

Preliminary Economic Analysis

California Air Resources Board

Economic Modeling

- Goal: Evaluate the economic impact of options for achieving the 2030 GHG target
 - Estimate the economic impact of various technology pathways and carbon pricing
 - Inform measure development
 - Assess the economic impact of options for achieving the 2030 emissions target on the California economy, California businesses, and individuals
- Tools: California PATHWAYS and Regional Economic Models, Inc. (REMI)

Models and Cost Estimation

▣ PATHWAYS

- ▣ Estimates direct technology, energy, and fuel costs of the GHG reduction scenarios
- ▣ Data sources for costs include:
 - ▣ EIA Annual Energy Outlook (AEO) for fuel price projections
 - ▣ CPUC RPS Calculator for renewable generation costs
 - ▣ National Energy Modeling System (NEMS) for residential and commercial technology costs

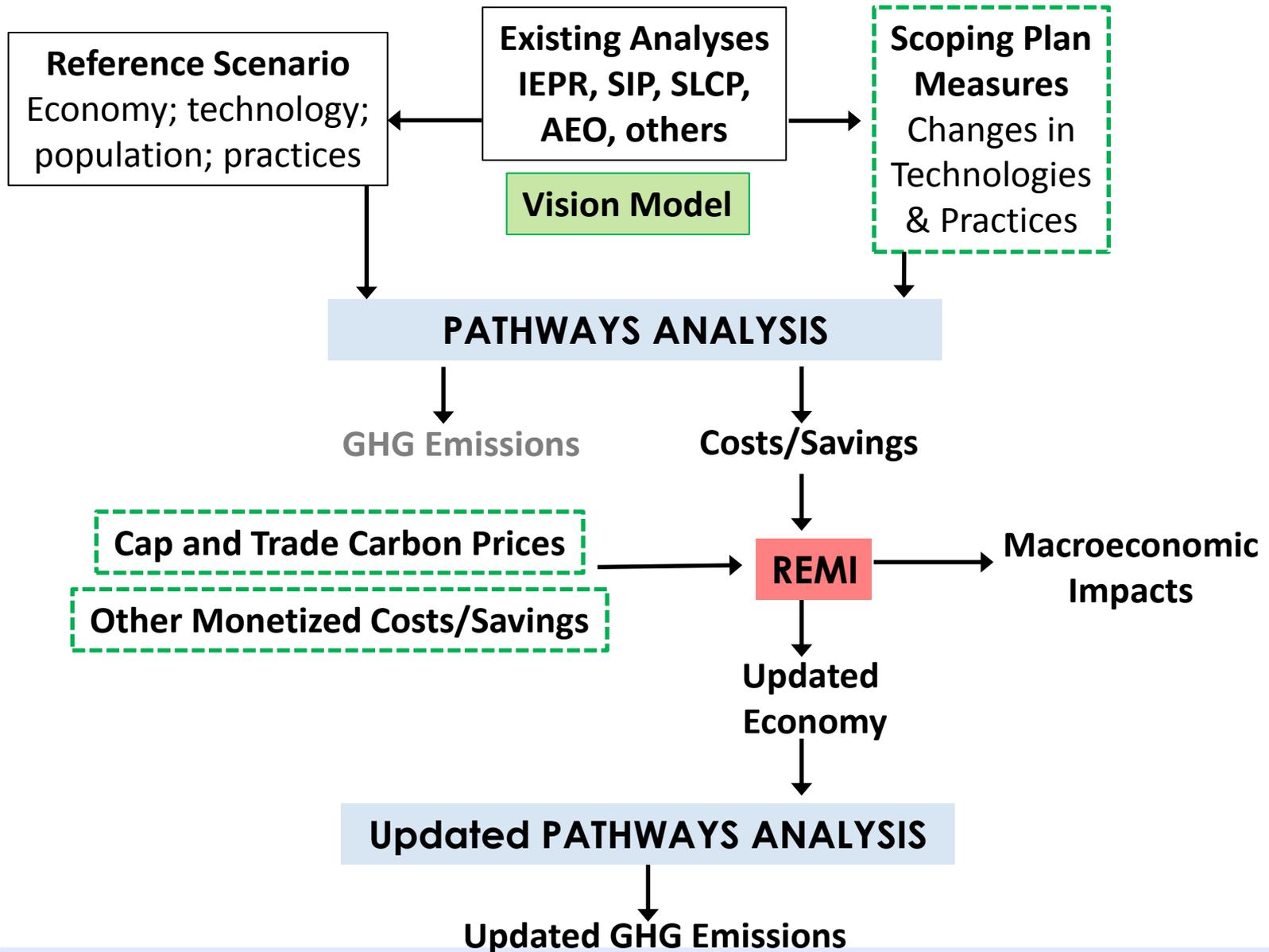
▣ REMI

- ▣ Models the economic impact of GHG reduction scenarios on the California economy
- ▣ Uses technology and fuel costs from PATHWAYS as an input
- ▣ Estimates the indirect and induced impacts of GHG reduction scenarios
- ▣ Provides estimates of impact of scenarios on industrial sectors, individuals, and overall California economy

