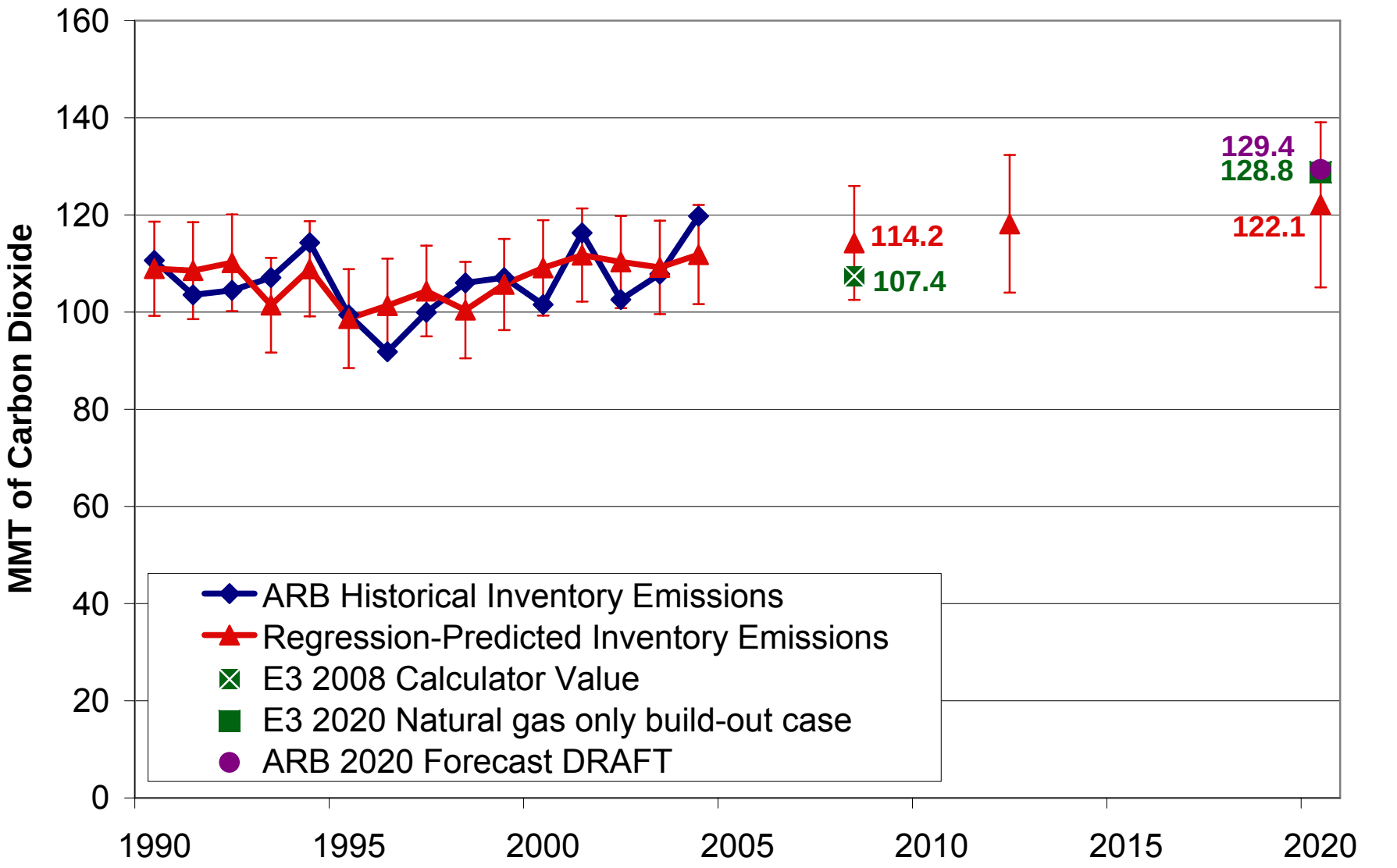
Benchmarking Total Electricity Sector Emissions



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Verification with PLEXOS

- Set up Test Case in both PLEXOS and the GHG Calculator to Verify Calculator Matches PLEXOS
- Comparison of Results Shows Close Match

Test Case is an extreme case

(stage 1 aggressive policy case)

•Very high EE

(168% of High Goals)

•High RPS

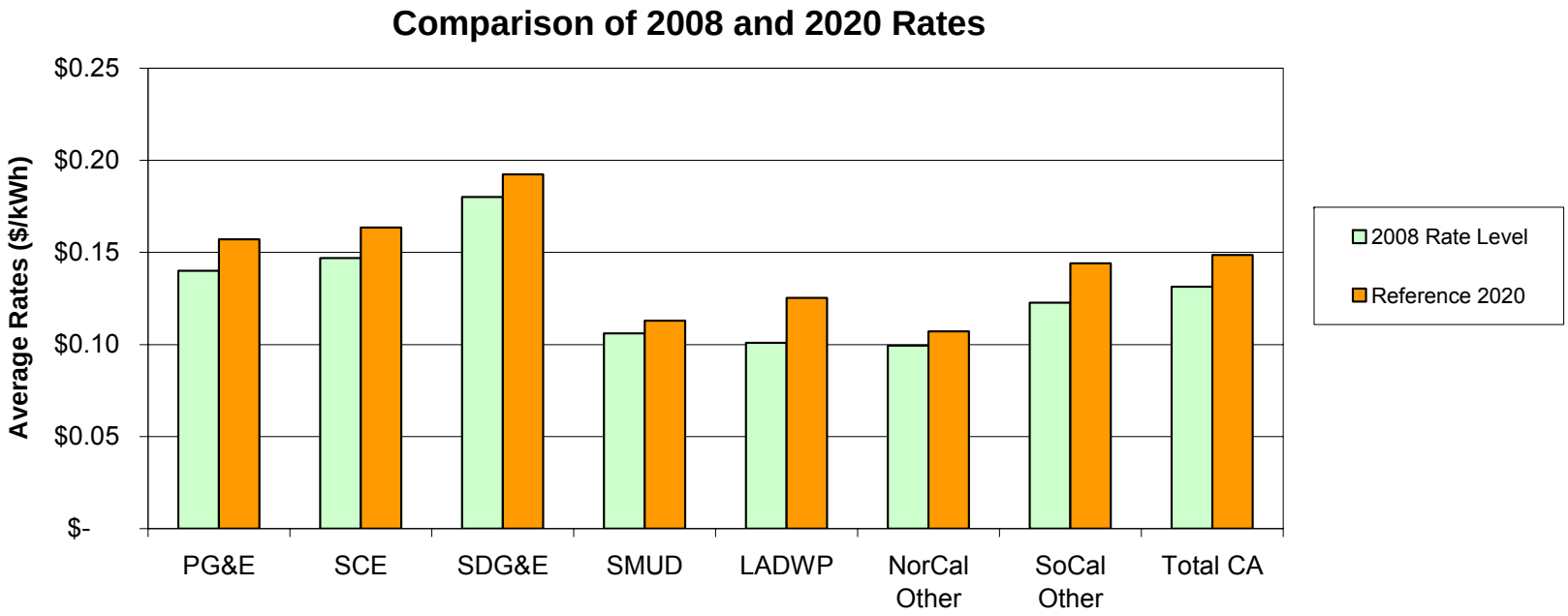
(33% statewide)

•No New CHP

	Business As Usual	PLEXOS TEST Case	Difference
PLEXOS Dispatch	431,810	401,641	30,169
Spreadsheet Dispatch	431,810	403,556	28,254
Hydro Adjustment	(2,196)	(2,196)	-
Onsite CHP	4,700	4,700	-
SF6	1,029	1,029	-
Export CHP	(340)	(340)	-
Total WECC	435,003	406,749	28,254
Total CA	107,033	78,779	28,254
Comparison of PLEXOS to Calculator		Difference (1000 tons)	1,915
		Difference % Savings	6%
		Difference % of CA	2%

Cost and Rate Impacts of Regulatory Policies

Rates Comparison:
2008 and 2020 Reference Case



Rate Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2008 to 2020 Ref. Case	12%	11%	7%	7%	24%	8%	17%	13%
2020 Ref. Case Rates ($/kWh)	$0.16	$0.16	$0.19	$0.11	$0.13	$0.11	$0.14	$0.15

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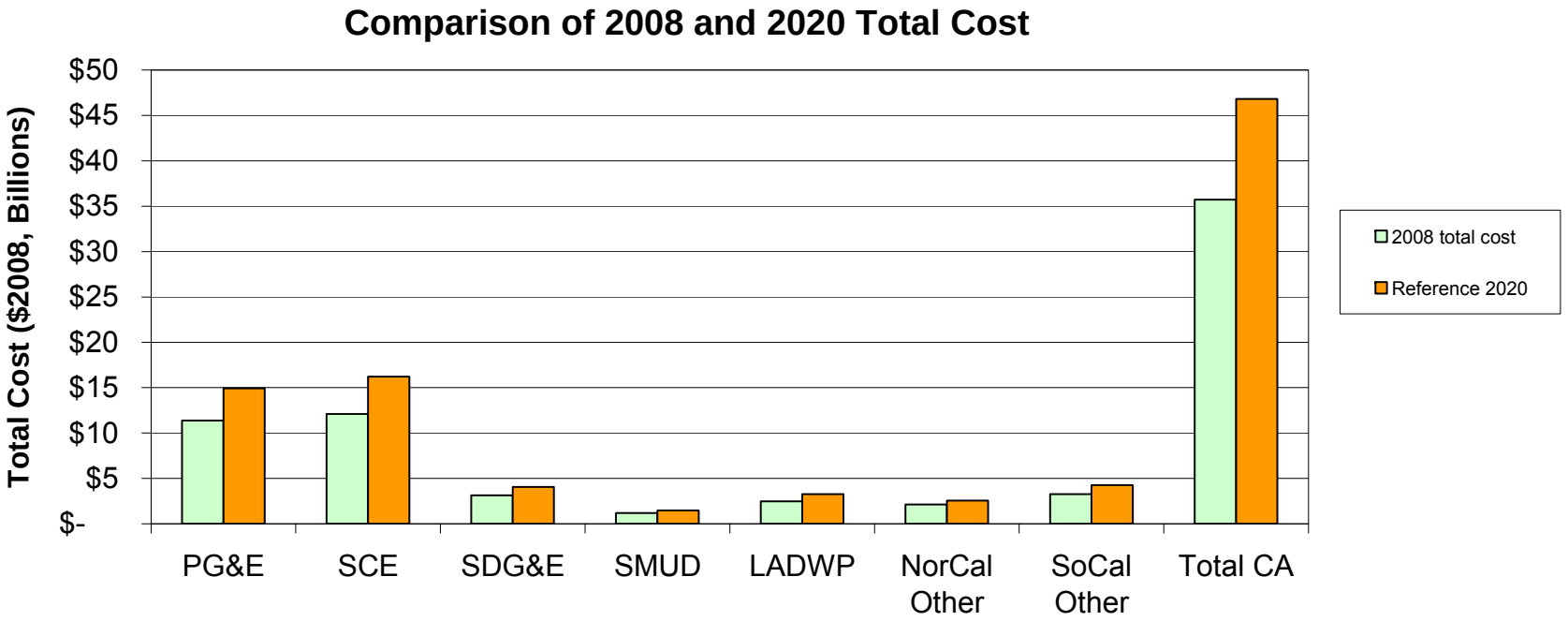
Utility Cost Comparison:
2008 and 2020 Reference Case



Total Cost Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2008 to 2020 Ref. Case	31%	34%	30%	25%	31%	20%	30%	31%
2020 Ref. Case Cost ($2008, billions)	$14.9	$16.2	$4.1	$1.5	$3.3	$2.6	$4.3	$46.8

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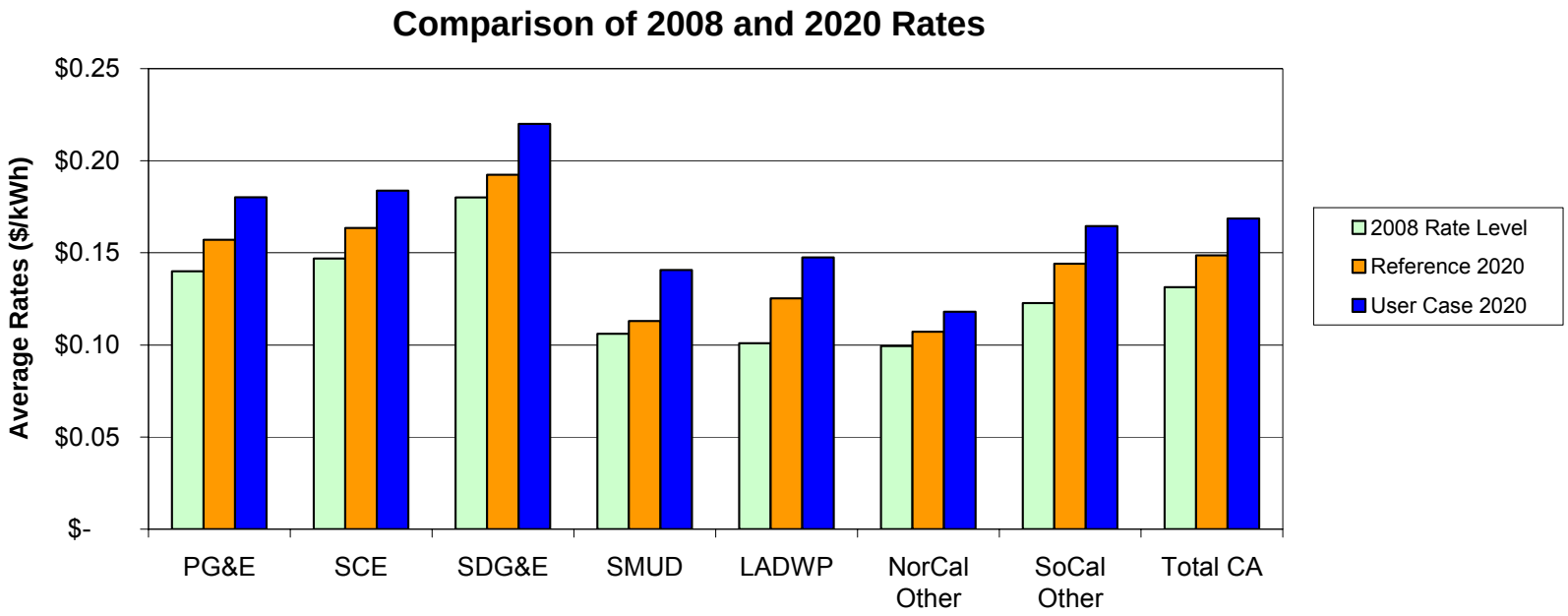
Rate Comparison:
Reference Case vs. 33%RPS/High EE Goals Case



Rate Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2020 Ref to 2020 User Case	14.7%	12.4%	14.4%	24.6%	17.7%	10.2%	14.2%	13.4%
Δ 2008 to 2020 User Case	28.7%	25.0%	22.3%	32.8%	46.1%	18.8%	34.1%	28.3%

