Insights from the California Energy Policy Simulator

California's Current Climate Strategy Is Unlikely to Hit the 2030 Target, but Policy Opportunities to Get on Track Are Within Reach

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ENERGY INNOVATION
POLICY & TECHNOLOGY LLC

OUTLINE

Part 1. The Energy Policy Simulator

Part 2. Current strategy evaluation

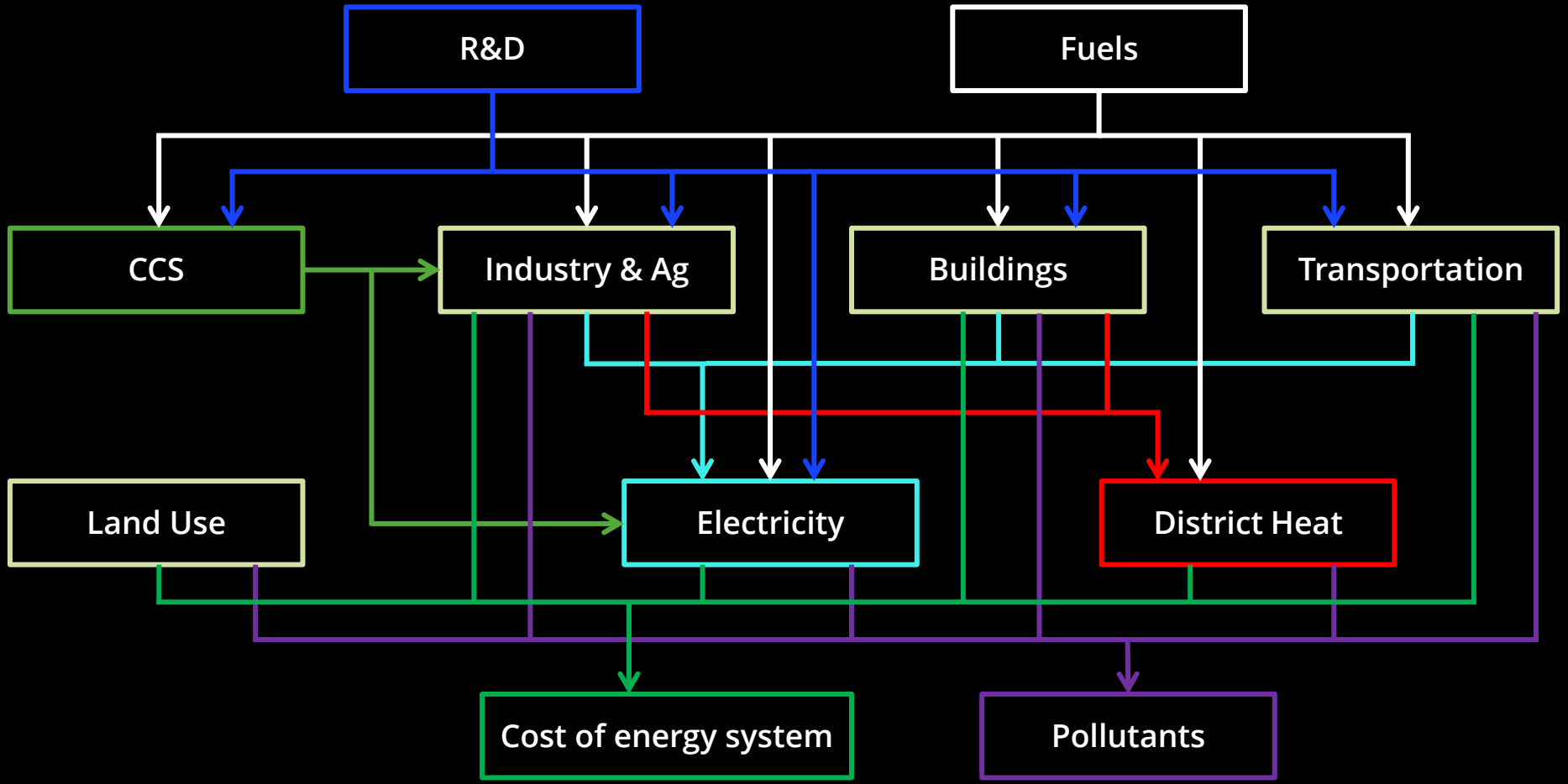
Part 3. Policy

ENERGY POLICY SIMULATOR