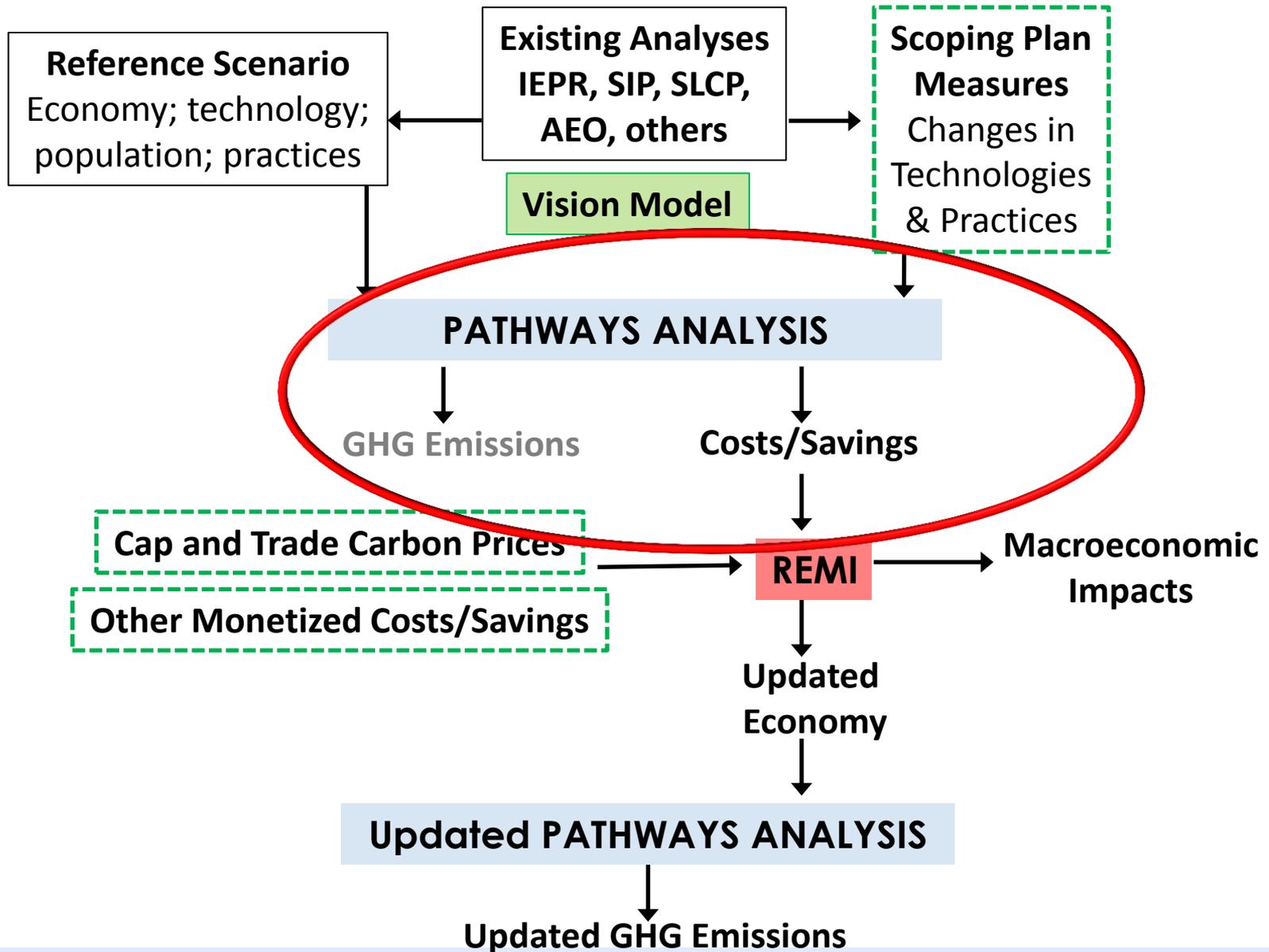
Social Cost Considerations

- AB 197 directs ARB to identify the cost-effectiveness, including avoided social cost, for each measure in the Scoping Plan
- AB 197 cost-effectiveness calculations will be included in the draft 2030 Target Scoping Plan

SCOPING PLAN ECONOMIC ANALYSIS



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PATHWAYS Cost Accounting

▣ Included

- ▣ Direct energy sector costs and savings by sector
 - ▣ Household, commercial, industrial, trucking, etc.
 - ▣ Annualized capital costs
 - ▣ Annual energy costs
- ▣ Electricity and natural gas rates are calculated, other fuel prices are inputs
- ▣ Mitigation costs of short-lived climate pollutants
- ▣ Federal incentives and tax credits

▣ Not Included

- ▣ Cap and trade or carbon tax impacts
- ▣ Structural/macroeconomic changes to the economy
- ▣ Climate or health benefits of GHG mitigation
- ▣ Criteria and toxic pollutant emissions
- ▣ In-state transfers or incentive payments

Scenarios

- **Draft Scoping Plan Policy Scenario – Includes Cap-and-Trade and Direct Regulations**
 - Cap-and-Trade Program is needed to achieve 2030 GHG target
 - Cap and Trade carbon price modeled in REMI

- **Alternative 1 – No Cap-and-Trade with Focus on Direct Regulations**
 - Additional direct regulations
 - More modeling work needed to meet 2030 GHG target