Scenario: User Case = 33%RPS/High EE goals Scenario

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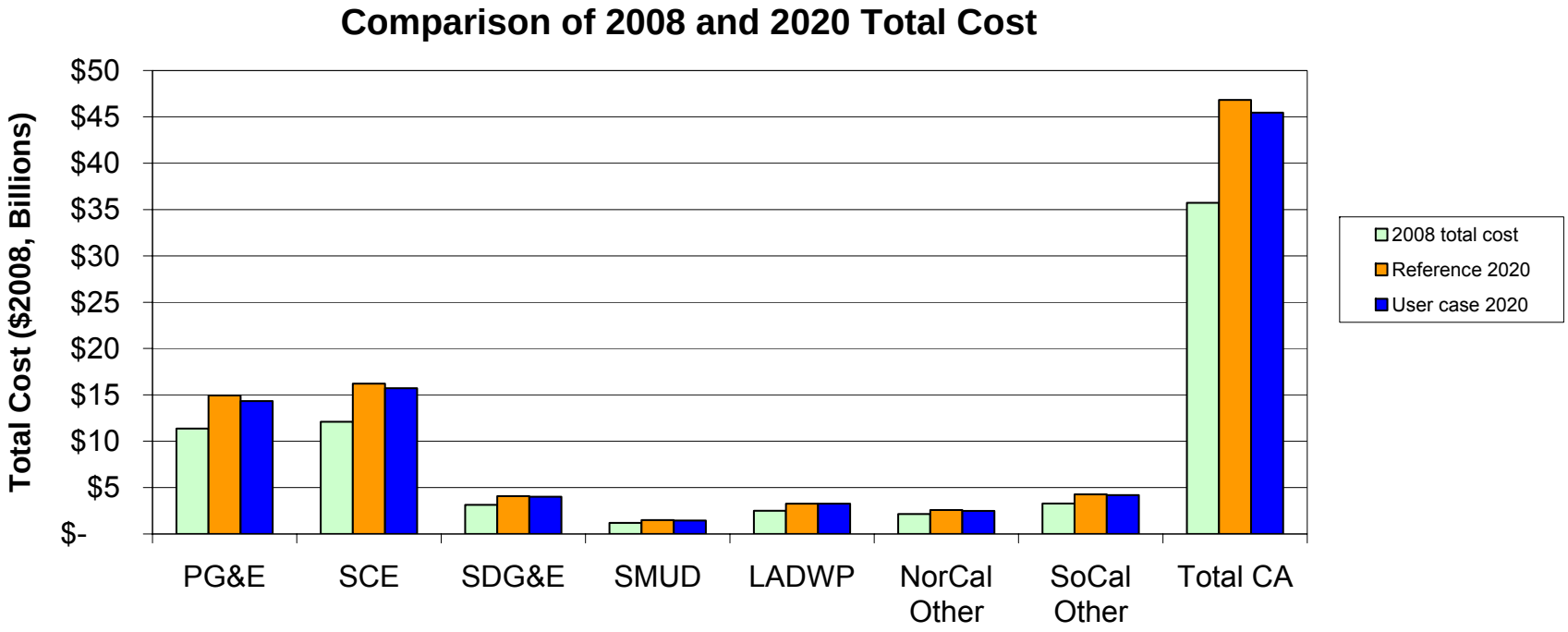
Cost Comparison:

Reference Case vs. 33% RPS/High EE Goals Case



Total Cost Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2020 Ref to 2020 User Case	-4.3%	-3.3%	-1.5%	-2.3%	0.1%	-3.2%	-1.5%	-3.0%
Δ 2008 to 2020 User Case	26%	30%	28%	23%	31%	16%	28%	27%

Scenario: User Case = 33%RPS/High EE goals Scenario

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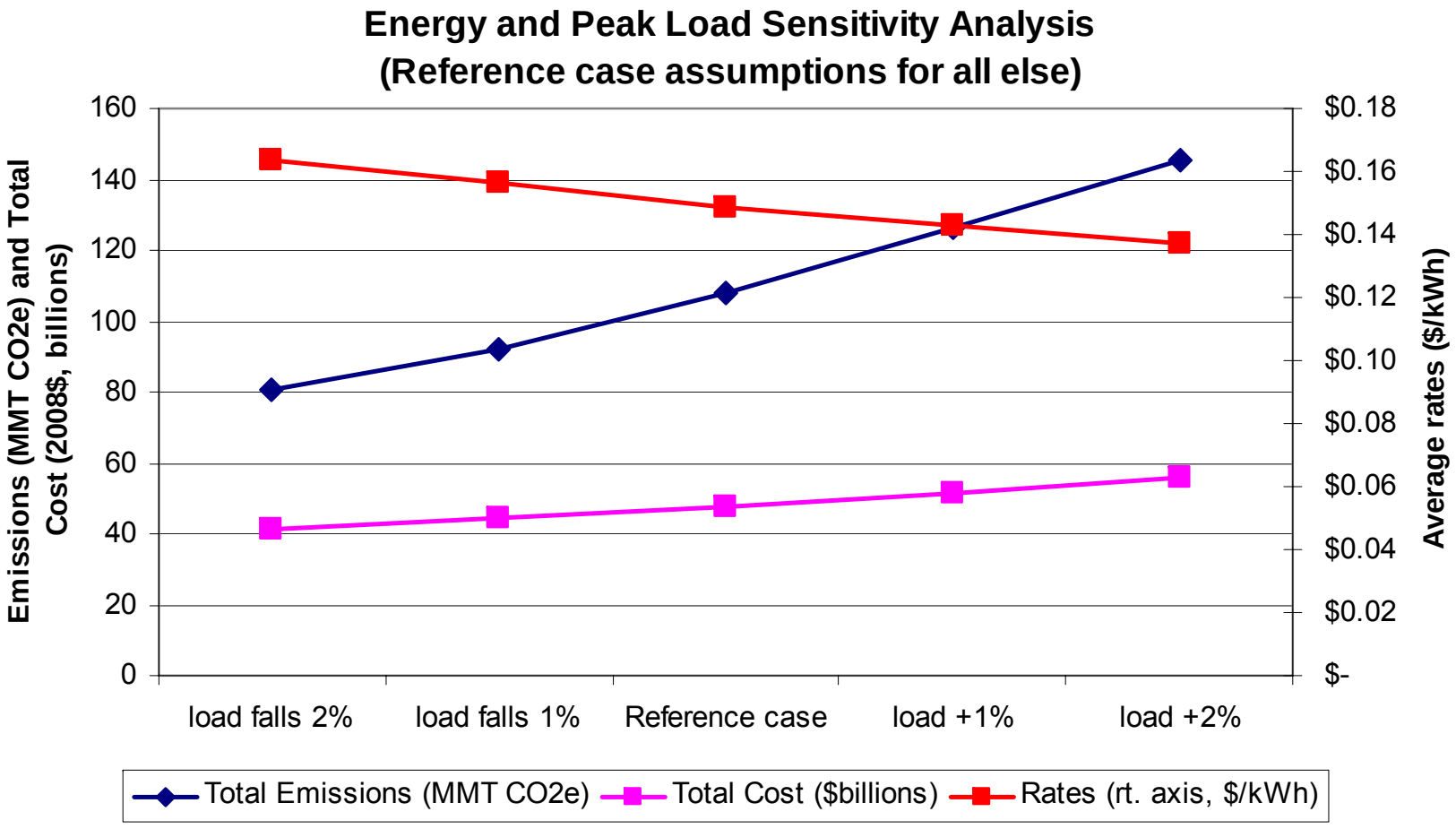
Sensitivity Analysis

Electricity Sector Key Drivers of Results

- Load growth
- Fuel prices
- EE achievements
- CO2 market costs

Load Growth Sensitivity



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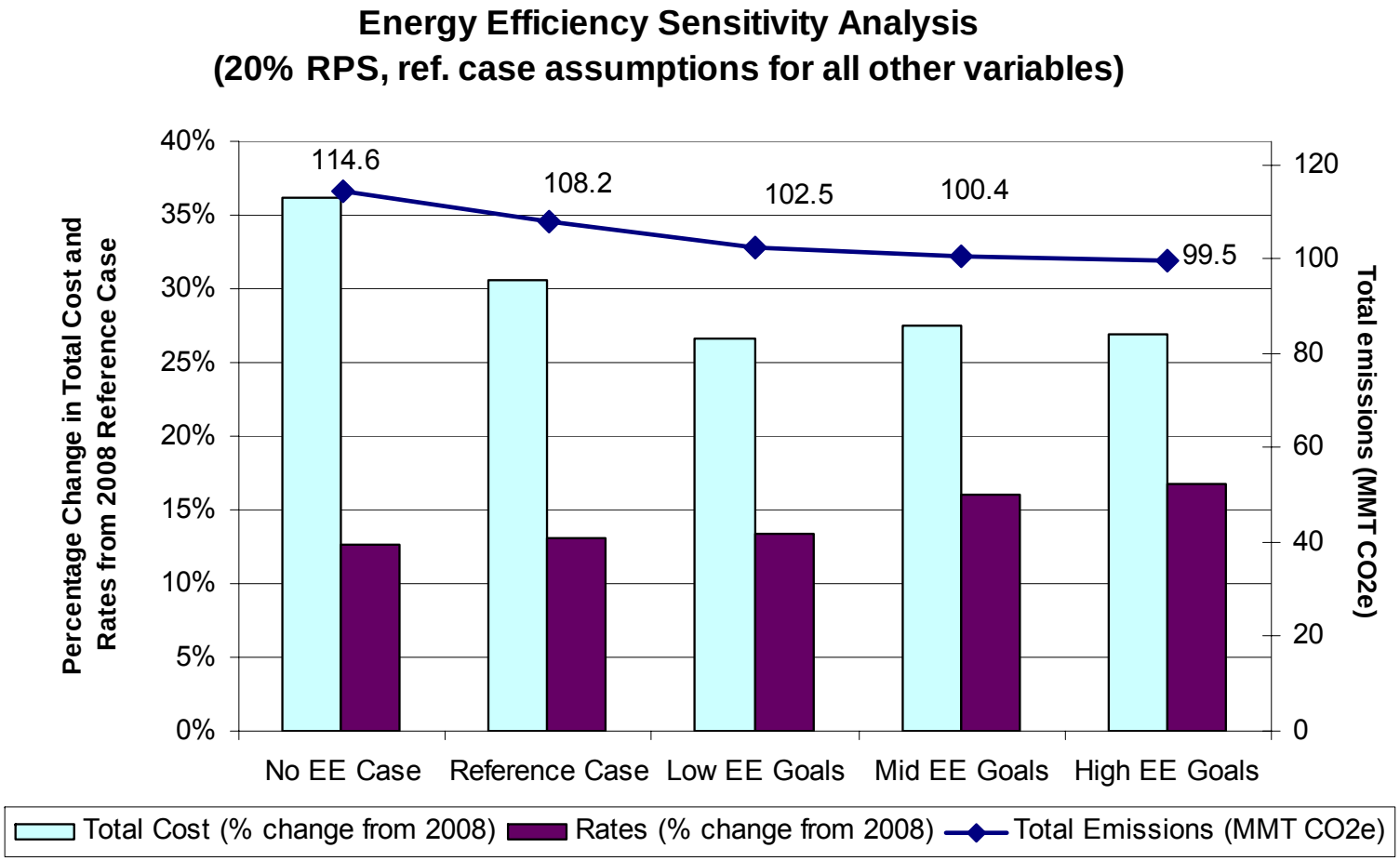
Energy Efficiency Sensitivity



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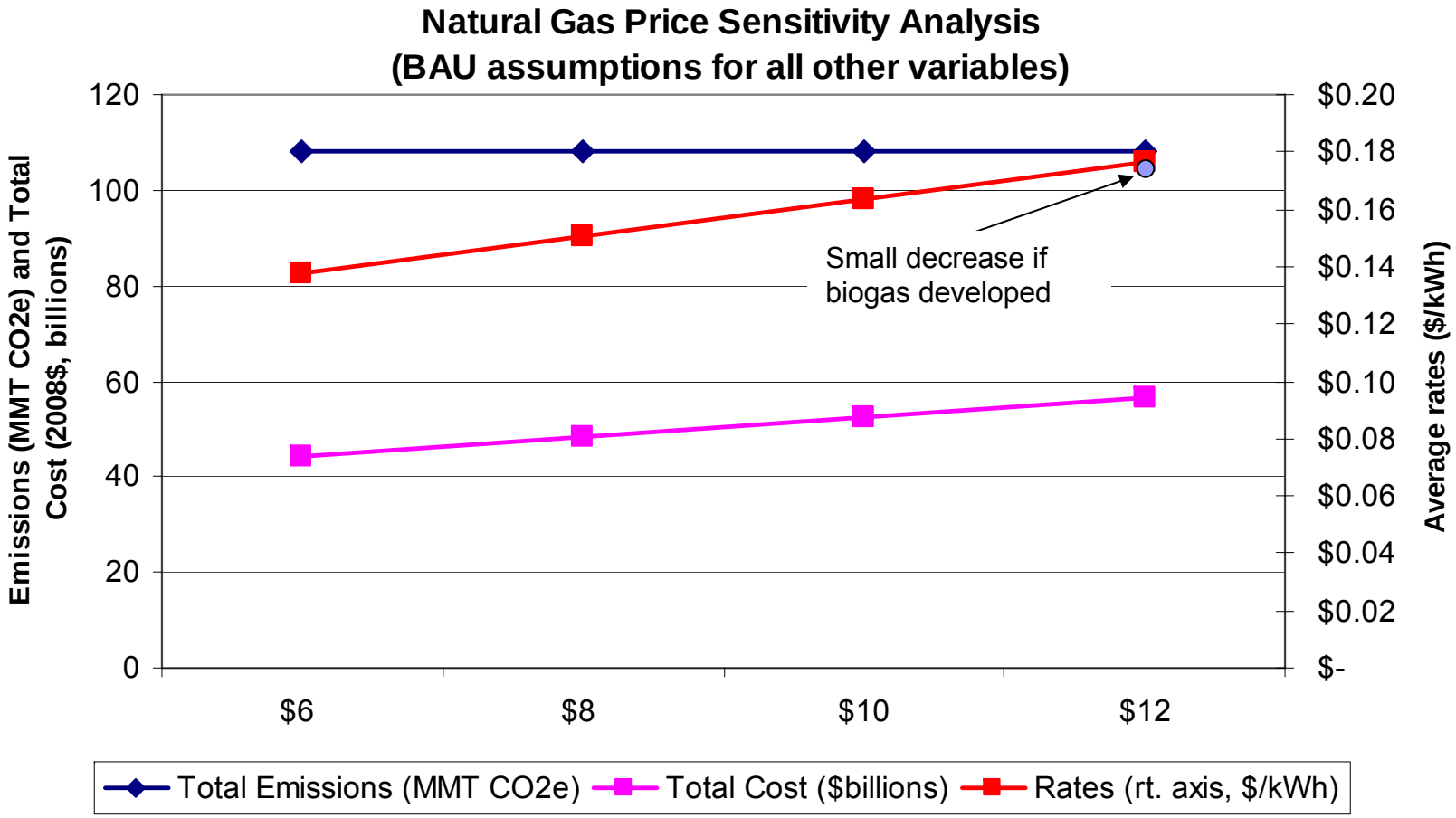
Natural Gas Price Sensitivity



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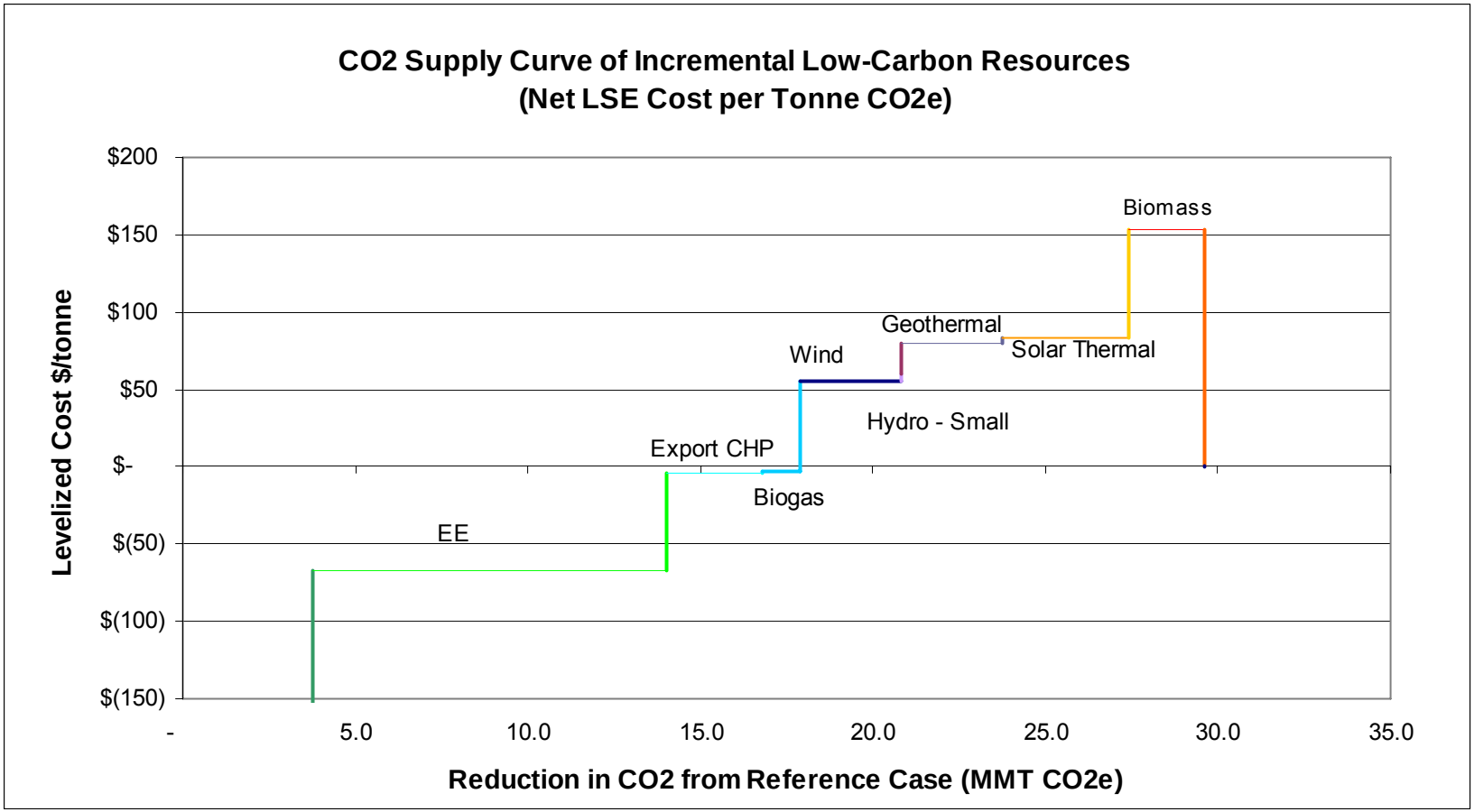
High EE, 33% RPS Supply Curve with $12/MMBtu Natural Gas