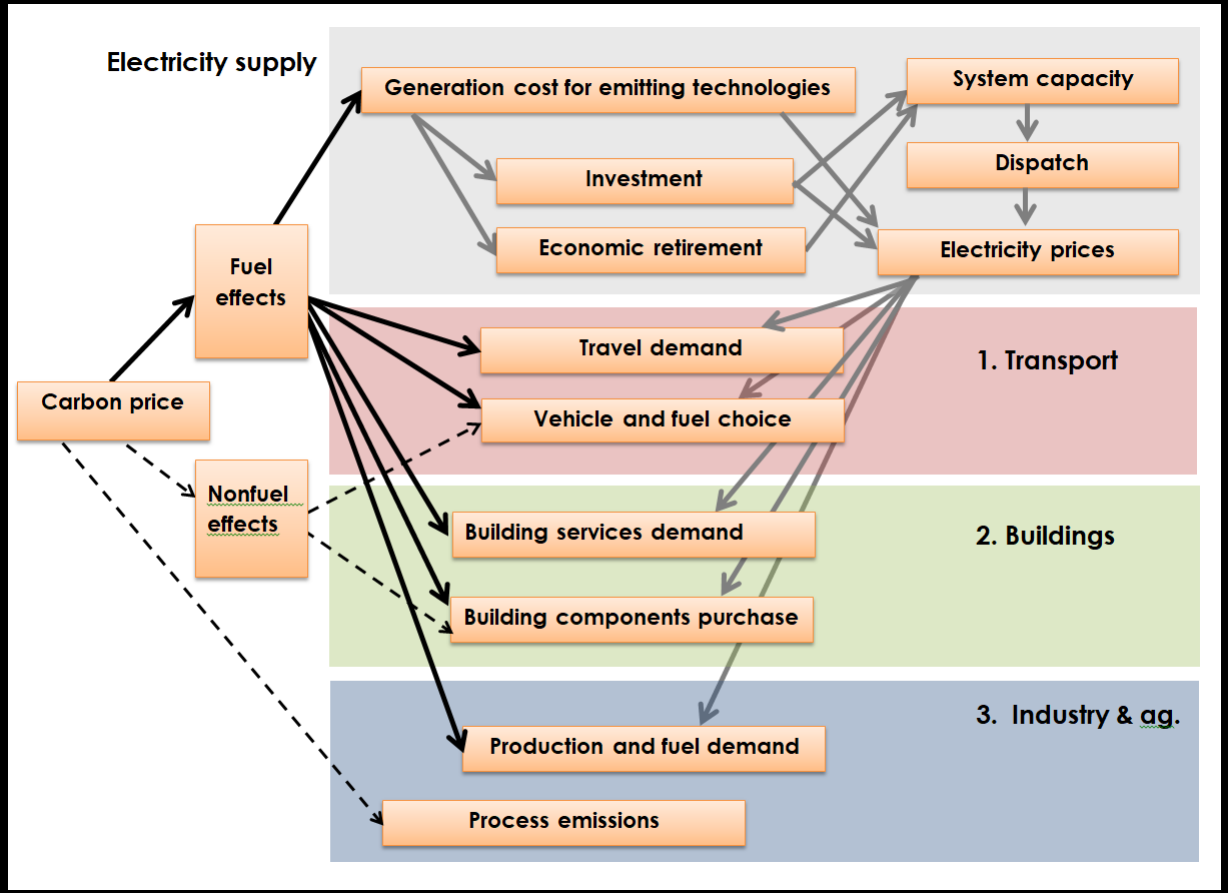
ADAPTATIONS COVER 55% OF GLOBAL GHG EMISSIONS

Web access @ https://energypolicy.solutions/

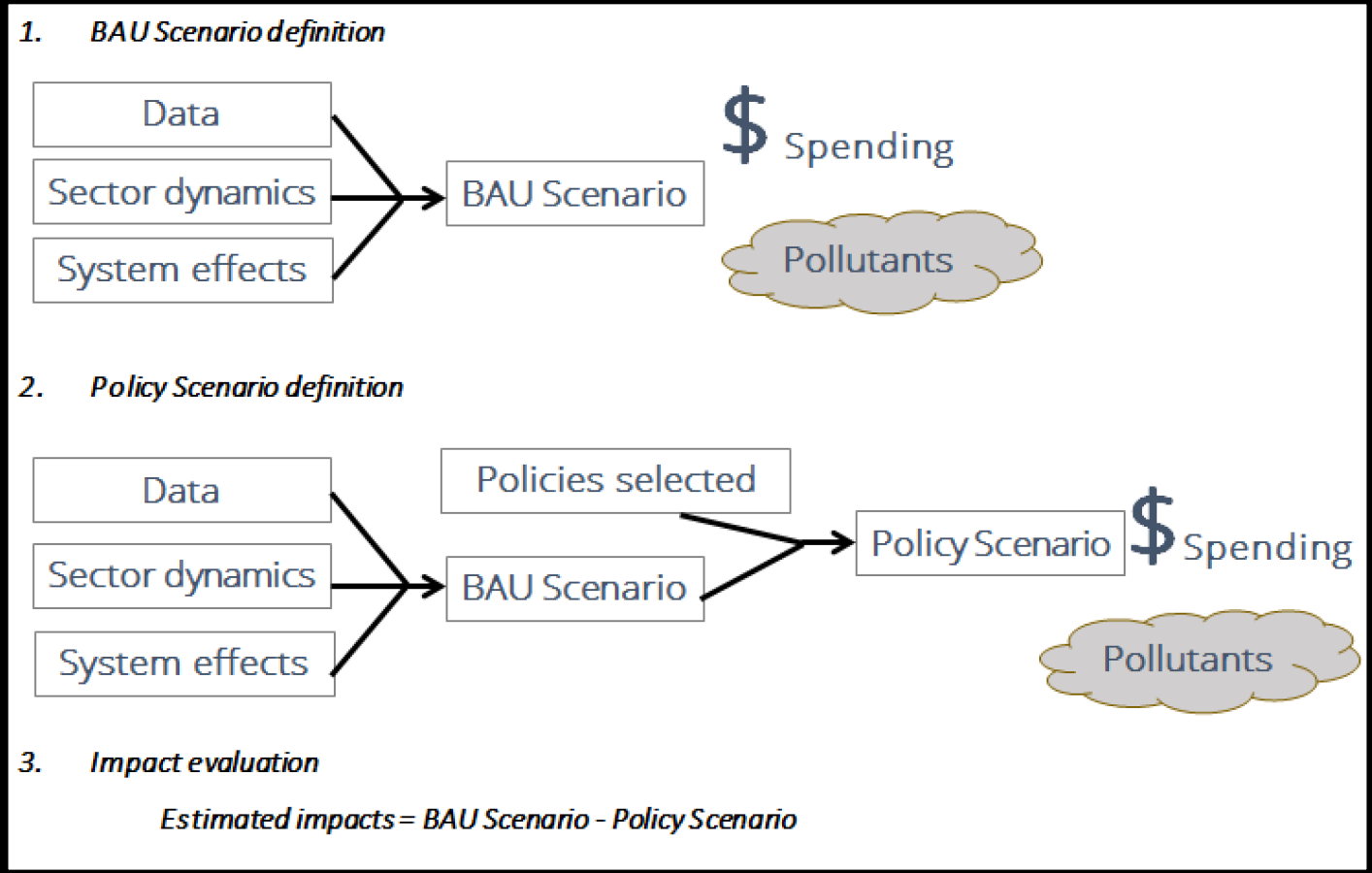
STRUCTURAL OVERVIEW



CARBON PRICE EFFECTS



IMPACT EVALUATION



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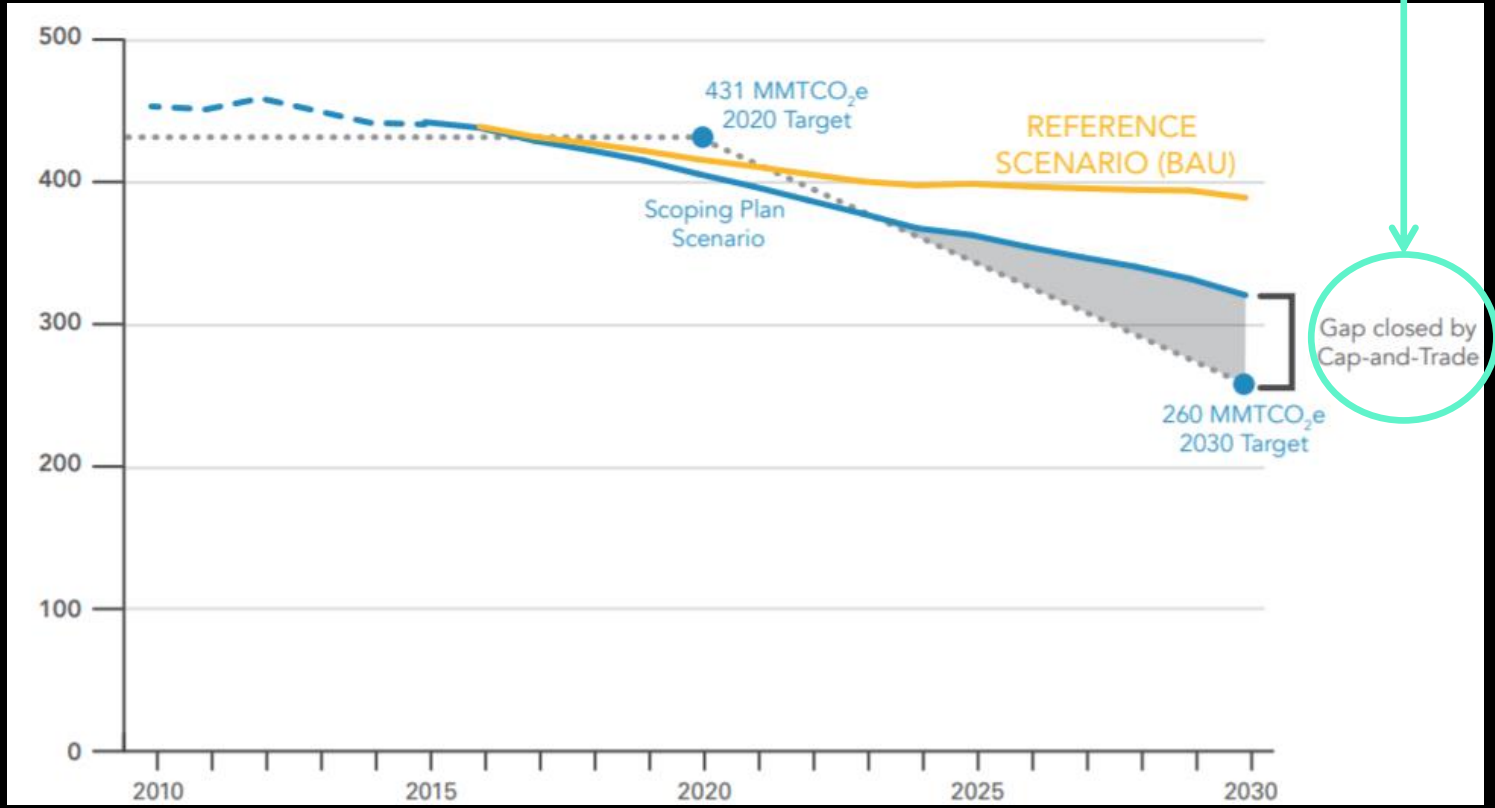
2030 STRATEGY IN 2017 SCOPING PLAN

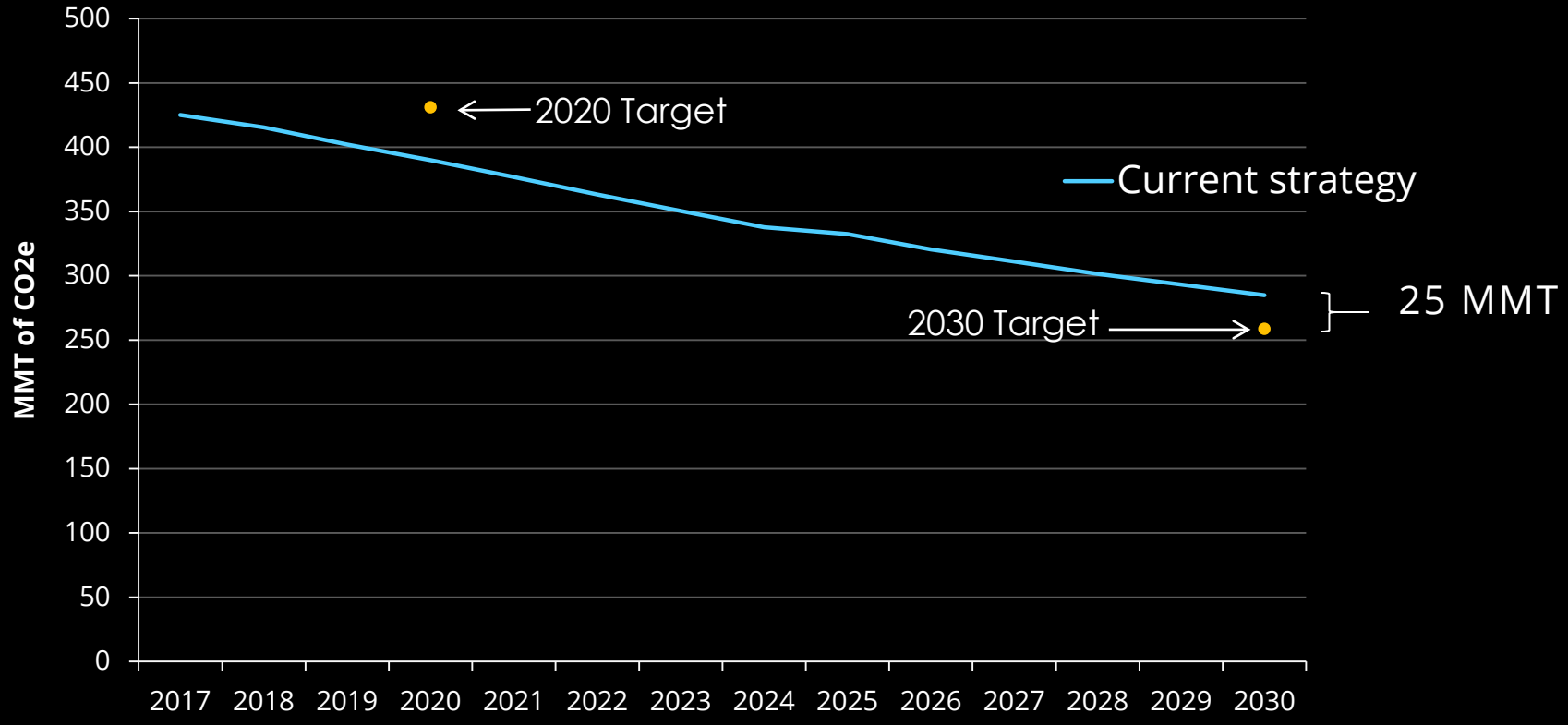
"GAP CLOSED WITH CAP-AND-TRADE"