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Cost and Rate Impacts of CO2 Market: Allocation Scenarios

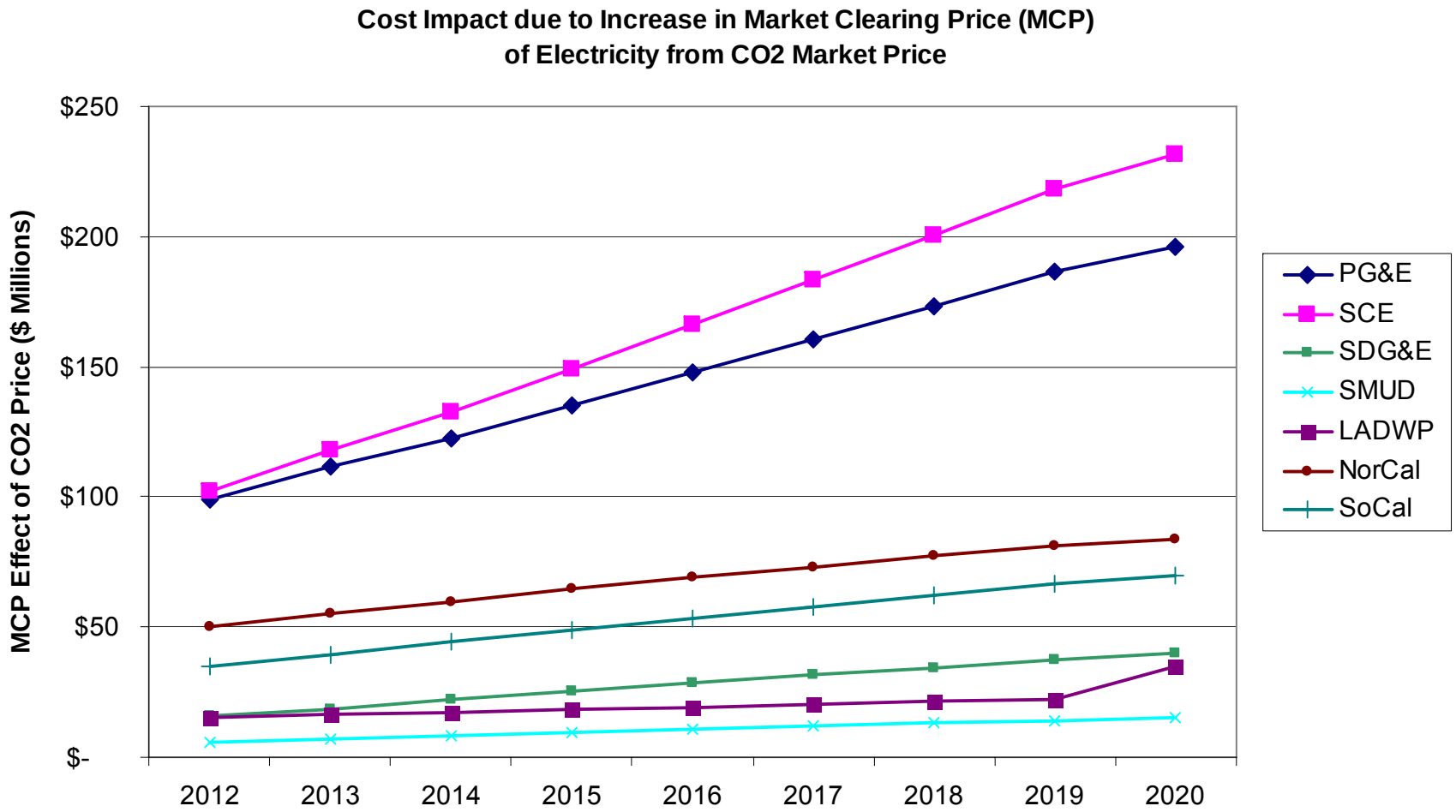
Seven Allocation Scenarios

1. ‘Pure Emission-Based Allocation’
2. ‘Pure Output-Based Allocation’
   a) Pure Output-Based Allocation excluding non-fossil generators
3. ‘Pure Auction’ with no Auction Revenue Recycling
4. ‘Pure Auction’ with Auction Revenue Recycling
5. Staff ‘Preferred Emission-Based Allocation’ proposal
6. Staff ‘Preferred Output-Based Allocation’ proposal
7. Staff ‘Preferred Auction’ proposal

Metrics for Evaluating Allocations

- Net Cost of CO2
  - Additional cost passed on to LSEs from energy deliverers from introduction of the CO2 market, net of any administrative allocation and auction revenue return
- Average Retail Rate Projection
  - Average rate levels by LSE in 2008 and 2020
- Percentage Change in Retail Rates

Market Clearing Price Effect of CO2 Price



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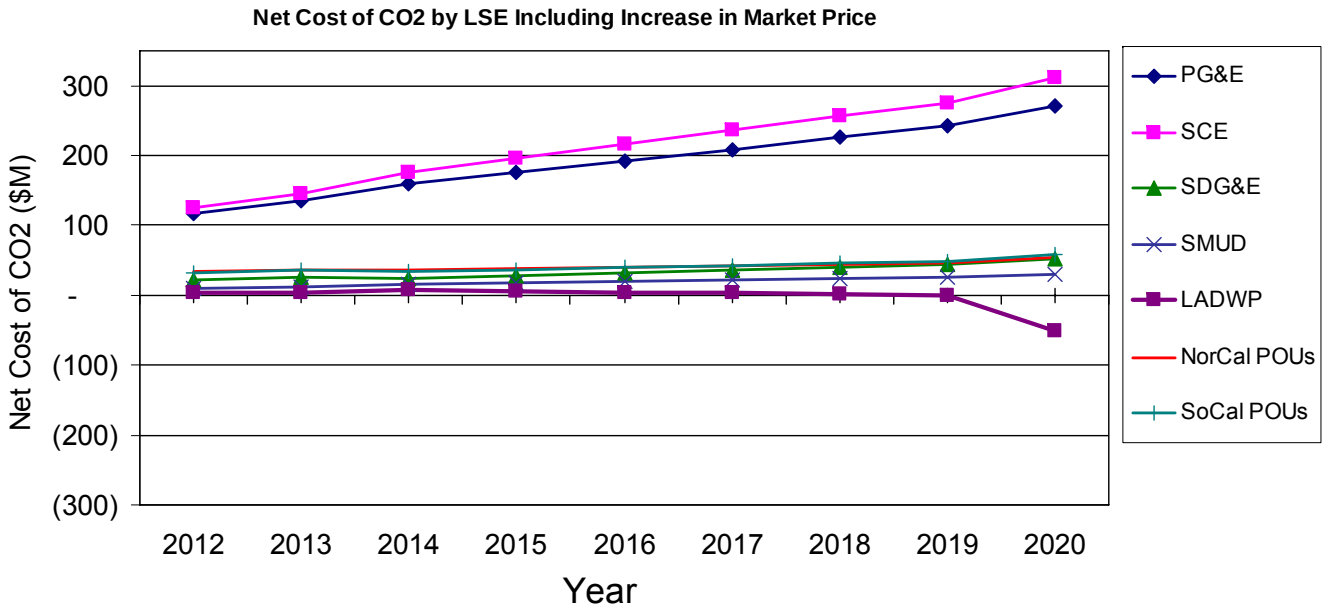
Scenario 1: 'Pure Emission-Based'

100% administrative allocation based on historical 2008 emissions



Summary

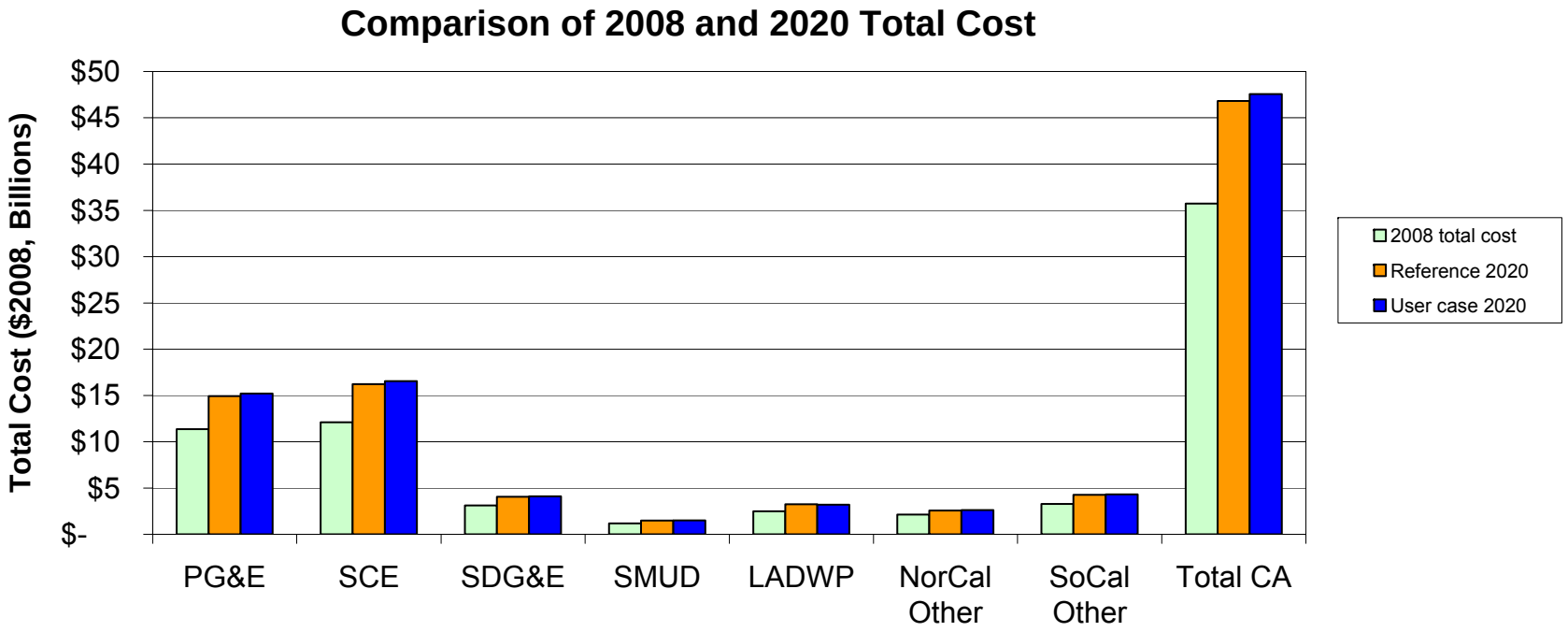
Low emissions, low self-resourced LSEs fair the worst.

Note: Same result as 100% auction with revenue return based on 2008 emissions

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

Scenario 1: 'Pure Emission-Based'

100% administrative allocation based on historical 2008 emissions



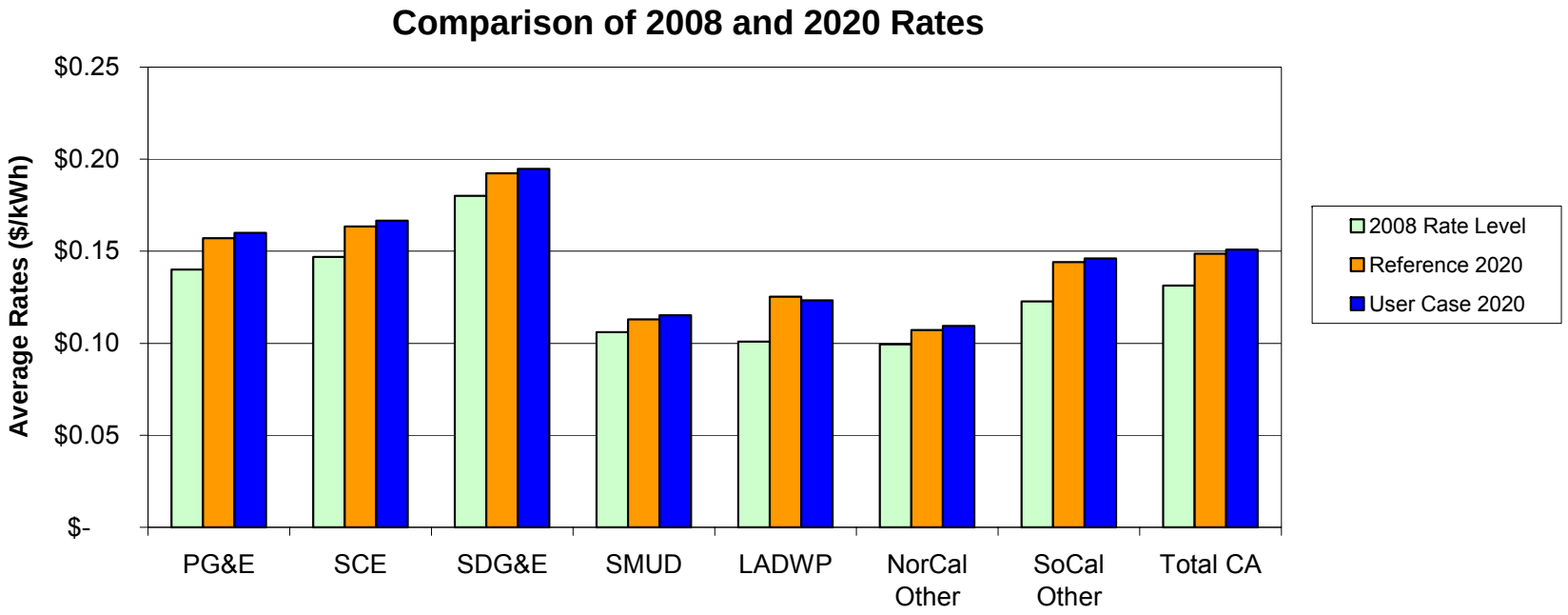
Total Cost Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2020 Ref to 2020 User Case	1.8%	1.9%	1.2%	2.0%	-1.6%	2.1%	1.4%	1.5%
Δ 2008 to 2020 User Case	34%	37%	31%	28%	29%	22%	32%	33%

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

Scenario 1: 'Pure Emission-Based'