Source: Figure 9 in 2017 Scoping Plan

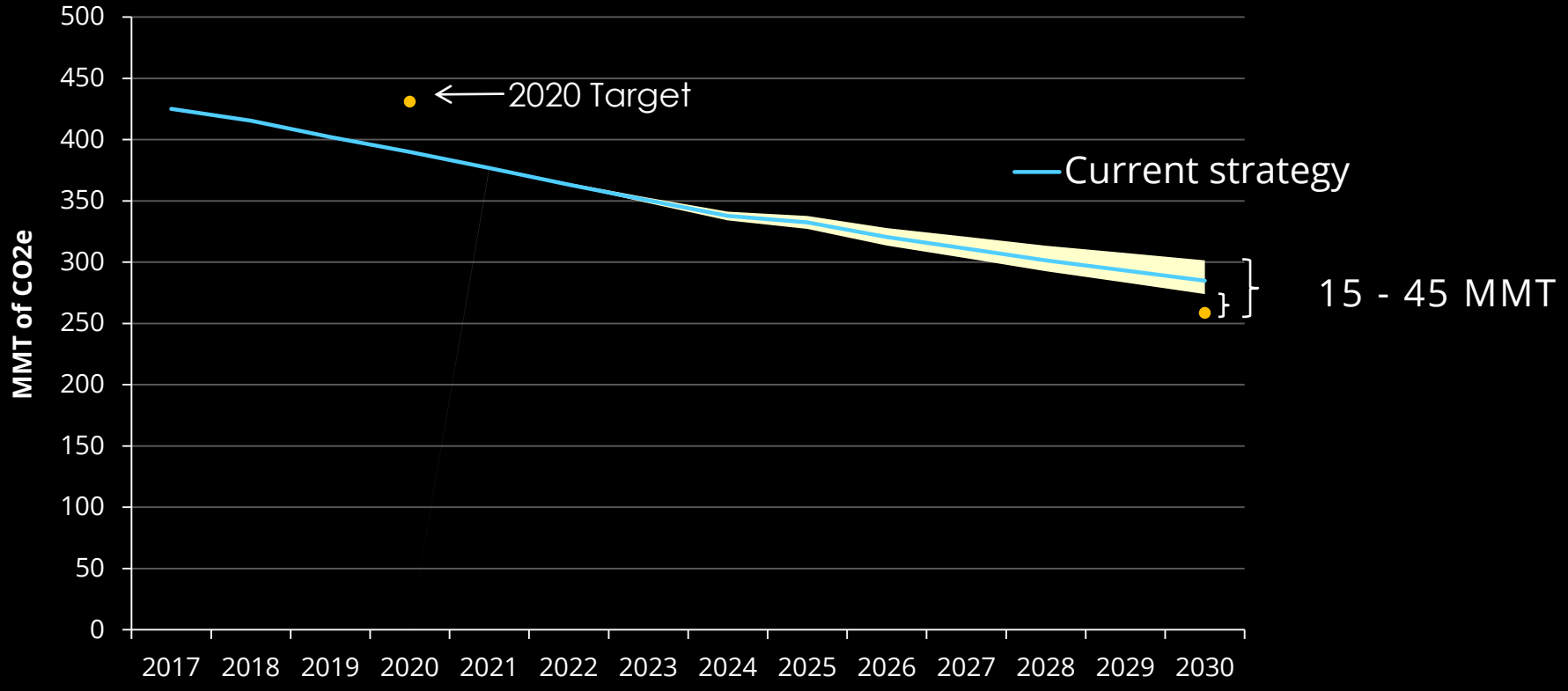
CURRENT STRATEGY EXPECTED EMISSIONS

OPTIMISTIC ASSUMPTION OF IMPLEMENTATION AS PLANNED



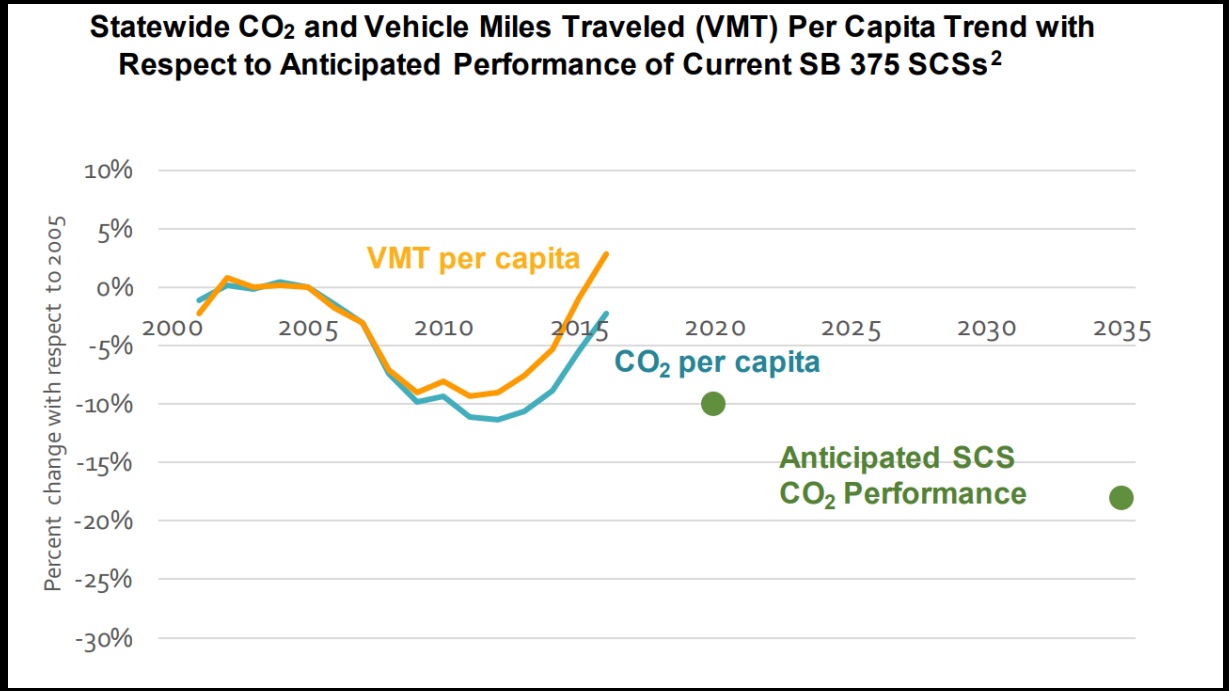
VARIATIONS ON POLICY EFFECTIVENESS

SENSITIVITY ANALYSIS FINDS GAP OF 15 – 45 MMT



SUSTAINABLE COMMUNITY STRATEGIES

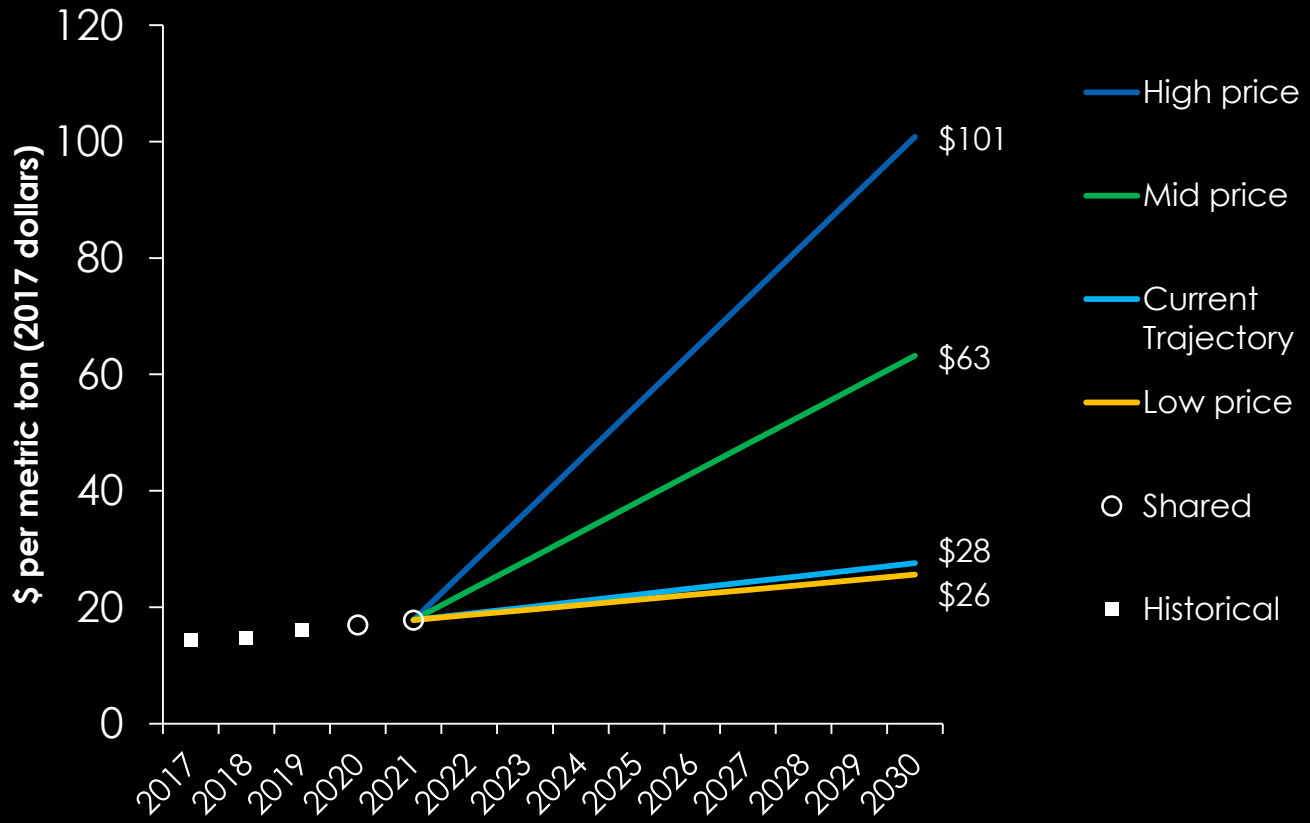
DISCONNECT BETWEEN CURRENT TREND & STATED TARGETS



Source: Air Resources Board, "2018 Progress Report on California's Sustainable Communities and Climate Protection Act"

CAP-AND-TRADE PROGRAM

PRICE SCENARIOS



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RECOMMENDATIONS OVERVIEW

POLICY	Existing or new
Cap-and-trade	Strengthen existing
Renewable portfolio standard	Strengthen existing
Zero emission vehicle deployment	Strengthen existing
Building electrification	Strengthen nascent efforts
Industry heat decarbonization requirements	New
Concrete-specific decarbonization requirements	New

INCREASE ELECTRICITY SECTOR AMBITION

BOOST THE STANDARD FOR ZERO EMISSION ELECTRICITY

Modeling of recommendation	Modeling of current strategy