100% administrative allocation based on historical 2008 emissions



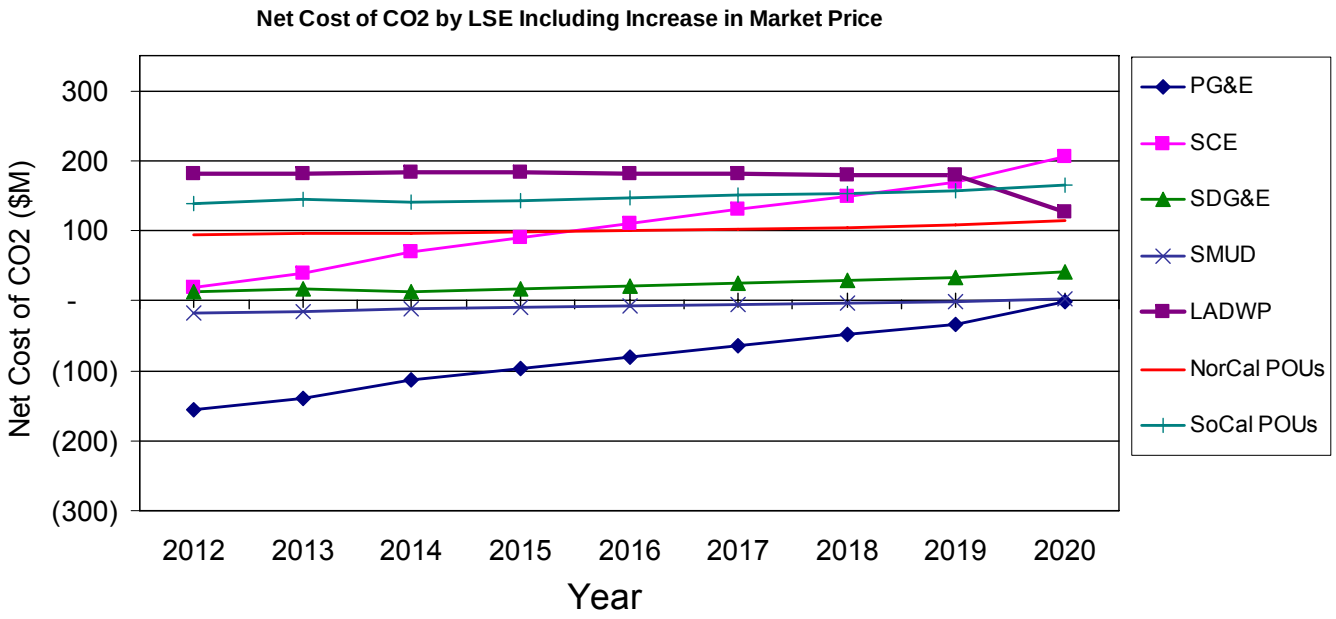
Rate Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2020 Ref to 2020 User Case	1.8%	1.9%	1.3%	2.1%	-1.5%	2.1%	1.4%	1.5%
Δ 2008 to 2020 User Case	14.3%	13.4%	8.2%	8.8%	22.1%	10.1%	19.0%	14.8%

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

Scenario 2: 'Pure Output-Based'

100% administrative allocation based on updating yearly output (GWh)



Summary

High emissions retail providers fair the worst.

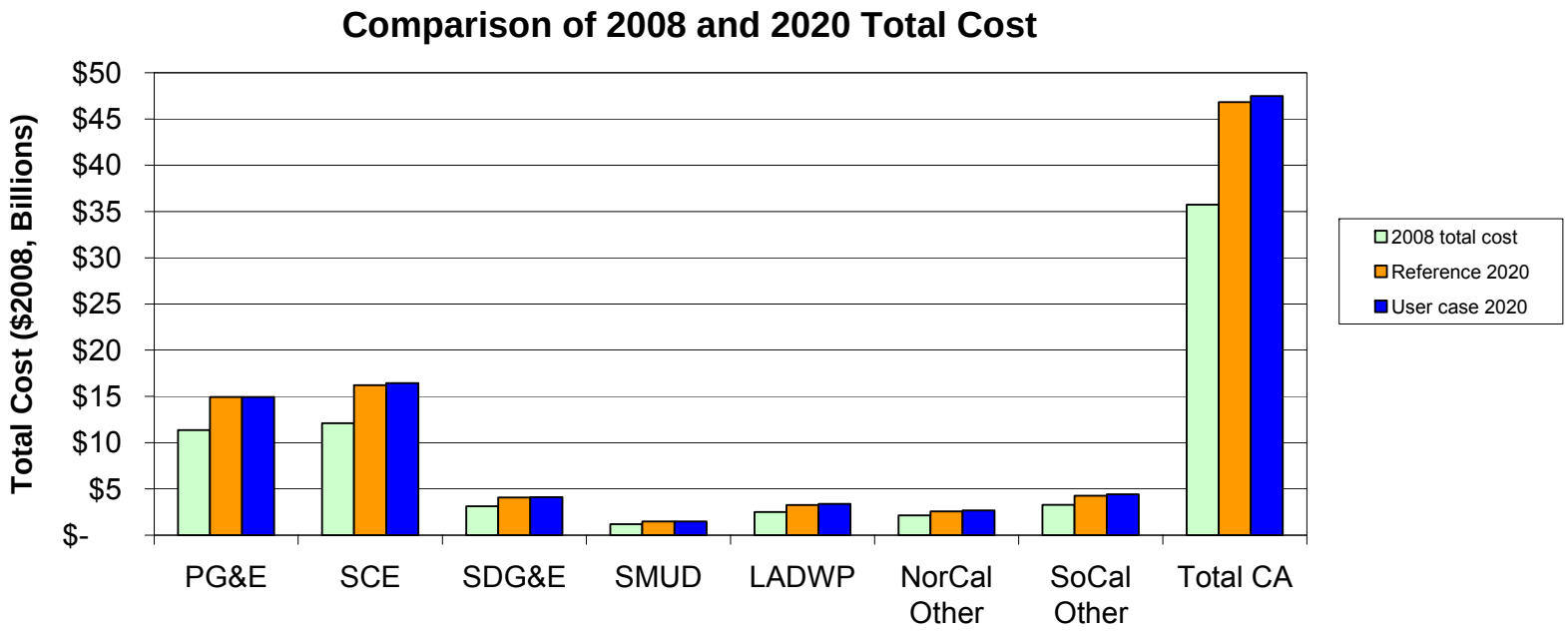
Increasing electricity market purchases at higher market price drive up slope for some retail providers.

Note: Same result as 100% auction with revenue return based on updating retail sales

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

Scenario 2: 'Pure Output-Based'

100% administrative allocation based on updating yearly output (GWh)



Total Cost Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2020 Ref to 2020 User Case	0.0%	1.3%	1.0%	0.2%	3.7%	4.3%	3.7%	1.4%
Δ 2008 to 2020 User Case	31%	36%	31%	26%	36%	25%	35%	33%

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

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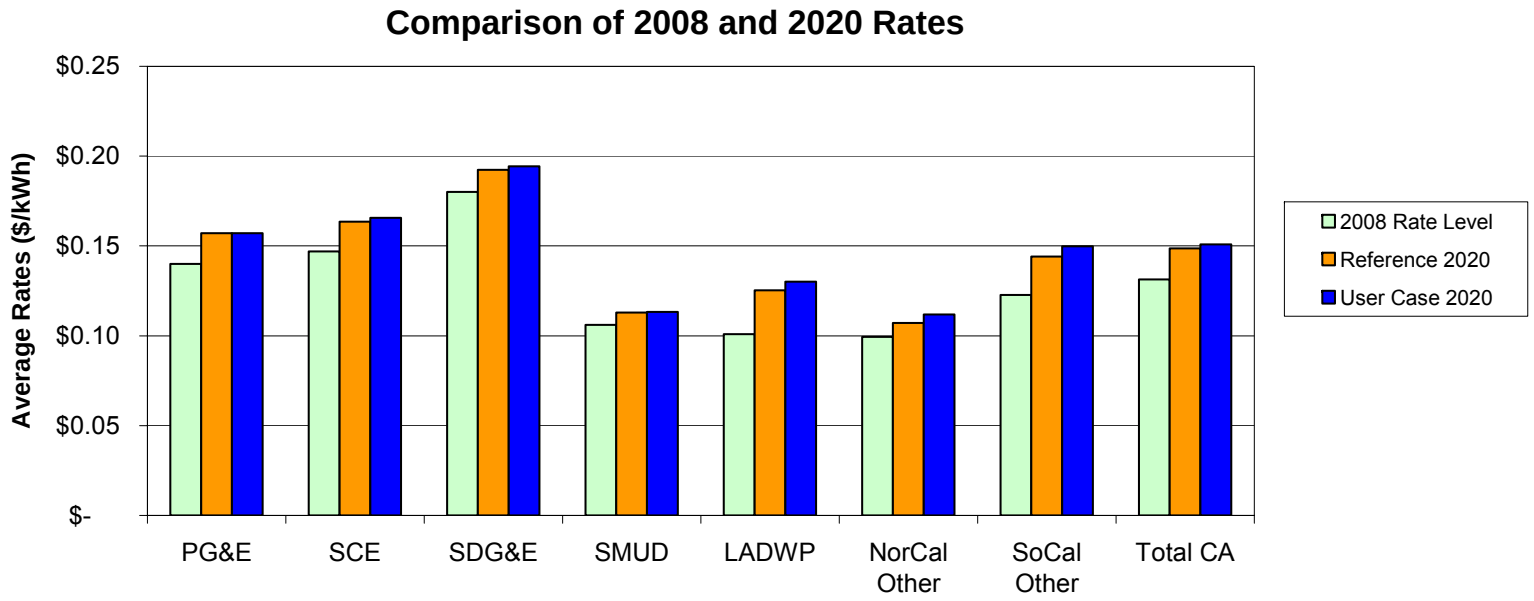
Scenario 2: 'Pure Output-Based'

100% administrative allocation based on updating yearly output (GWh)



Rate Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2020 Ref to 2020 User Case	0.0%	1.3%	1.0%	0.2%	3.9%	4.4%	3.9%	1.5%
Δ 2008 to 2020 User Case	12.2%	12.6%	8.0%	6.8%	28.8%	12.6%	22.0%	14.8%

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

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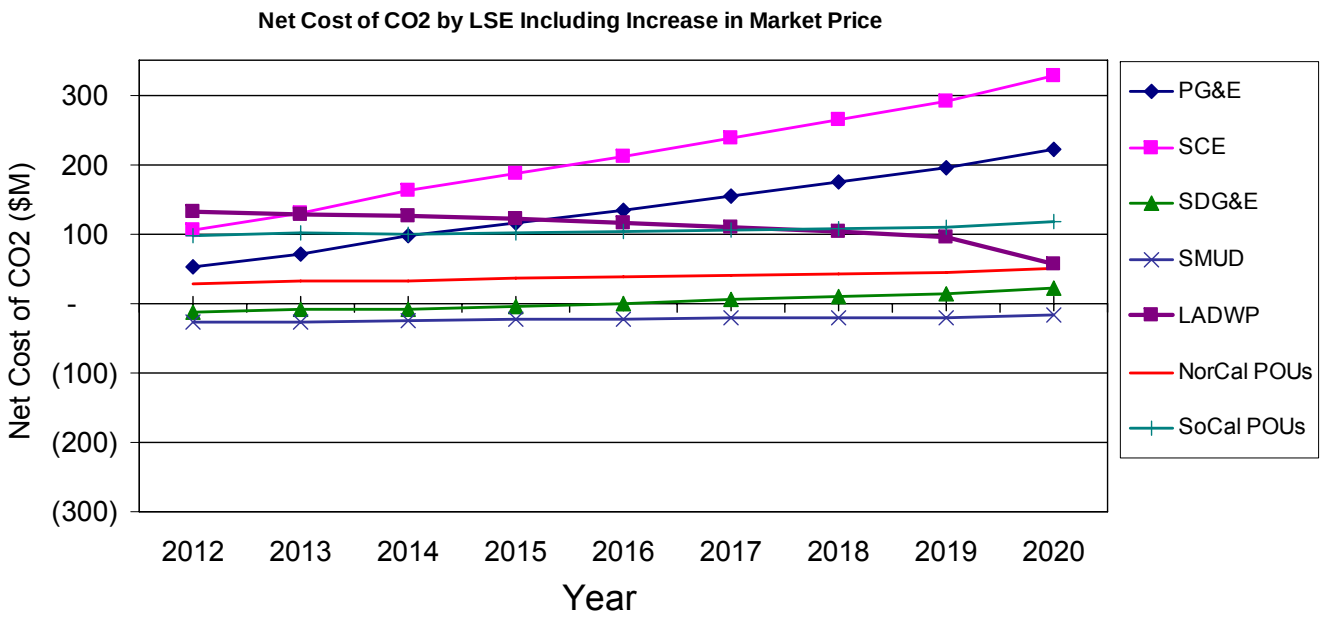
Scenario 2a: Pure Output-Based Allocation excluding non-fossil generators

100% administrative allocation based on updating yearly output (GWh)

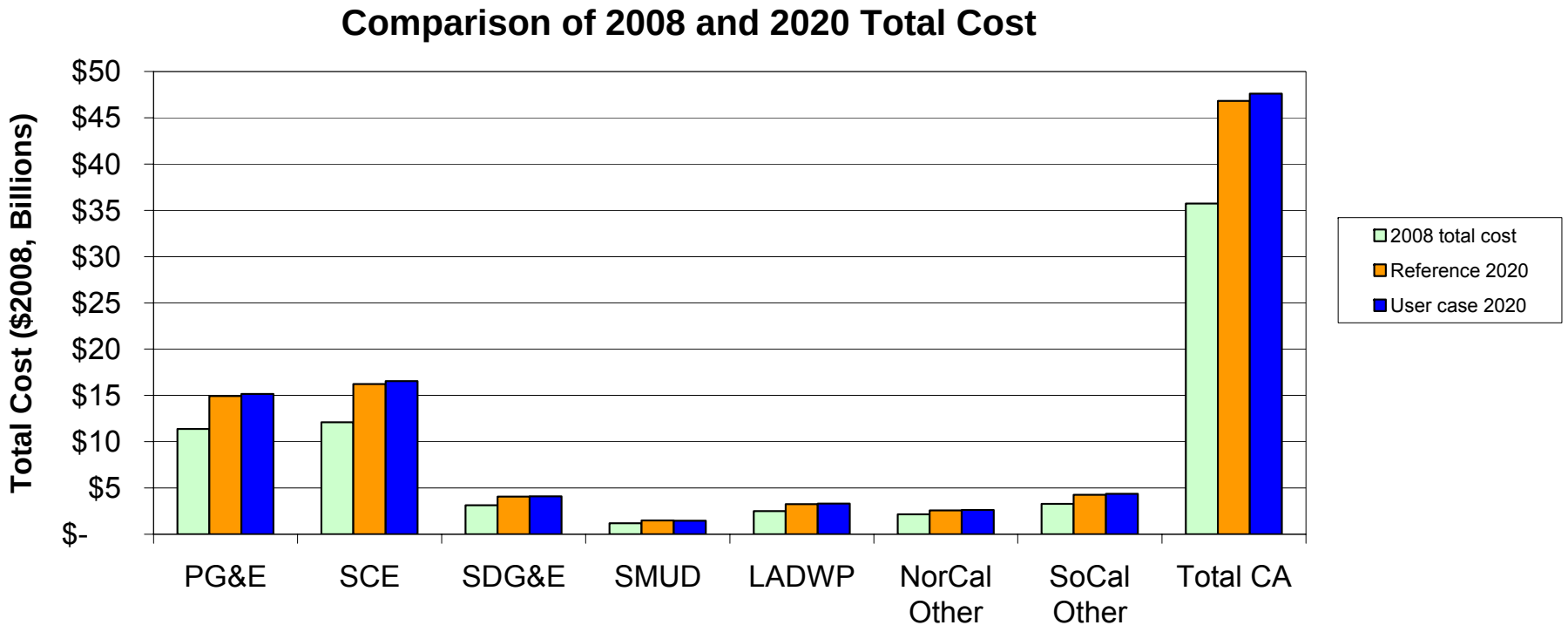


Summary

LSEs with zero carbon resources, (nuclear, hydro and renewable energy) fair worse than in pure output based allocation.

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

Scenario 2a: Pure Output-Based Allocation excluding non-fossil generators



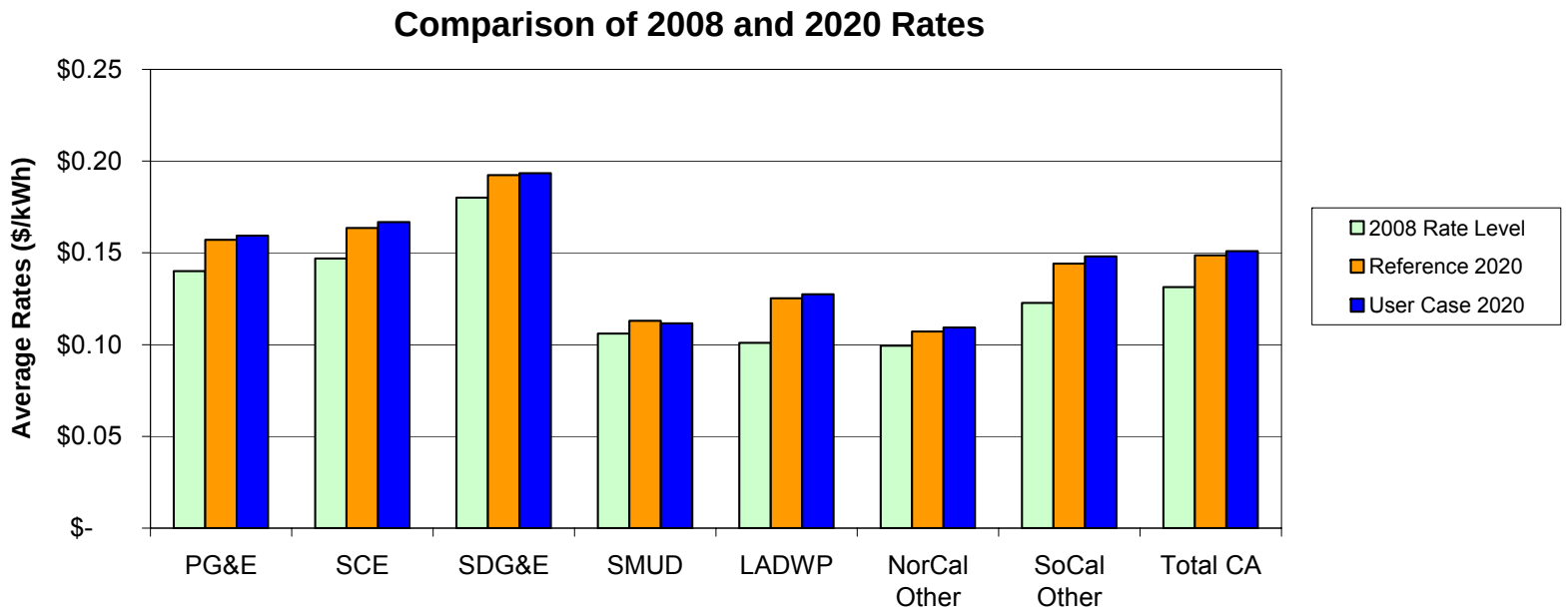
Total Cost Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2020 Ref to 2020 User Case	1.5%	2.0%	0.5%	-1.2%	1.7%	1.9%	2.7%	1.6%
Δ 2008 to 2020 User Case	33%	37%	30%	24%	33%	22%	33%	33%

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

Scenario 2a: Pure Output-Based Allocation excluding non-fossil generators

100% administrative allocation based on updating yearly output (GWh)

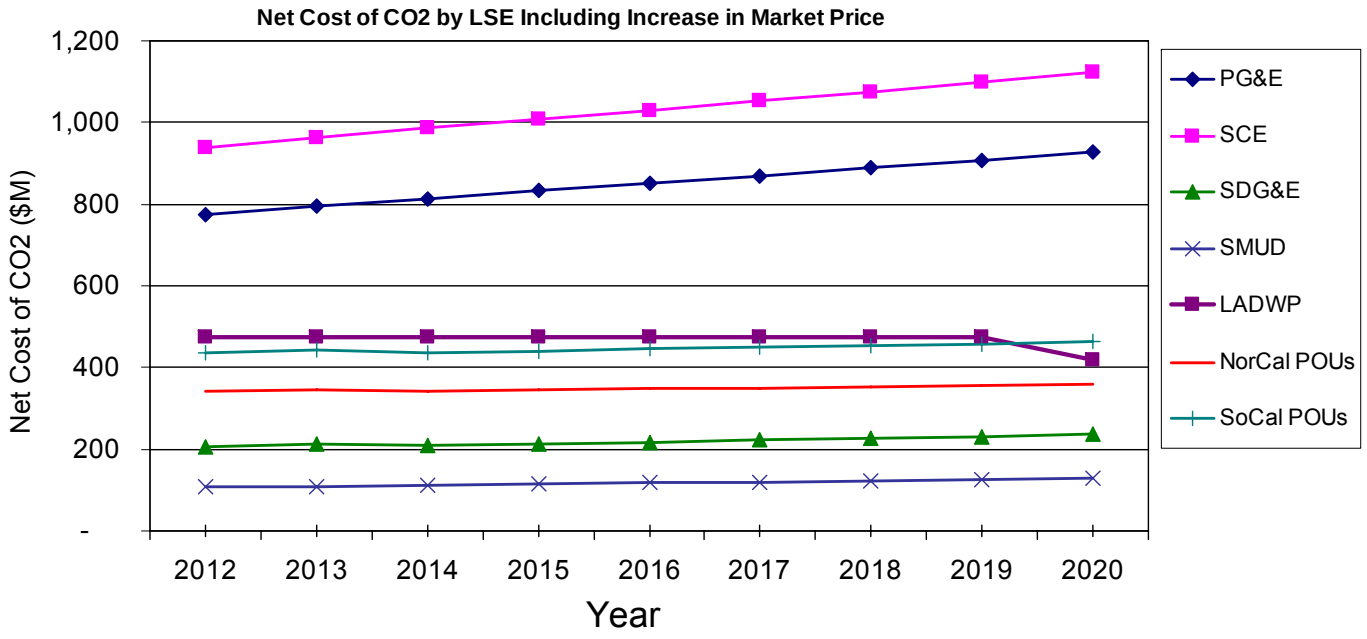


Rate Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2020 Ref to 2020 User Case	1.5%	2.0%	0.5%	-1.2%	1.7%	2.0%	2.7%	1.5%
Δ 2008 to 2020 User Case	13.9%	13.5%	7.5%	5.3%	26.2%	9.9%	20.6%	14.8%

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

Scenario 3: 'Pure Auction' – no revenue recycling



Summary

All LSEs see high cost and rate increases.

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

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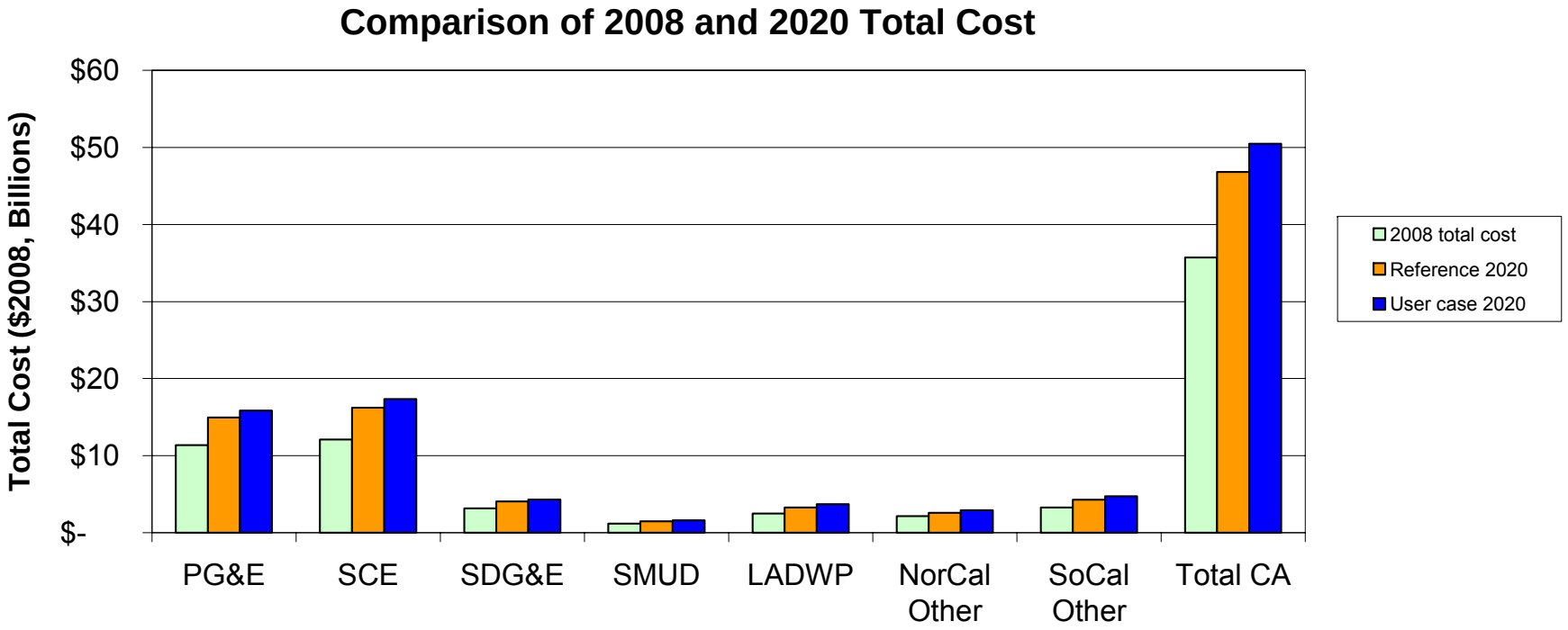
Scenario 3: 'Pure Auction' – no revenue recycling

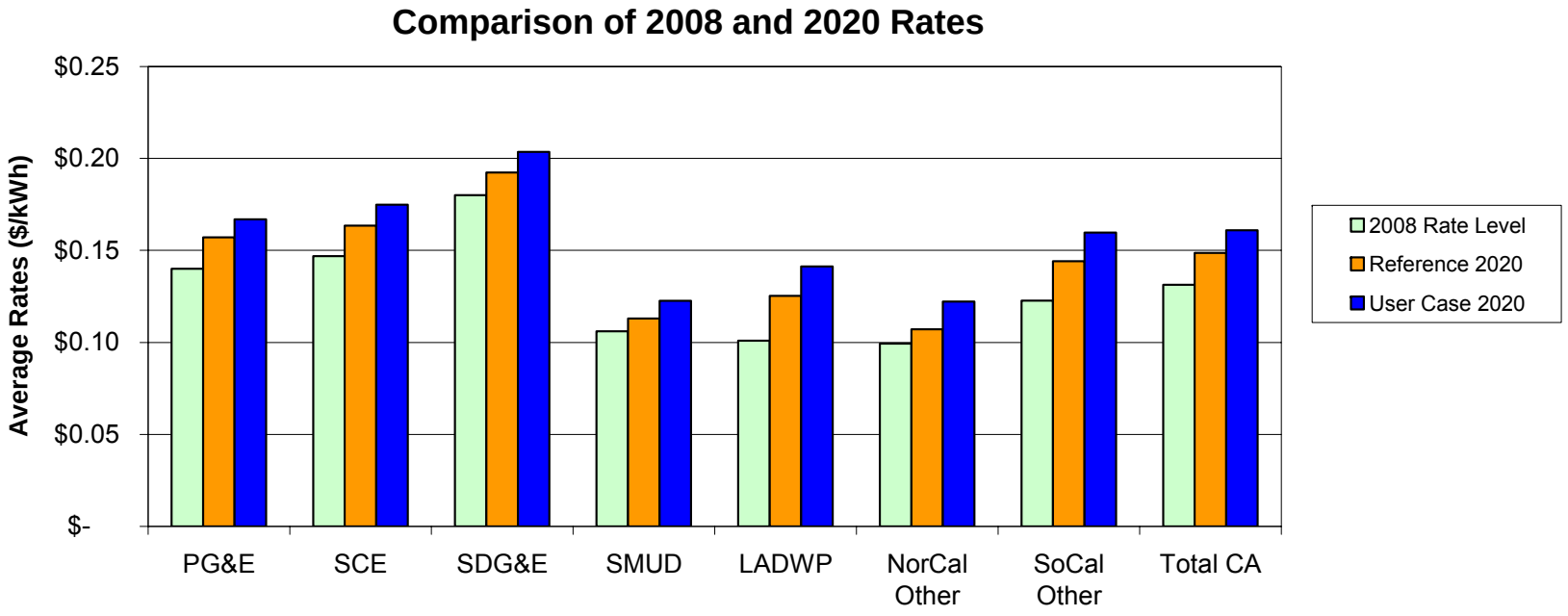


Total Cost Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2020 Ref to 2020 User Case	5.8%	6.5%	5.5%	7.9%	11.4%	12.3%	9.8%	7.2%
Δ 2008 to 2020 User Case	39%	43%	37%	36%	48%	37%	44%	41%

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

Scenario 3: 'Pure Auction' – no revenue recycling



Rate Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2020 Ref to 2020 User Case	6.2%	6.9%	5.8%	8.6%	12.8%	14.0%	10.8%	8.3%
Δ 2008 to 2020 User Case	19.2%	18.9%	13.1%	15.7%	39.9%	22.9%	30.1%	22.5%

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

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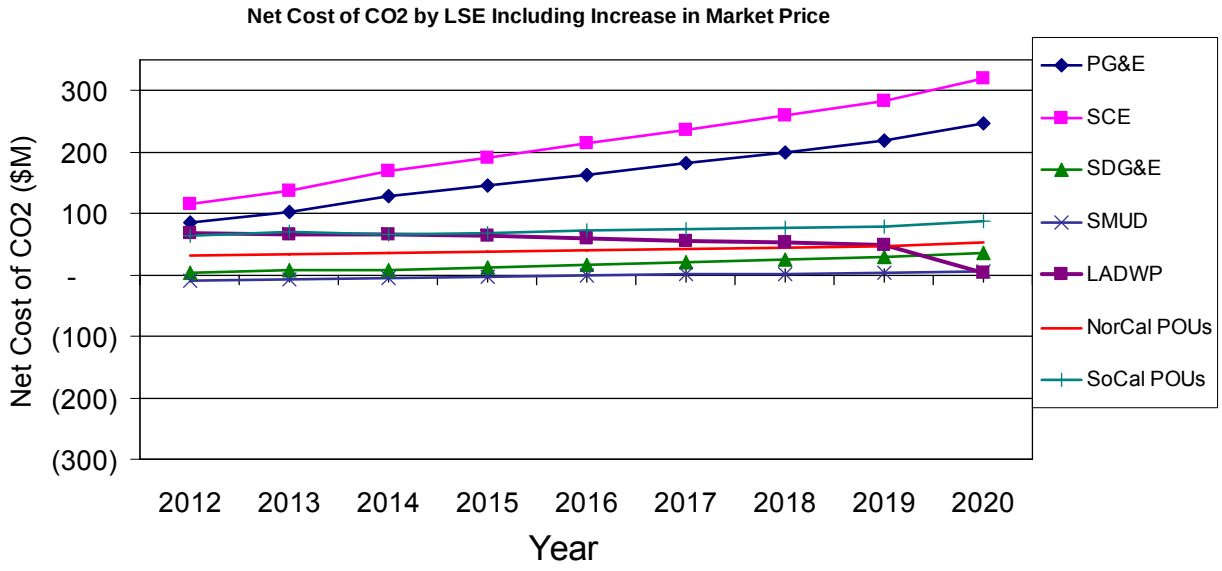
Scenario 4: 'Pure Auction' with revenue recycling