• 67% RPS in 2030 • Electricity emissions 38 MMT	60% RPS in 2030 Electricity emissions 46 MMT

- Level selected to align with long range planning at CPUC.
- Shifting peak demand a cost effective opportunity at risk.

BOOST ZERO EMISSION VEHICLE GOALS

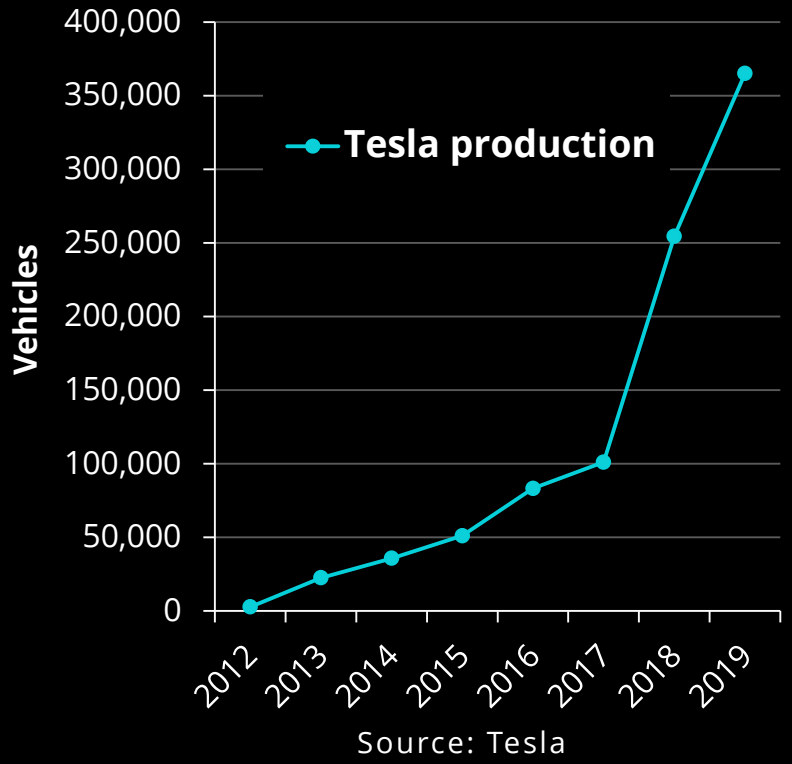
INCREASE 2030 AMBITION FOR CARS AND TRUCKS BY HALF

Modeling of recommendation	Modeling of current strategy
ZEVs grow to 7.5 million on the road Reaching 80% of new car and light truck sales in 2030	ZEVs grow to 5 million on the road Reaching 50% of new car and light truck sales in 2030

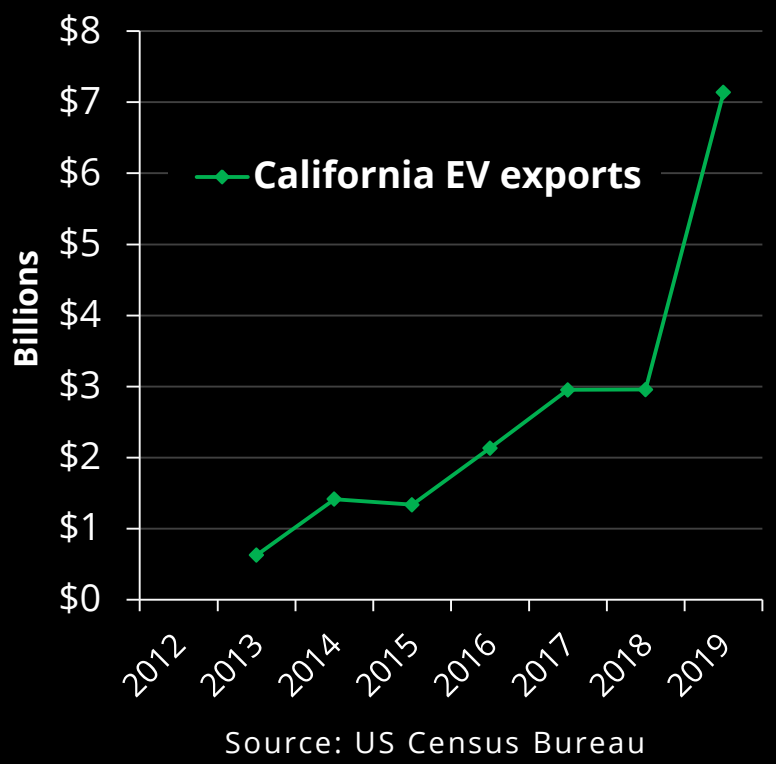
- Waiver revocation complications
- Will require a portfolio of measures, including building infrastructure

ZERO EMISSION VEHICLES

Electric vehicles were California's **2nd most valuable export** in 2019



Source: Tesla



Source: US Census Bureau

BUILDING ELECTRIFICATION

TAKE ADVANTAGE OF OPPORTUNITIES IN BUILIDNG HEAT

Modeling of recommendation	Modeling of current strategy
Advanced heat pumps grow to at least 50% of sales of new water heater and space heaters for the residential market	No advanced heat pumps expected