50% revenue recycling based on LSE sales, 50% based on 2008 emissions



Summary

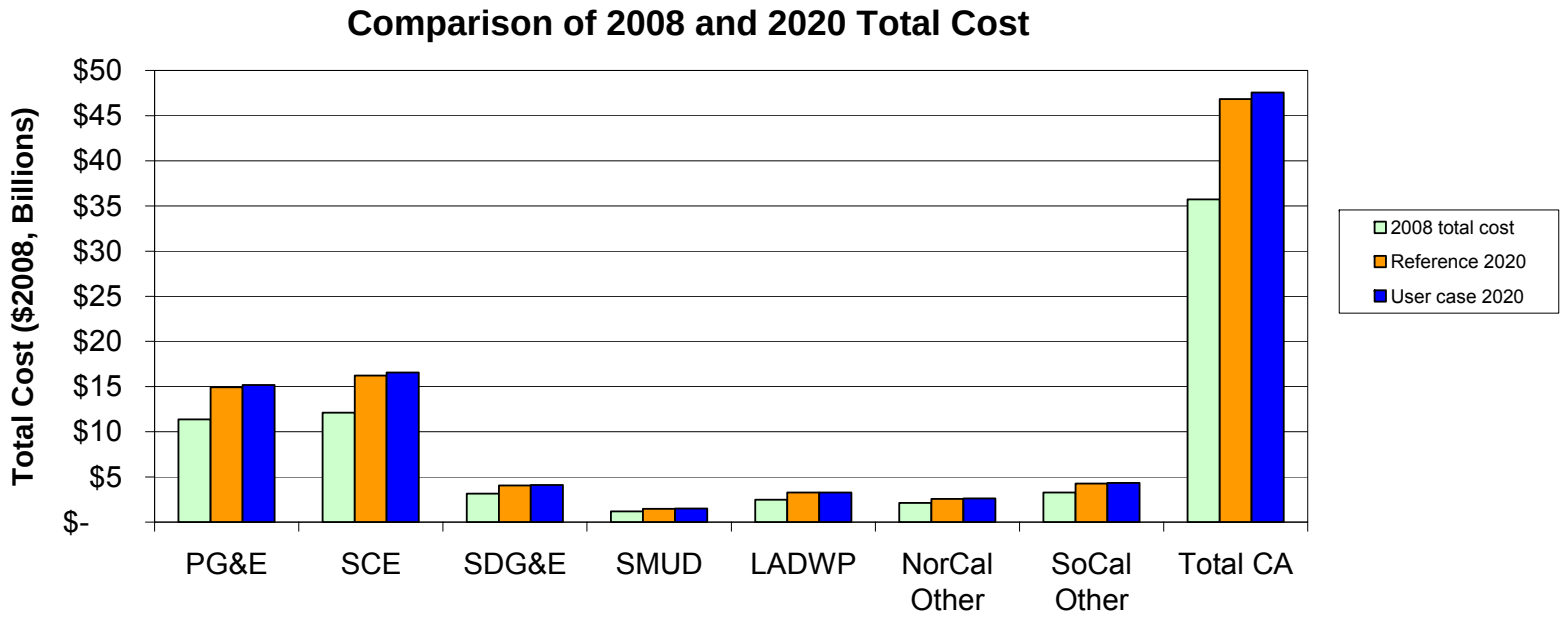
Revenue recycling mitigates impact of auction to all LSEs.

Mix of sales-based and output-based revenue recycling excluding non-fossil generators groups the LSE's impacts closer together.

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

Scenario 4: 'Pure Auction' with revenue recycling

50% revenue recycling based on LSE sales, 50% based on 2008 emissions



Total Cost Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2020 Ref to 2020 User Case	1.6%	1.9%	0.9%	0.4%	0.1%	2.0%	2.0%	1.6%
Δ 2008 to 2020 User Case	33%	37%	31%	26%	31%	22%	33%	33%

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

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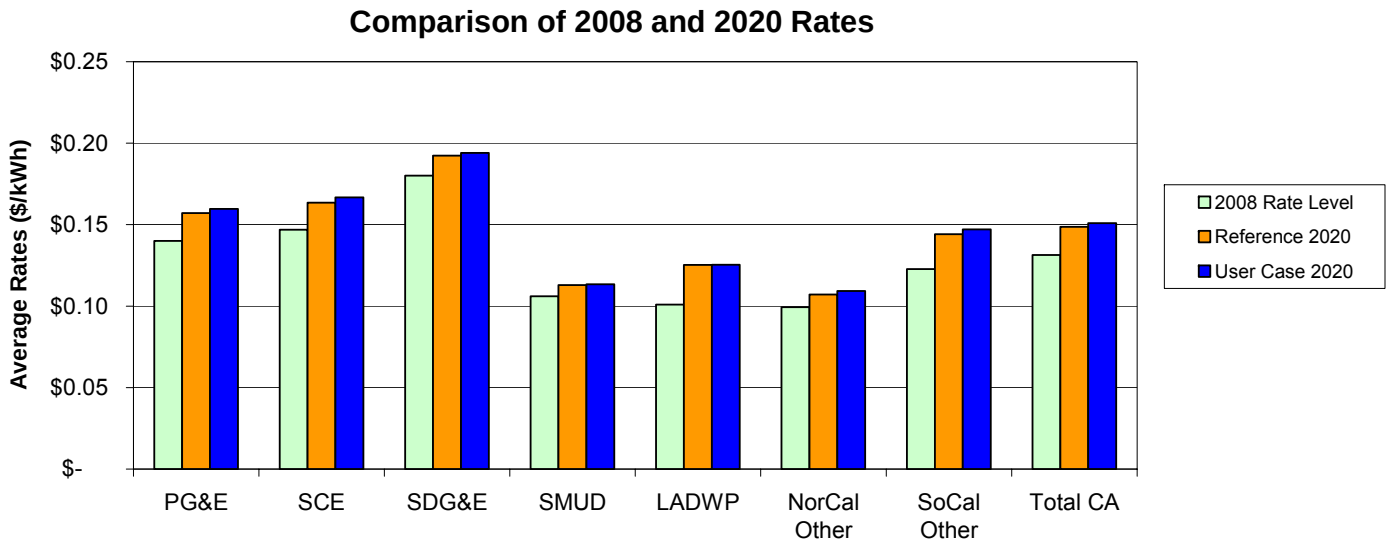
Scenario 4: 'Pure Auction' with revenue recycling

50% revenue recycling based on LSE sales, 50% based on 2008 emissions



Rate Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2020 Ref to 2020 User Case	1.7%	2.0%	0.9%	0.4%	0.1%	2.0%	2.1%	1.5%
Δ 2008 to 2020 User Case	14.1%	13.4%	7.9%	7.0%	24.2%	10.0%	19.8%	14.8%

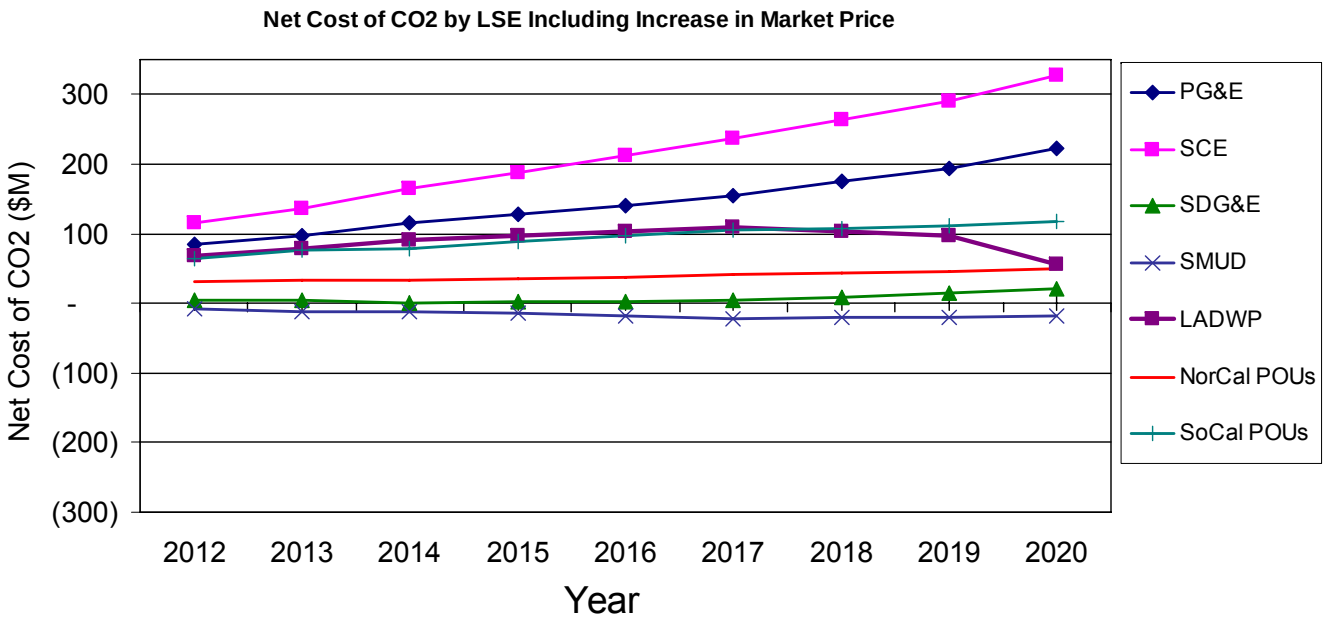
Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

Scenario 5: 'Preferred Emission-Based' Staff Straw Proposal

- If emission-based allocation is adopted, staff recommend:
- 100% admin. allocation starting with split between emissions and output based allocation, with transition to 100% output-based
- Allowances allocated only to fossil-fuel based generators

Year	% allocated on emissions basis	% allocated on output basis
2012	50%	50%
2013	40%	60%
2014	30%	70%
2015	20%	80%
2016	10%	90%
2017+	0%	100%

Scenario 5: 'Preferred Emission-Based' Staff Straw Proposal

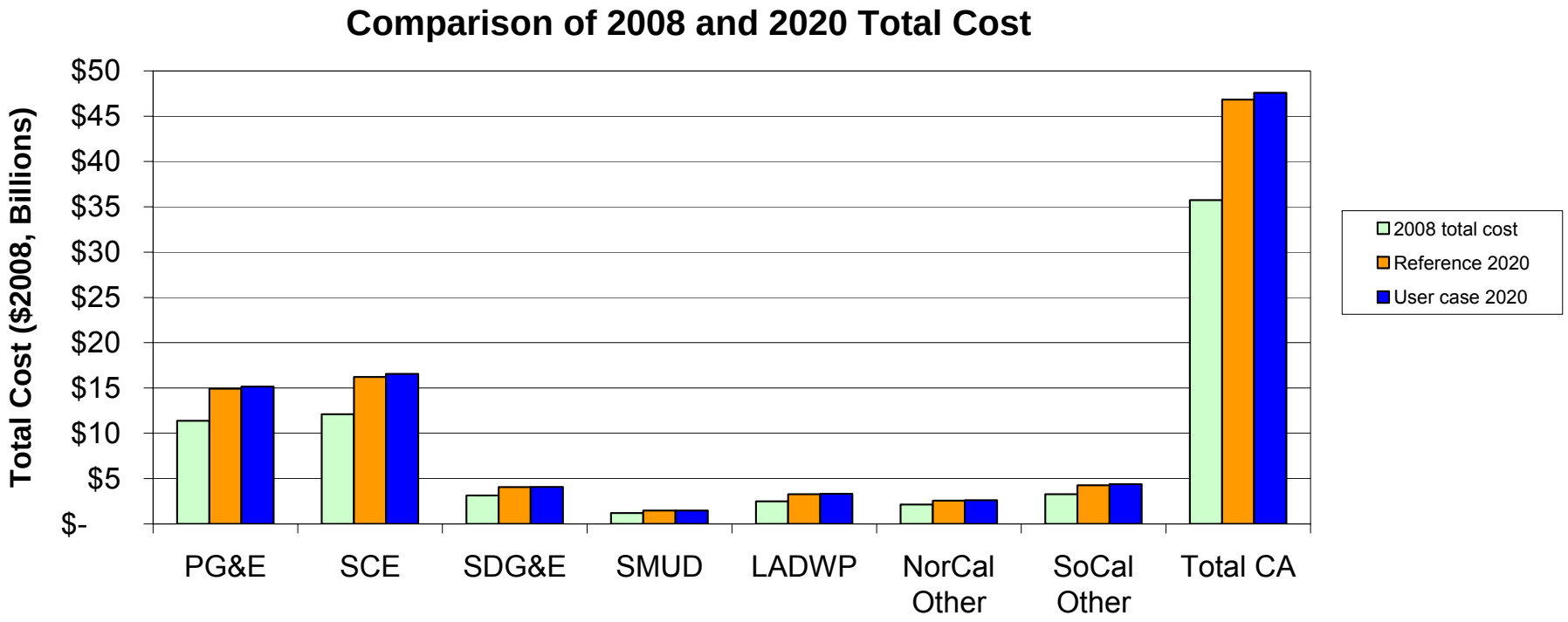


Summary

Transition from 50% emissions, 50% output allocation to 100% output basis increases costs to high emissions LSEs and decreases costs to low emissions LSEs compared to pure emissions-based allocation.

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

Scenario 5: 'Preferred Emission-Based' Staff Straw Proposal



Total Cost Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2020 Ref to 2020 User Case	1.5%	2.0%	0.5%	-1.2%	1.7%	1.9%	2.7%	1.6%
Δ 2008 to 2020 User Case	33%	37%	30%	24%	33%	22%	33%	33%

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

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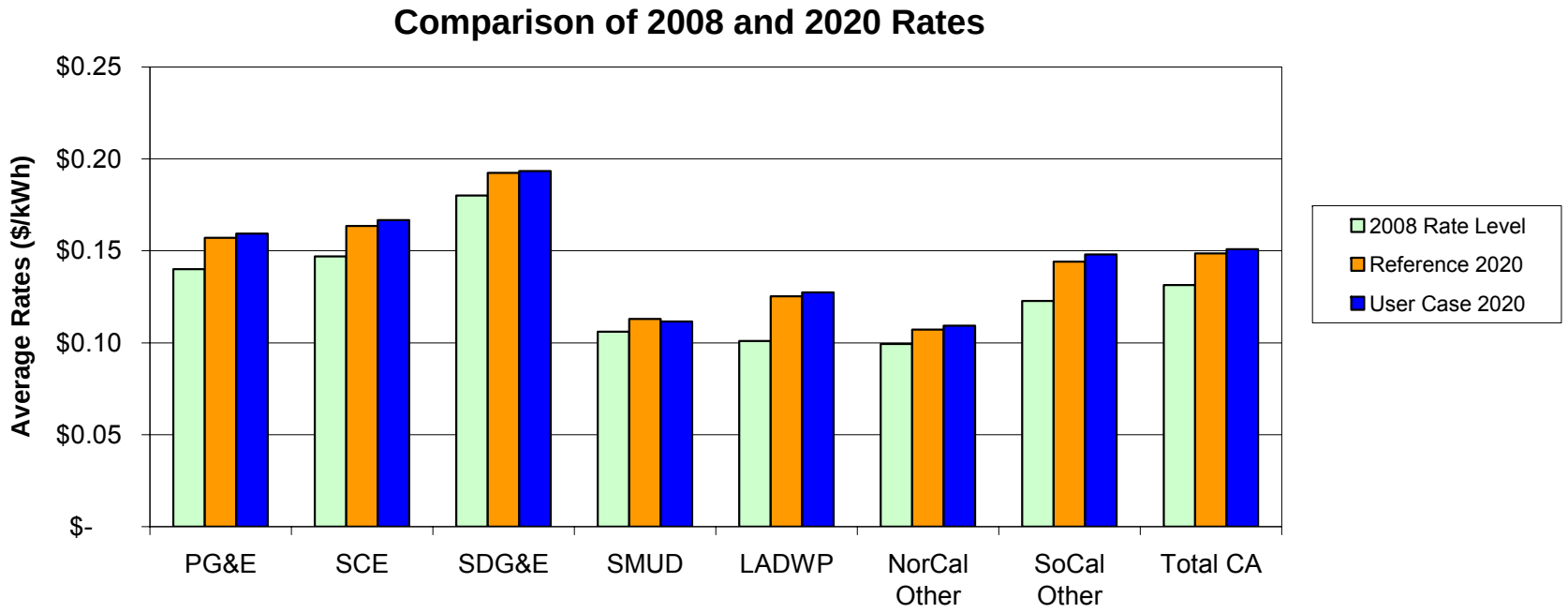
Scenario 5: 'Preferred Emission-Based' Staff Straw Proposal



Rate Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2020 Ref to 2020 User Case	1.5%	2.0%	0.5%	-1.2%	1.7%	2.0%	2.7%	1.5%
Δ 2008 to 2020 User Case	13.9%	13.5%	7.5%	5.3%	26.2%	9.9%	20.6%	14.8%