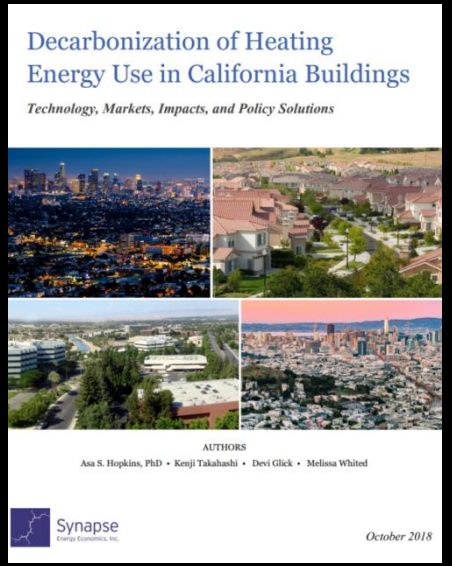
- Challenge created by federal preemption
- Market transformation will require a portfolio of state - local measures

BUILDING ELECTRIFICATION

CAPITAL COST SAVINGS IN SYNAPSE STUDY

- Installed cost comparing assuming heating and cooling service provision

Building type	Natural gas	Heat pump	Savings
New construction			
Single family	$7,997	$6132	$1865
Multi family	$6065	$4506	$1559
Retrofit			
Single family	$9,628	$7,342	$2,286
Multi family	$6,065	$4,506	$1,559

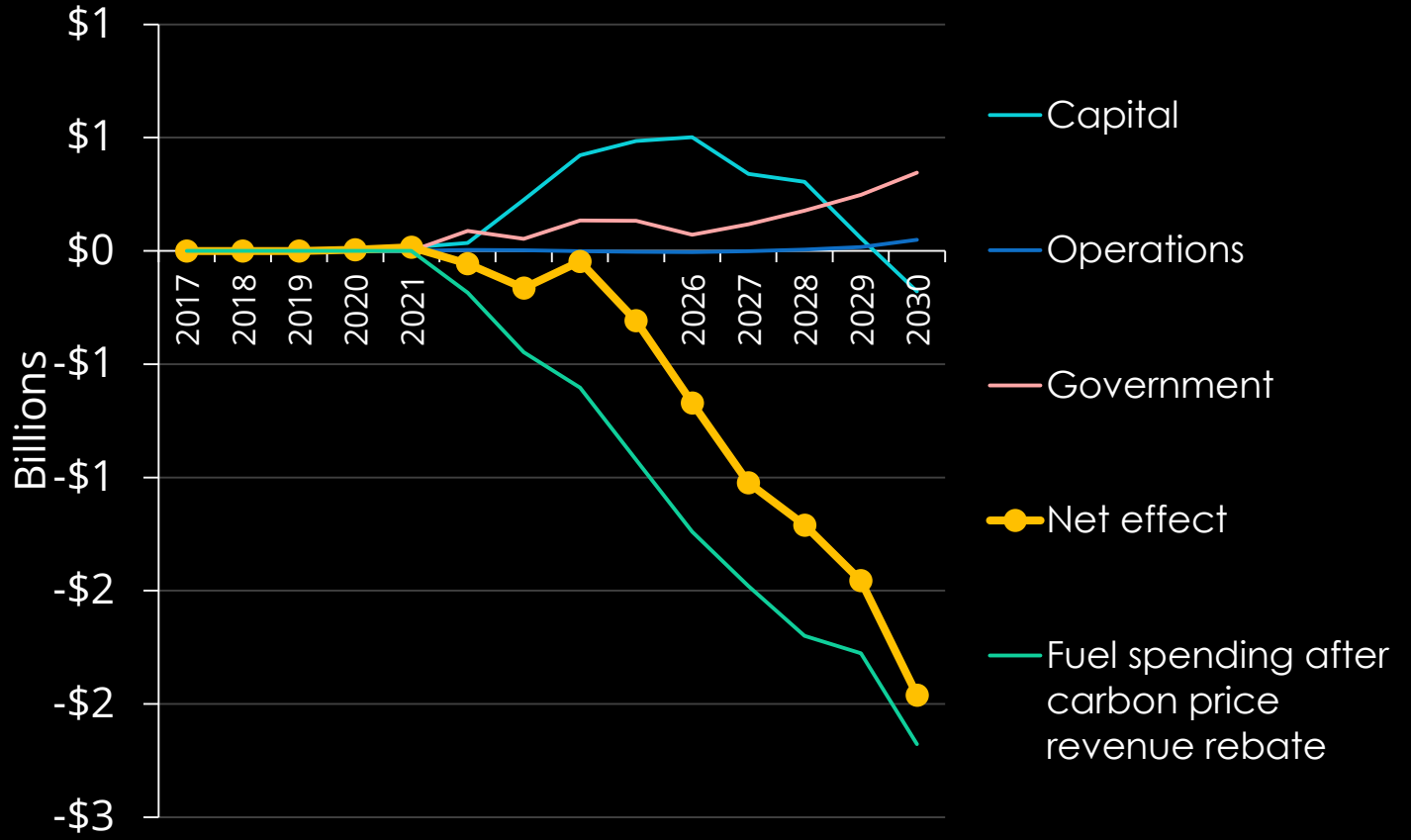


IMPORTANCE OF PEAK LOAD SHIFTING

SENSITIVITY ANALYSIS ON COST IN ITS ABSENCE

		Economic impact
Clean energy standard	With demand shift	$3.9 per metric ton
	Without demand shift	$40 per metric ton
Building electrification	With demand shift	– $58 per metric ton
	Without demand shift	$52 per metric ton

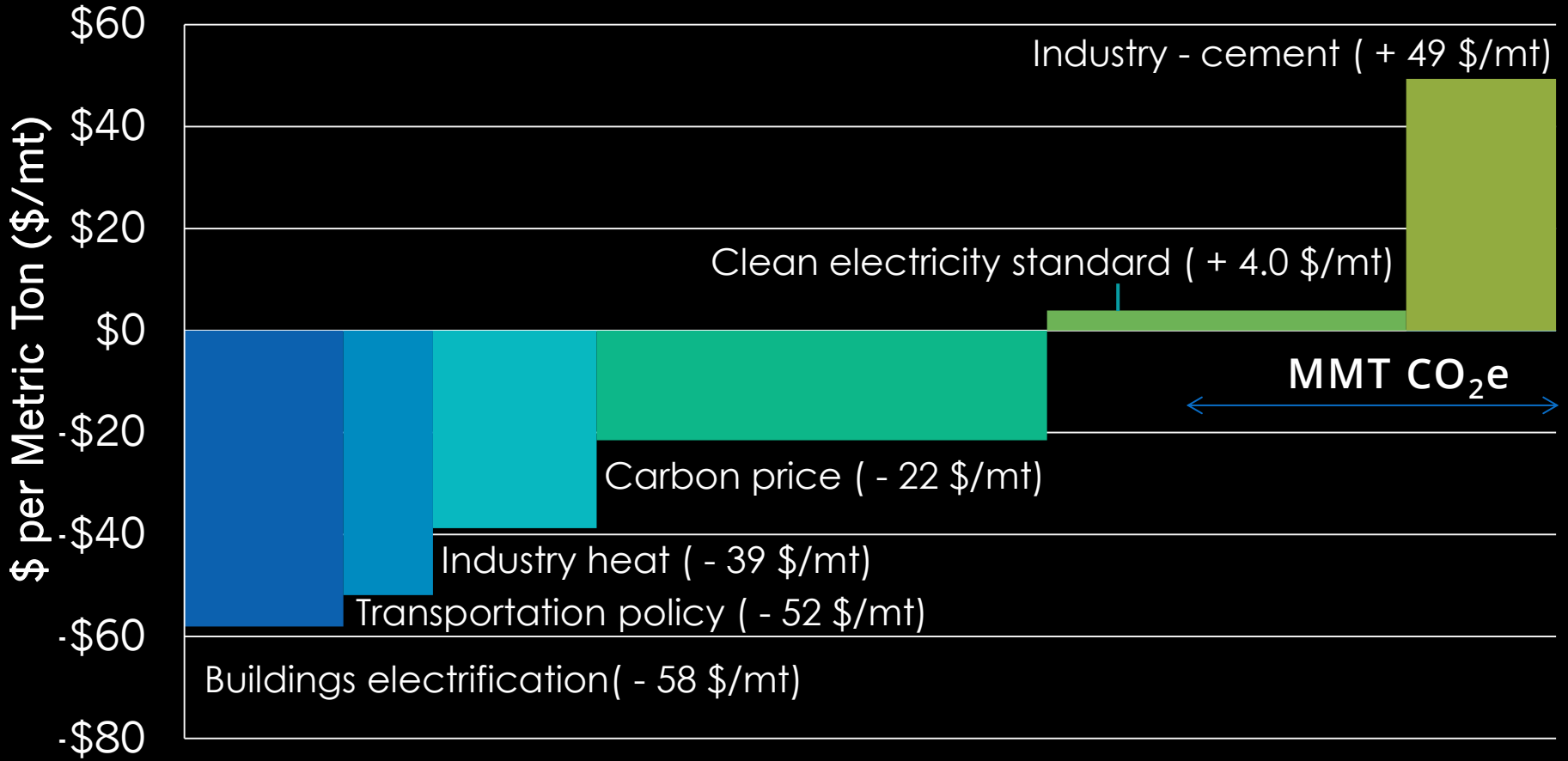
ECONOMIC COST COMPONENTS



Fuel saving origins:

- EVs ~3x more efficient
- Renewables have no fuel cost
- Conservation

ECONOMIC AND EMISSION IMPACTS BY POLICY



CONCLUSION

Promise

- Innovation is paying off and more is in the pipeline
- Policy strengthening benefits estimated as $7 billion economic + $14 billion social

Peril

- Current policies appear unlikely to put the state on track for deeper decarbonization goals.
- Delay increases the future degree of difficulty

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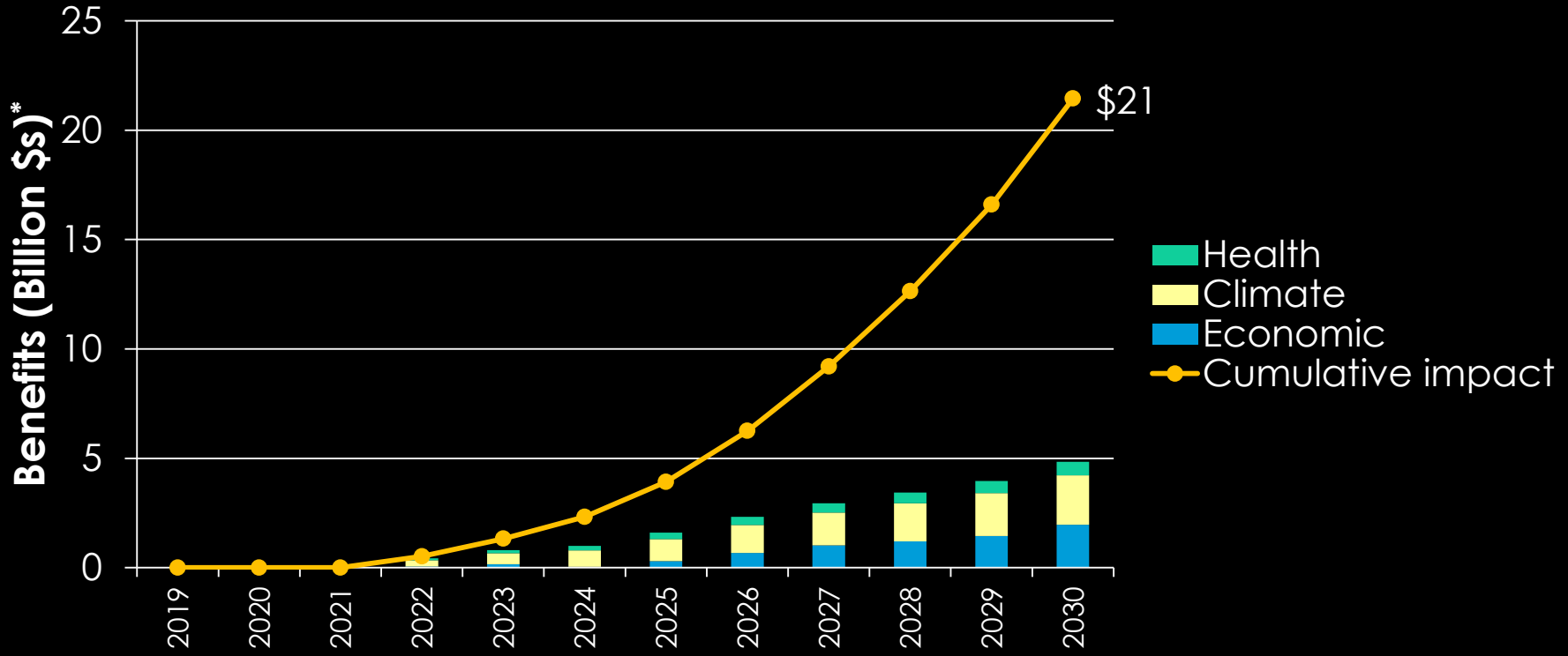
THANK YOU

DETAILED IMPACT ESTIMATES BY POLICY

Sector	Policy	2030 Reductions (MMT of CO_2e)	Costs ($ per metric ton)	
			Economic	Economic + Social
Buildings	Electric heat pumps	2.0	– $59	– $120
Transport	Zero emission vehicles	1.8	– $52	– $140
Industry	Heat standard	1.8	– $39	– $98
Cross-sector	Cap-and-trade	9.8	– $21	– $76
Electricity	Clean energy standard	8.0	$4	– $46
Industry	Clean concrete standard	3.1	$49	$6

ESTIMATED IMPACTS DUE TO THE PACKAGE OF SIX RECOMMENDATIONS



*Monetary results in 2017 dollars discounted at 3% annually

1. FORTIFY CAP-AND-TRADE PROGRAM

LINK PRICE FLOOR TO PROGRESS TOWARD 2030 TARGET

How it would work

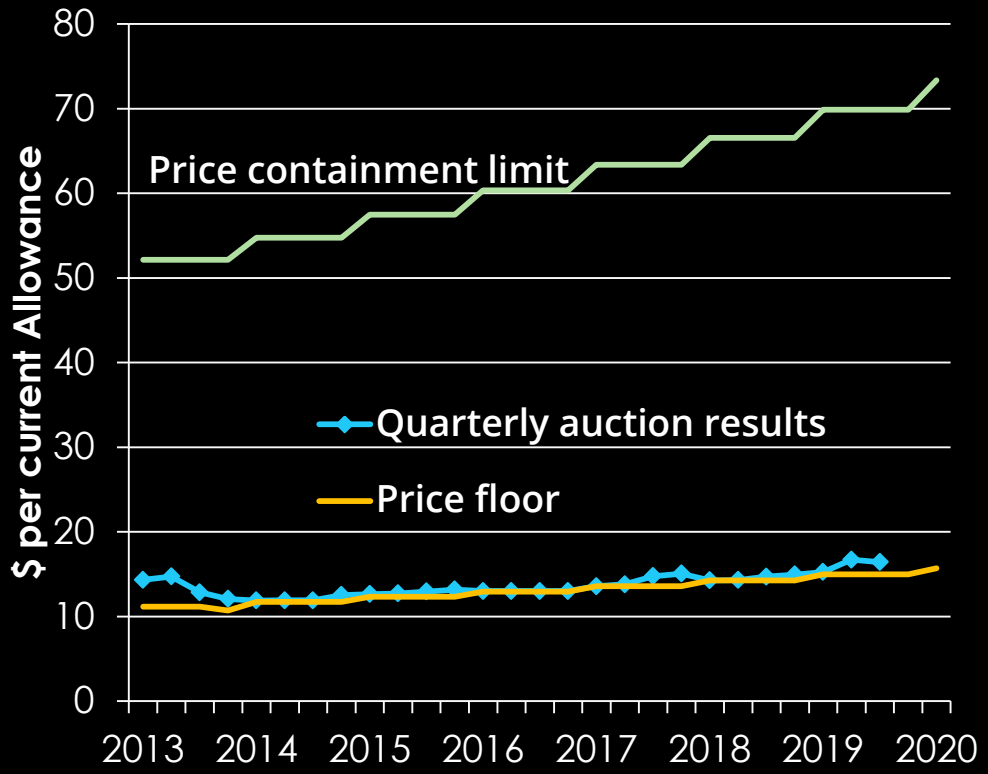
- Price floor rises more quickly if emissions are not on track.
- If emission are on track, pause the annual adjustment.

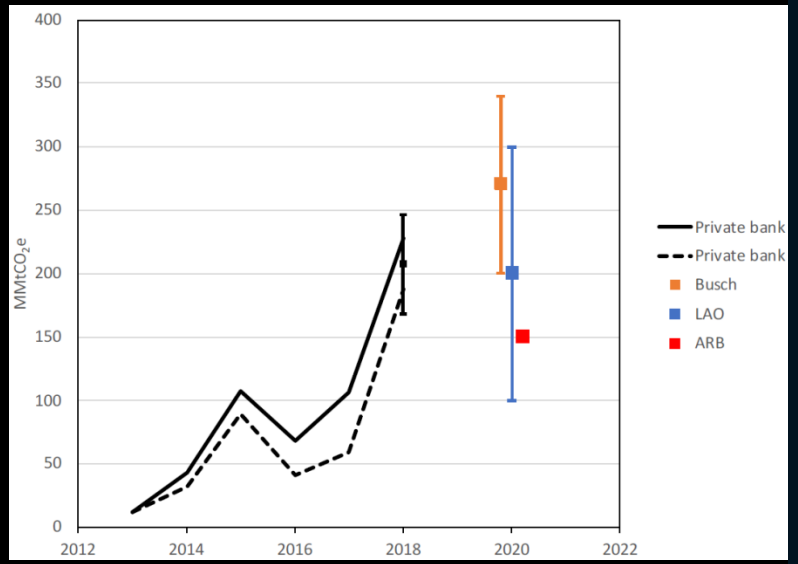
Modeling of recommendation	Modeling of current strategy
Price rises to $63 in 2030	Price rises to $29 in 2030

Advantages

- Connection between environmental performance and price
- Dampening speculative pressure on price

1. CAP-AND-TRADE PROGRAM BACKGROUND

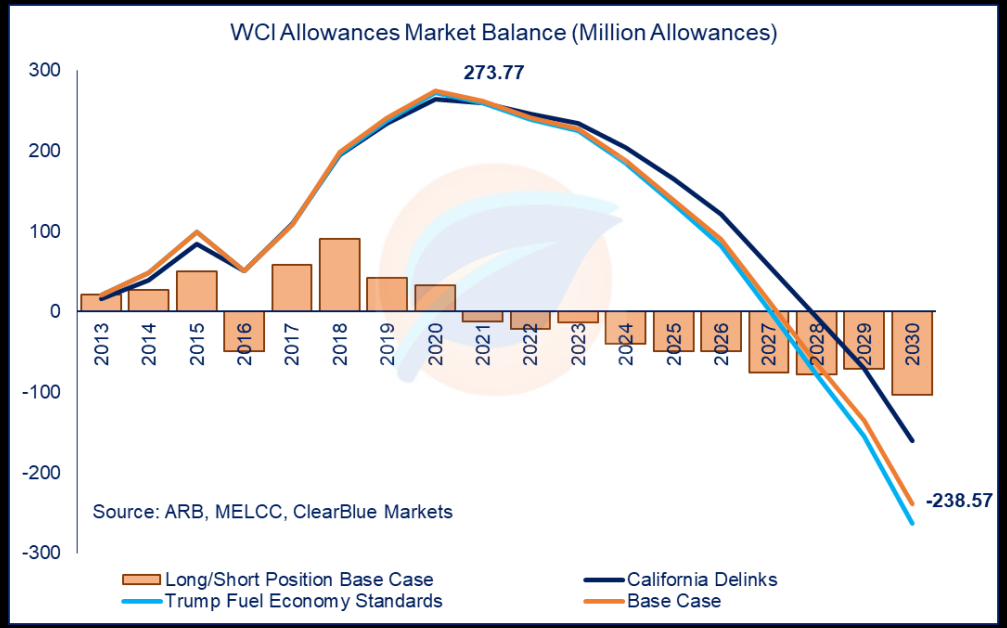




Source: NearZero

ClearBlue Market Carbon Market Analysis

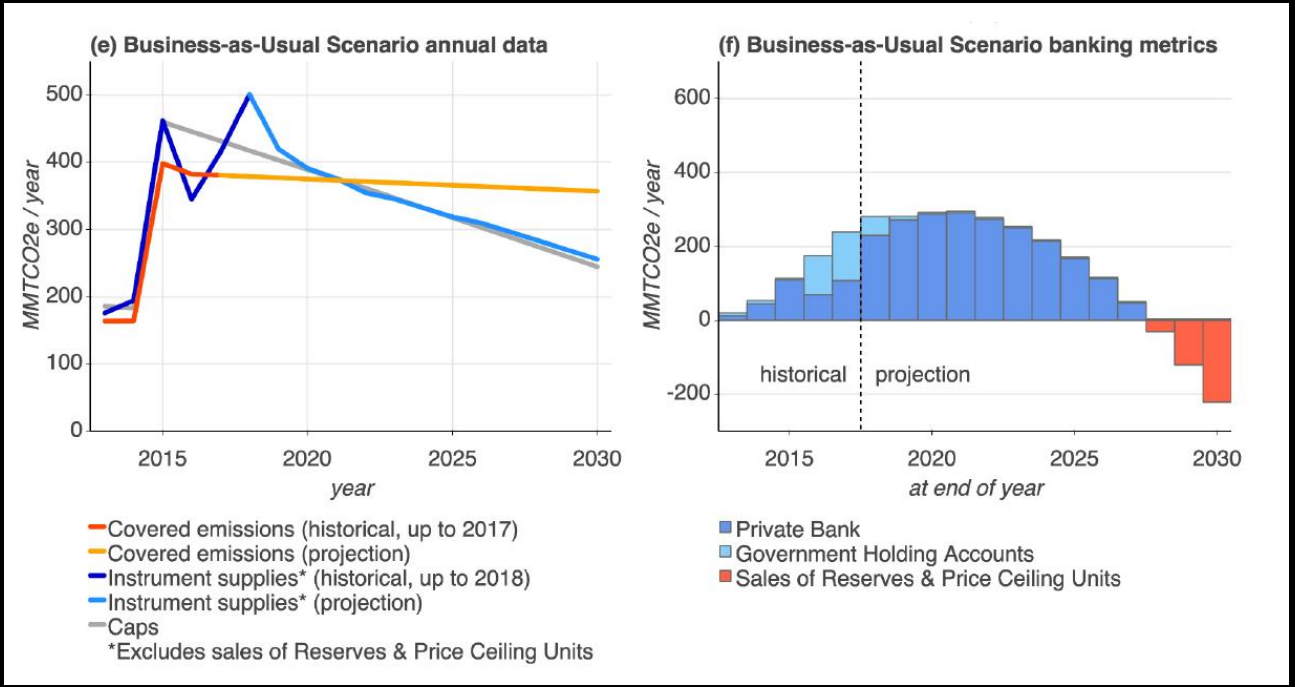
- The oversupply in the market is projected to peak in 2020 between 260-280M.
- The market is expected to see a yearly deficit starting in 2021
- The bank of unused allowances will be drawn by 2027, assuming market participants decide to use these allowances.



Source: ClearBlue Markets

ANALYSIS BY NET ZERO

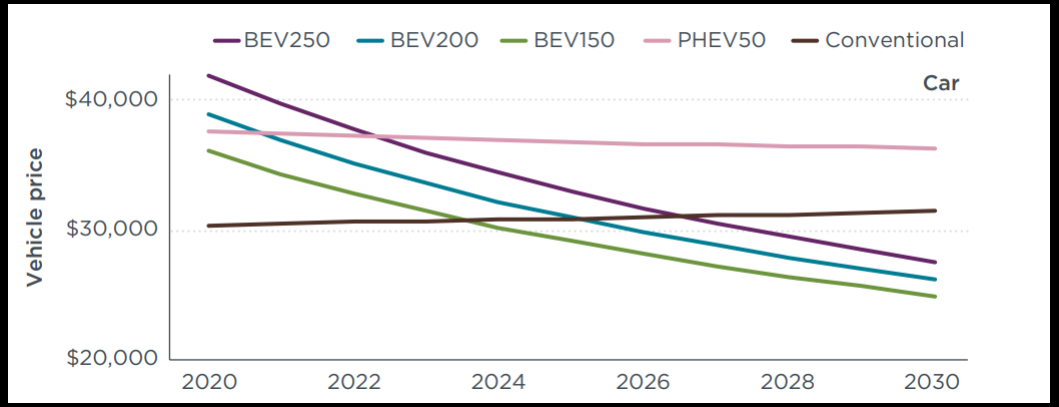
DEMONSTRATES HOW CLEAR BLUE FORECAST, NET SHORT OVER 200 MMT, IS A RESULT OF EMISSIONS SIGNIFICANTLY ABOVE LEVELS NEEDED TO REACH THE 2030 TARGET