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

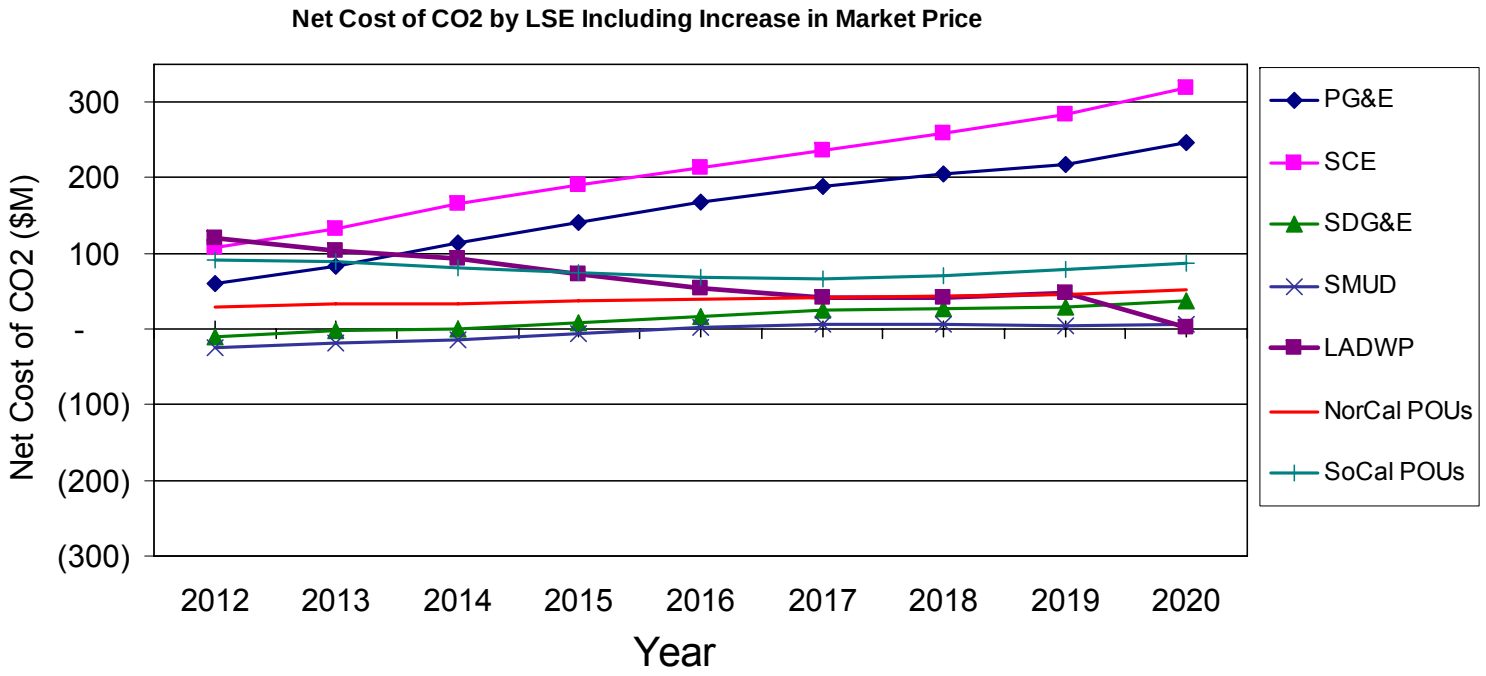
Scenario 6: 'Preferred Output-Based Allocation to Auction' Staff Straw Proposal

- If output-based allocation is adopted, staff recommend:
- Transition to 100% auction
- Revenue recycling based on staff preferred transition btwn. 2008 emissions and LSE sales
- Allowances allocated only to non-fossil generators

Year	% allocated on output basis	% auctioned	Revenue recycling on emissions basis	Revenue recycling on sales basis
2012	90%	10%	100%	0%
2013	80%	20%	95%	5%
2014	70%	30%	90%	10%
2015	50%	50%	85%	15%
2016	30%	70%	80%	20%
2017	10%	90%	70%	30%
2018	0%	100%	60%	40%
2019 +	0%	100%	50%	50%

Scenario 6: Administrative allocation transitioning to auction

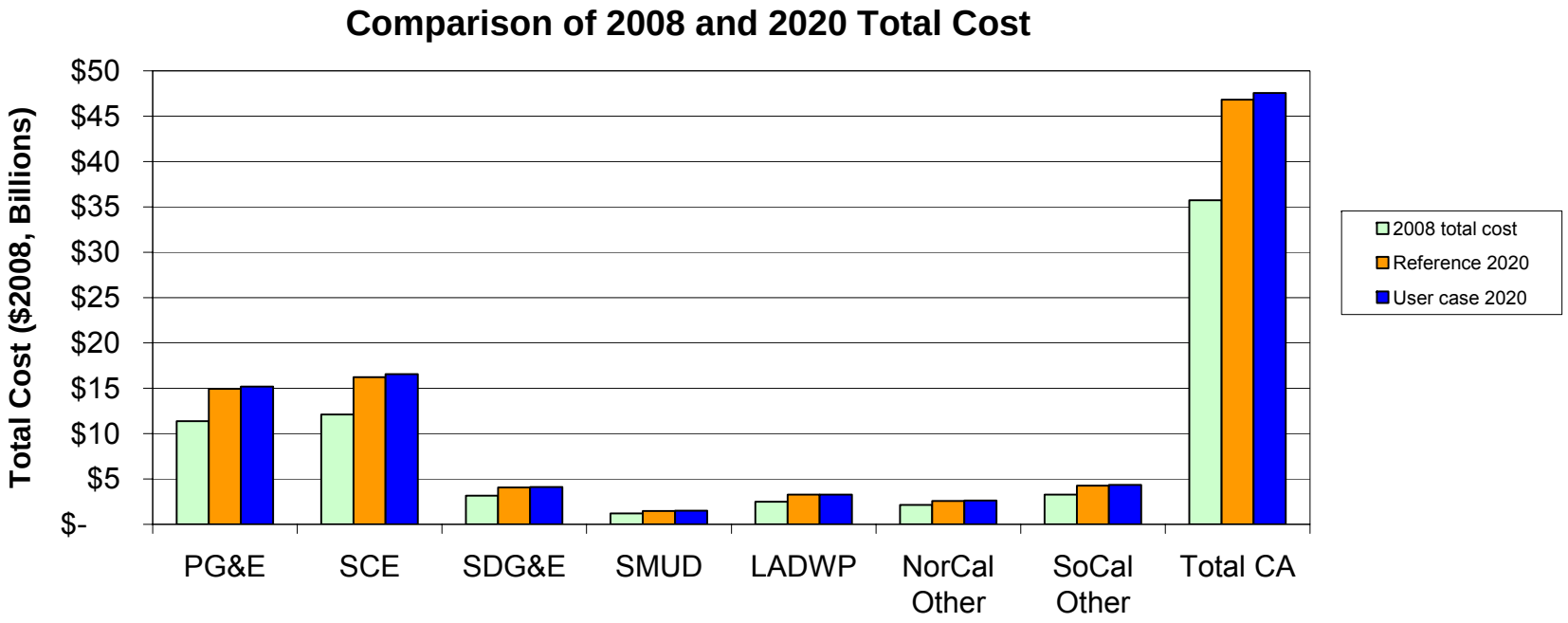
Transition to auction with for revenue recycling



Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

Scenario 6: Administrative allocation transitioning to auction

Staff preferred transition for revenue recycling



Total Cost Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2020 Ref to 2020 User Case	1.6%	1.9%	0.9%	0.4%	0.1%	2.0%	2.0%	1.6%
Δ 2008 to 2020 User Case	33%	37%	31%	26%	31%	22%	33%	33%

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

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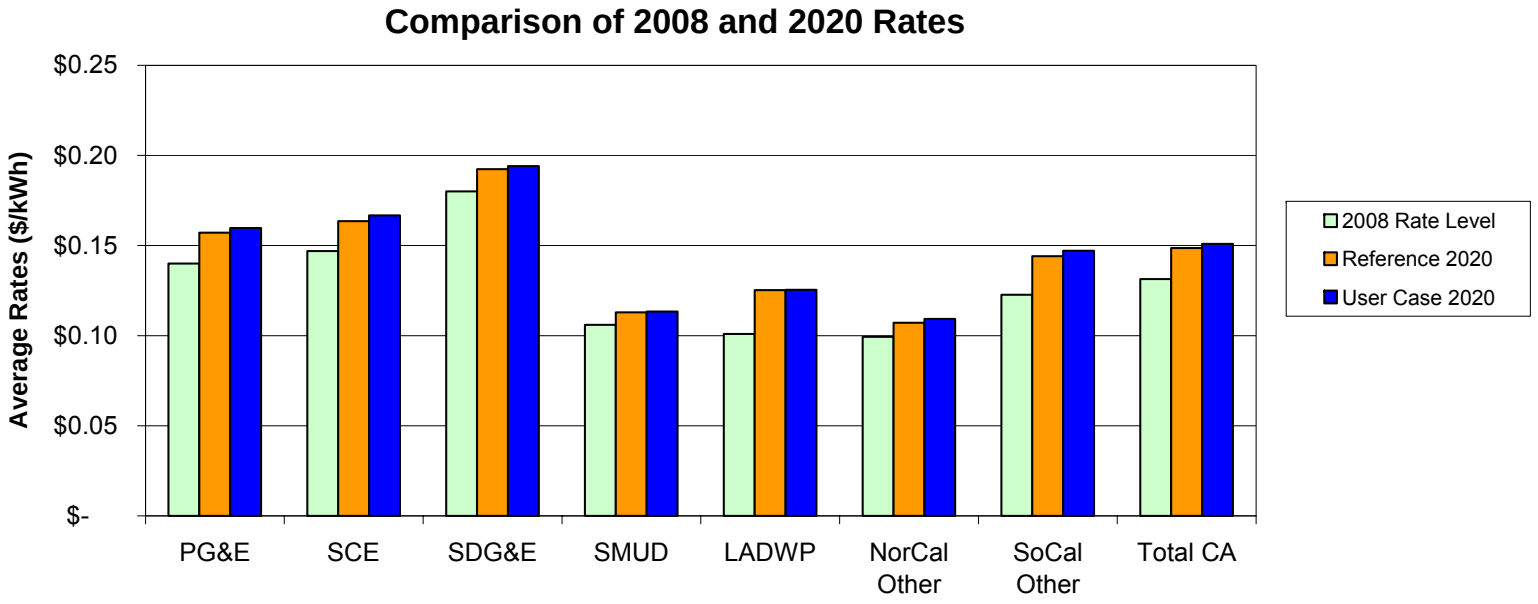
Scenario 6: Administrative allocation transitioning to auction

Staff preferred transition for revenue recycling



Rate Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2020 Ref to 2020 User Case	1.7%	2.0%	0.9%	0.4%	0.1%	2.0%	2.1%	1.5%
Δ 2008 to 2020 User Case	14.1%	13.4%	7.9%	7.0%	24.2%	10.0%	19.8%	14.8%

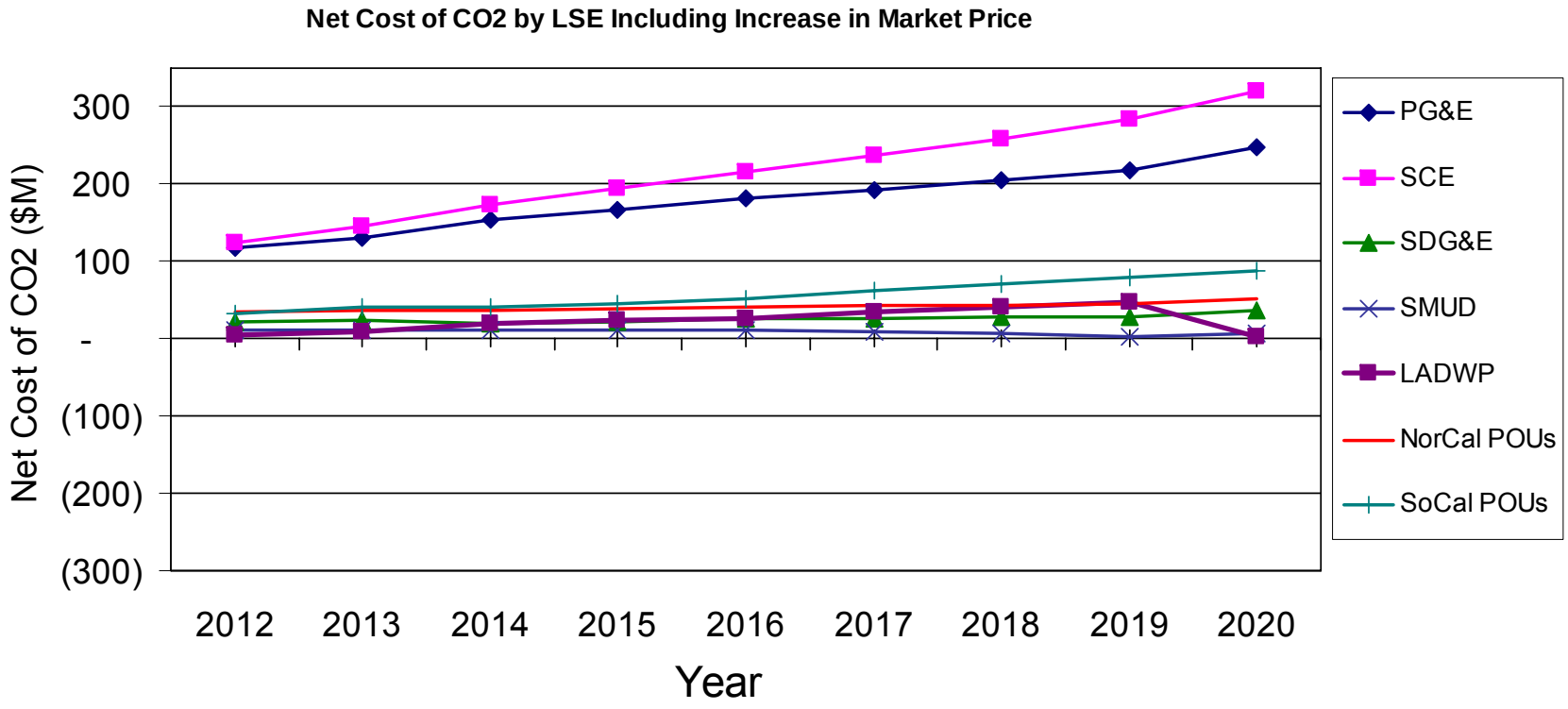
Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

Scenario 7: 'Preferred Auction' Staff Straw Proposal

- If auction is adopted, staff recommend:
- 100% auction revenue recycling on historic emissions basis transitioning to sales-basis