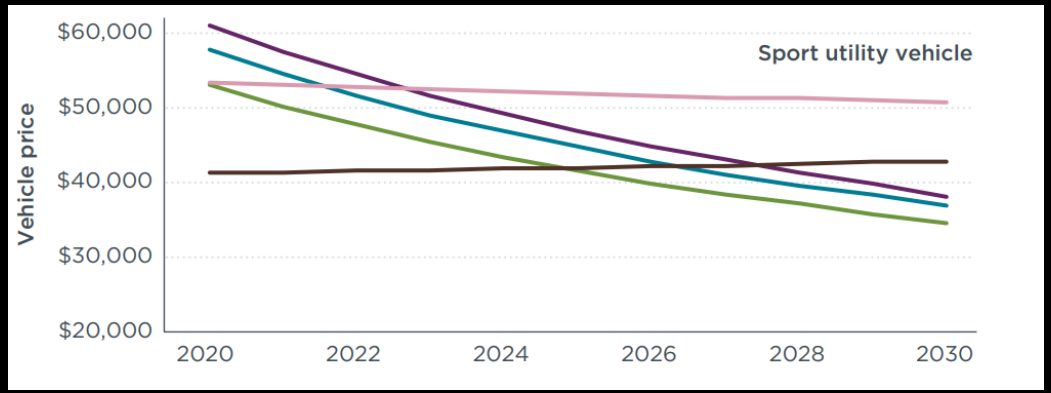


Inman et al. (2019), WCI-RULES model, https://osf.io/s7hq3/

3. ZERO EMISSION VEHICLE (ZEV) MANDATE

Encouraging trends in battery and vehicle cost





Source: International Council on Clean Transportation

3. ZERO EMISSION VEHICLES

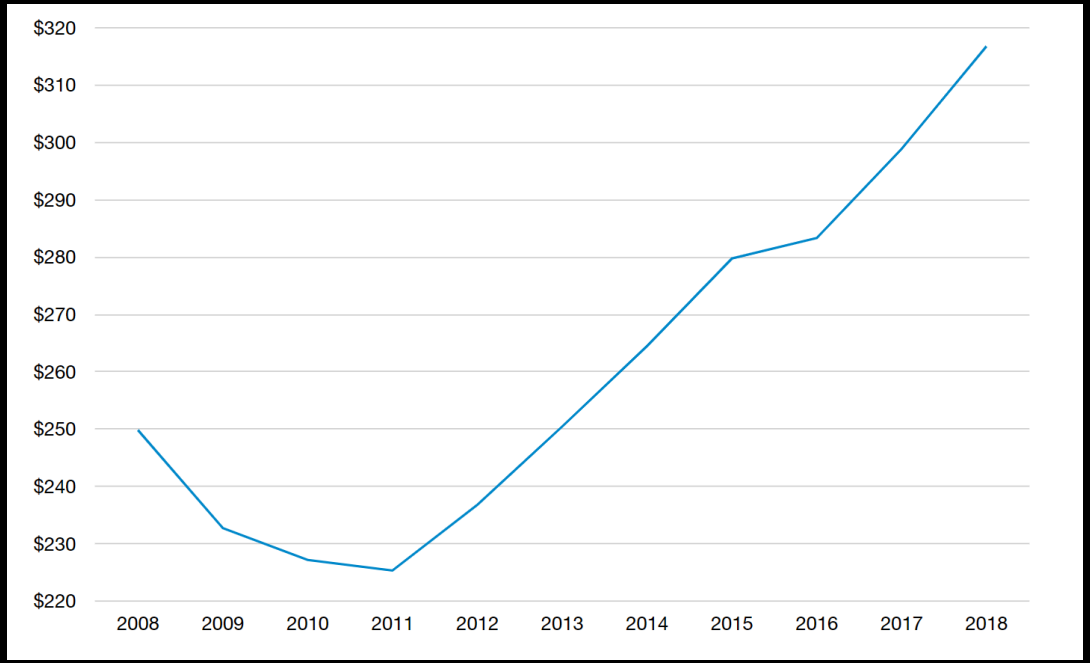
GOOD JOBS POTENTIAL

- EV manufacturing 6th largest contributor to manufacturing job growth in 2018 when EV's were ranked 8th in exports.
- Stipulate importance of good jobs and need to address labor problems at Tesla.
- BYD and Proterra also manufacturing in CA.

3. ZERO EMISSION VEHICLES

EV MANUFACTURING ILLUSTRATIVE OF LARGER TRENDS

California Manufacturing Output (Billions 2018$s)



National Assoc. of Manufacturers graphic and data

California manufacturing <u>2008-2018 trends:</u>

- Output +27%
- Exports +23%

5. INDUSTRY HEAT DECARBONIZATION

THE TECHNOLOGY

- Existing technology: solar thermal steam
  - Mirrors concentrate sunlight to make steam
  - Roughly 20% of California's natural gas demand due to steam for oil production

- Emerging options for higher temperatures
  - Advanced solar thermal
  - Green hydrogen combustion

Photo sources: GlassPoint Solar and Heliogen

5. INDUSTRY HEAT DECARBONIZATION

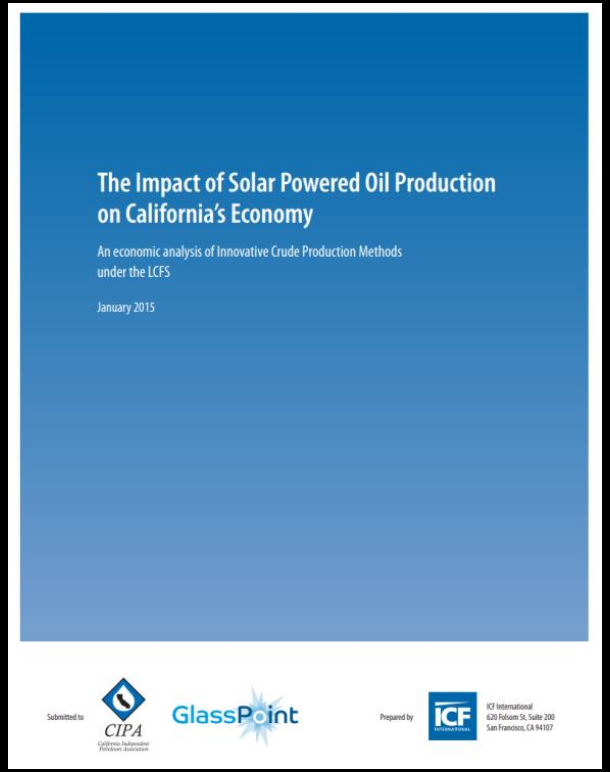
SET CARBON INTENSITY STANDARDS FOR INDUSTRIAL HEAT

Modeling of recommendation	Modeling of current strategy
• Displaces 12% of natural gas steam use for oil extraction in 2030 • Equivalent to displacement of 6% of all industry natural gas (excludes electricity)	No deployment

- Goal of investment-grade policy
  - "Financial trouble, design changes delay major solar project in west Kern oilfield," Sept. 19, 2019, *The Bakersfield Californian*

5. INDUSTRY HEAT GHG STANDARD
TECHNICAL FEASIBILITY

- Feasibility evident in overlap with CARB's "illustrative compliance scenario calculator."
- EI Scenario reaches half of ICF "Accelerated Deployment" scenario.
- ICF quantifies job and macroeconomic benefits due to higher in-state content (outside of EPS scope).



6. CLEAN CONCRETE STANDARD TECHNOLOGY

- Largest source of coal combustion in California.
- Existing technology options
  - Process innovation, e.g. Carbon Cure, Blue Planet
  - Energy efficiency
  - Switch to natural gas, electricity, green hydrogen
  - Carbon capture and sequestration

6. CLEAN CONCRETE STANDARD

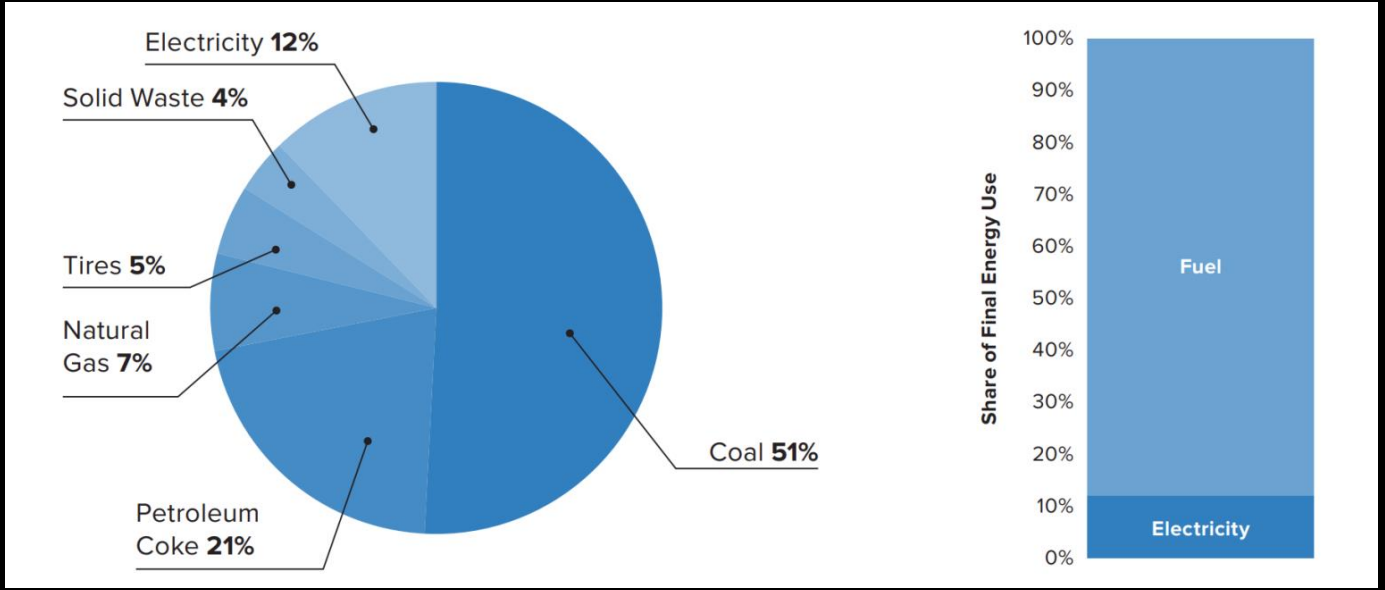
A DECLINING CARBON INTENSITY STANDARD

Modeling of recommendation	Modeling of current strategy
Emissions fall ~50%	Emissions fall ~20%

- Regulation possible with existing authority
- Include border adjustment on imports to ensure level playing field
- Low carbon concrete option would capitalize on low carbon fuel standard success defending against legal challenges

6. GHG EMISSION STANDARD FOR CONCRETE
BACKGROUND

California energy mix cement and concrete production in 2015



Source: Global Efficiency Intelligence 2019