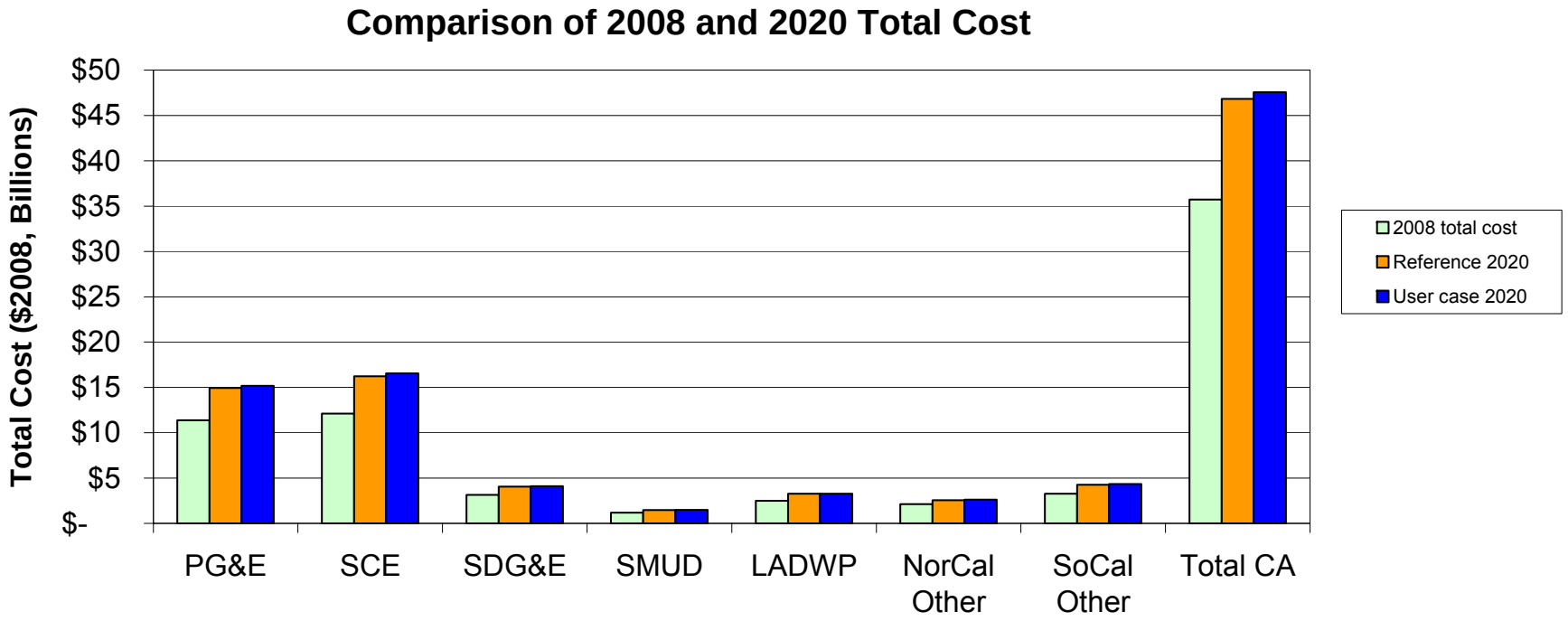
Year	Revenue recycling on emissions basis	Revenue recycling on sales basis
2012	100%	0%
2013	95%	5%
2014	90%	10%
2015	85%	15%
2016	80%	20%
2017	70%	30%
2018	60%	40%
2019+	50%	50%

Scenario 7: 'Preferred Auction' Staff Straw Proposal



Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

Scenario 7: 'Preferred Auction' Staff Straw Proposal



Total Cost Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2020 Ref to 2020 User Case	1.6%	1.9%	0.9%	0.4%	0.1%	2.0%	2.0%	1.6%
Δ 2008 to 2020 User Case	33%	37%	31%	26%	31%	22%	33%	33%

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

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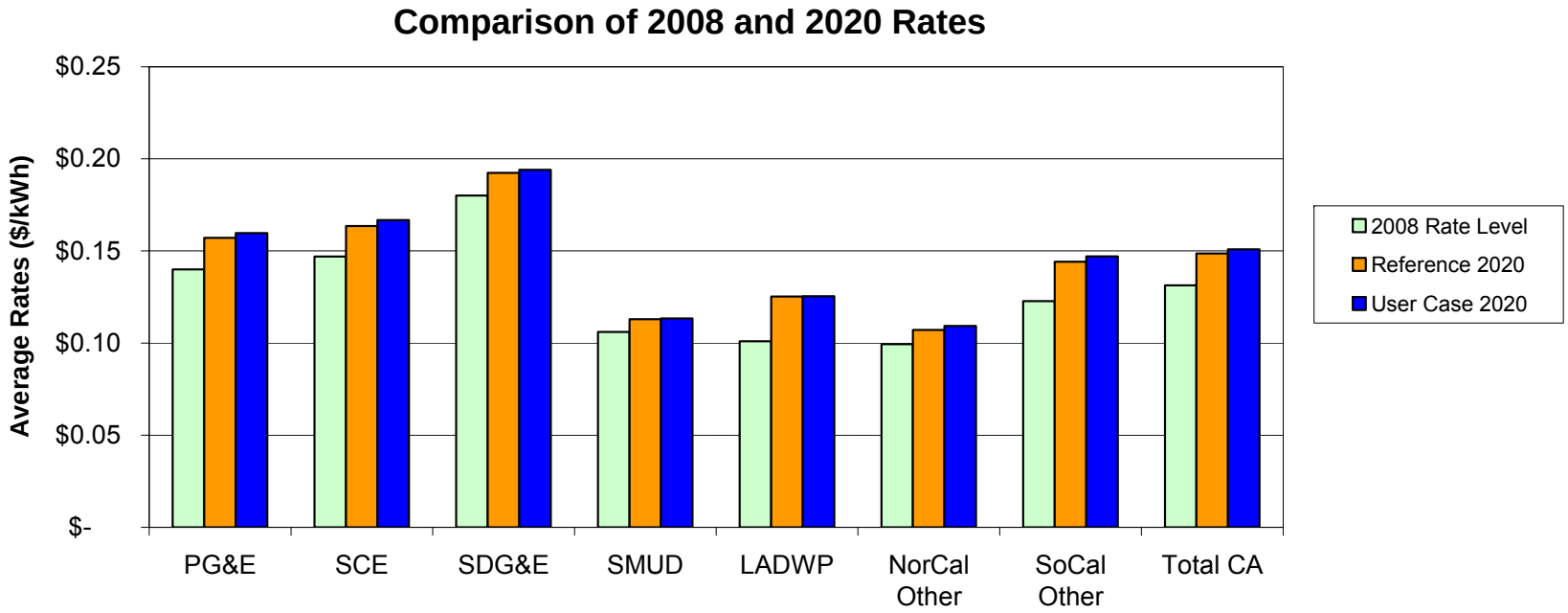
Scenario 7: 'Preferred Auction' Staff Straw Proposal



Rate Change between 2020 Reference and 2020 User Case

	PG&E	SCE	SDG&E	SMUD	LADWP	NorCal Other	SoCal Other	Total CA
Δ 2020 Ref to 2020 User Case	1.7%	2.0%	0.9%	0.4%	0.1%	2.0%	2.1%	1.5%
Δ 2008 to 2020 User Case	14.1%	13.4%	7.9%	7.0%	24.2%	10.0%	19.8%	14.8%

Scenario: market clearing price of $30/t CO2, 20% RPS, BAU reference case EE

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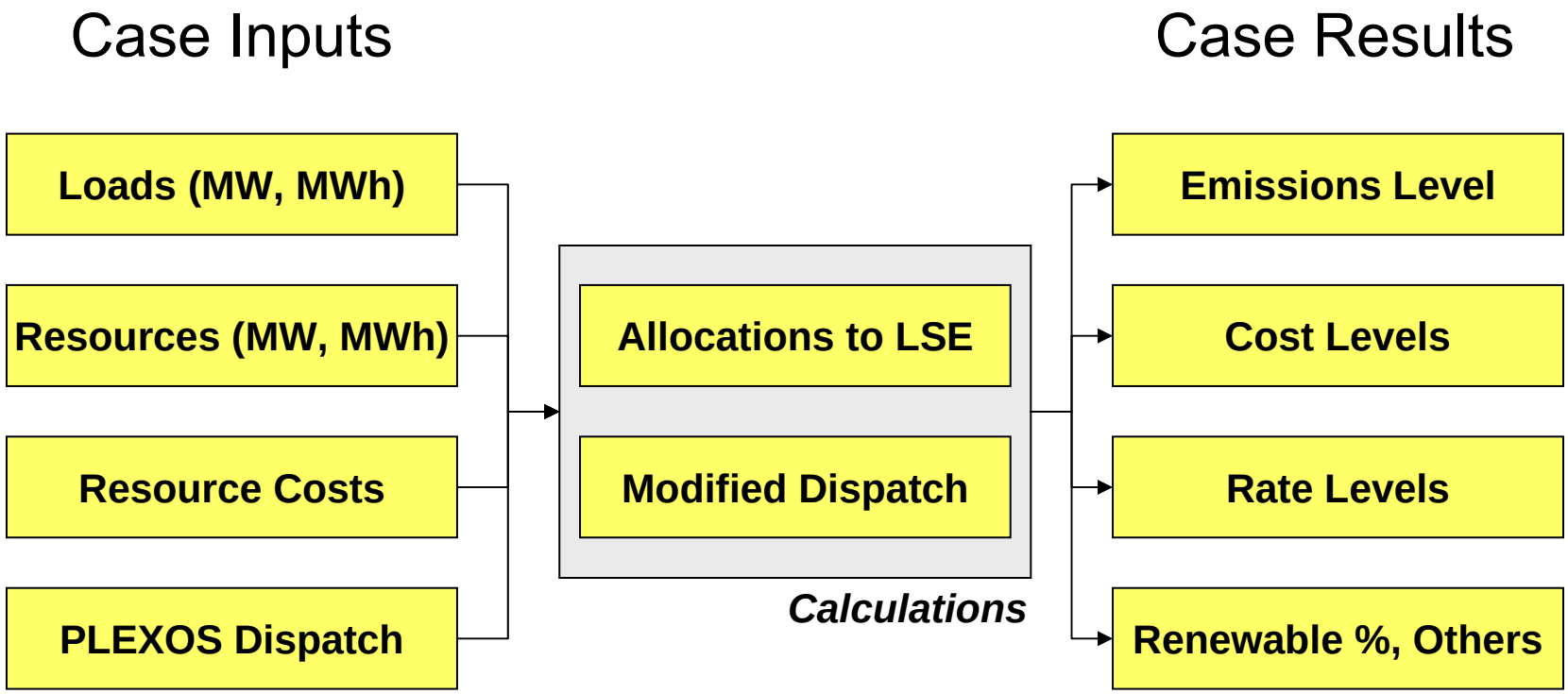
GHG Calculator Walk-through

Resource Inputs in the Model

Resources Tab

- Set Adjustments to load forecast
- Set energy efficiency, demand response, rooftop solar PV, combined heat & power
- Set renewable portfolio standard inputs
- Set additional large scale generation

E3 GHG Calculator Approach



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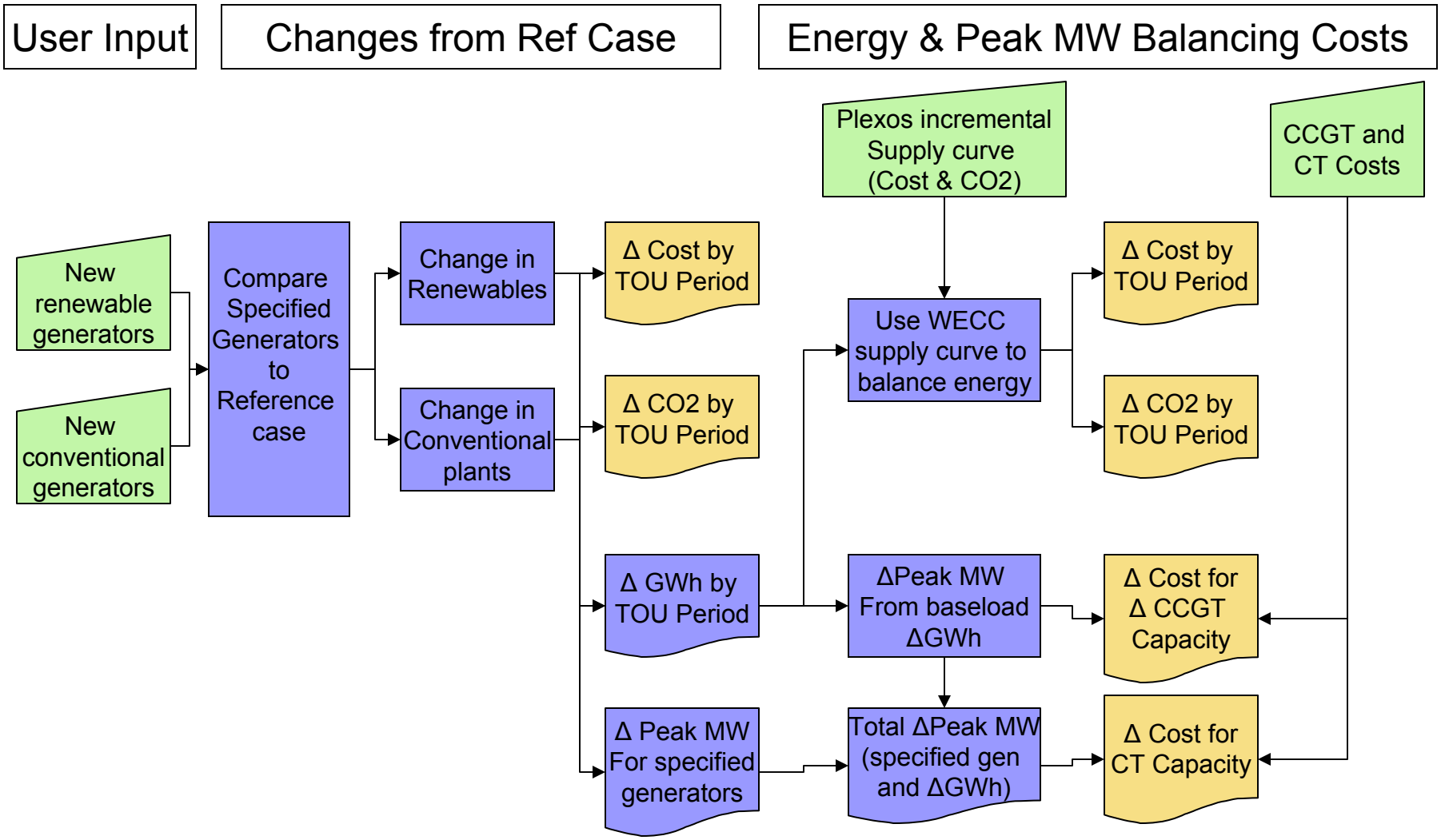
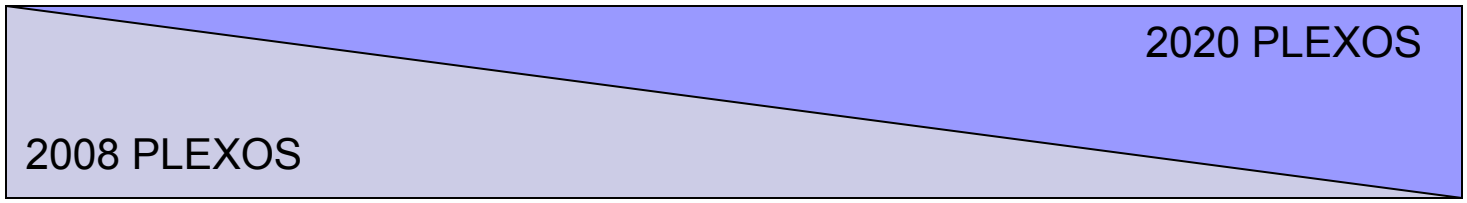
Modeling of Dispatch



Year by Year Evaluation

- Model interpolates between 2008 and 2020
- Loads adjusted by year
- Coal contracts adjusted by year
- RPS hits target by 2012, then matches growth
- Production simulation is interpolated



CO2 Market Inputs in the Model

CO2 Market Tab

- Set market price for GHG emission permits
- Set assumptions to apply to out-of-state coal contracts
- Choose whether permits will be auctioned or administratively allocated
  - If allocated, choose basis for allocation: updating output-based or historic emissions-based
- Choose whether auction revenues will be recycled to LSEs in the electricity sector
  - If recycled, choose basis for revenue reallocation: updating sales-basis or historic emissions-based
- Choose whether to allow carbon 'offsets'
  - If offsets are allowed: pick price and % allowable for several types of offsets

Generator Costs and Electricity Price

	Specified	Unspecified
In-State	VOM + Fuel cost + Generator CO2 price	MCP + Generator CO2 price (or choose VOM + Fuel cost)
Outside CA	VOM + Fuel cost + Generator CO2 price	MCP + CO2 price at the deemed emissions intensity for imports

VOM = Variable Costs plus Operation and Maintenance Costs

Generator CO2 = generator cost for emissions permit

MCP = Market Clearing Price for electricity

GHG Calculator Walkthrough

Topics to be Covered

- Layout of the GHG Calculator
  - Tabs, Inputs, Outputs, Calculation
- Review of the BAU case
- Loading alternative cases
- Review of the Aggressive Policy Case
- Review of CO2 input page
- How to document your changes for the record

Thank You