 - ARB requests input on closing GHG gap of 5 MMT in 2030

- **Alternative 2 – Includes Carbon Tax and Direct Regulations**
 - Uncertain if Alternative 2 will meet 2030 GHG target
 - Carbon tax structure and return of revenue currently undefined
 - Will be included in the draft 2030 Scoping Plan Update

Preliminary Direct Cost Estimates in 2030 Relative to Reference Case

Scenario	2030 GHG Reductions	2030 Stock Costs (Billion \$2012)	2030 Fuel Costs (Billion \$2012)	2030 Total Cost (Billion \$2012)
Draft Scoping Plan Scenario	90.5	\$6.2	-\$4.5	\$1.7
Alternative 1	127.3	\$8.7	\$1	\$9.7

- Results represent the GHG reduction scenarios as modeled in PATHWAYS
- Results do not reflect the cost and GHG reductions associated with the Cap-and-Trade Program in the Draft Scoping Plan Scenario (modeled in REMI)

Areas of Cost Uncertainty Draft Scoping Plan Scenario

See slide 20 for details on the measures within the Draft Scoping Plan Scenario

- ▣ Mobile Source Strategy and Transportation
 - ▣ Cost of achieving reductions in vehicle miles traveled are not estimated
 - ▣ Capital cost of efficiency improvements in aviation, rail and ocean-going vessels are not included in the modeling
- ▣ Refining Measure
 - ▣ Capital cost is not estimated
- ▣ Demand Response and Flexible Load
 - ▣ Flexible loads do not include any capital cost estimates
- ▣ Energy efficiency
 - ▣ Costs of behavioral conservation are not estimated

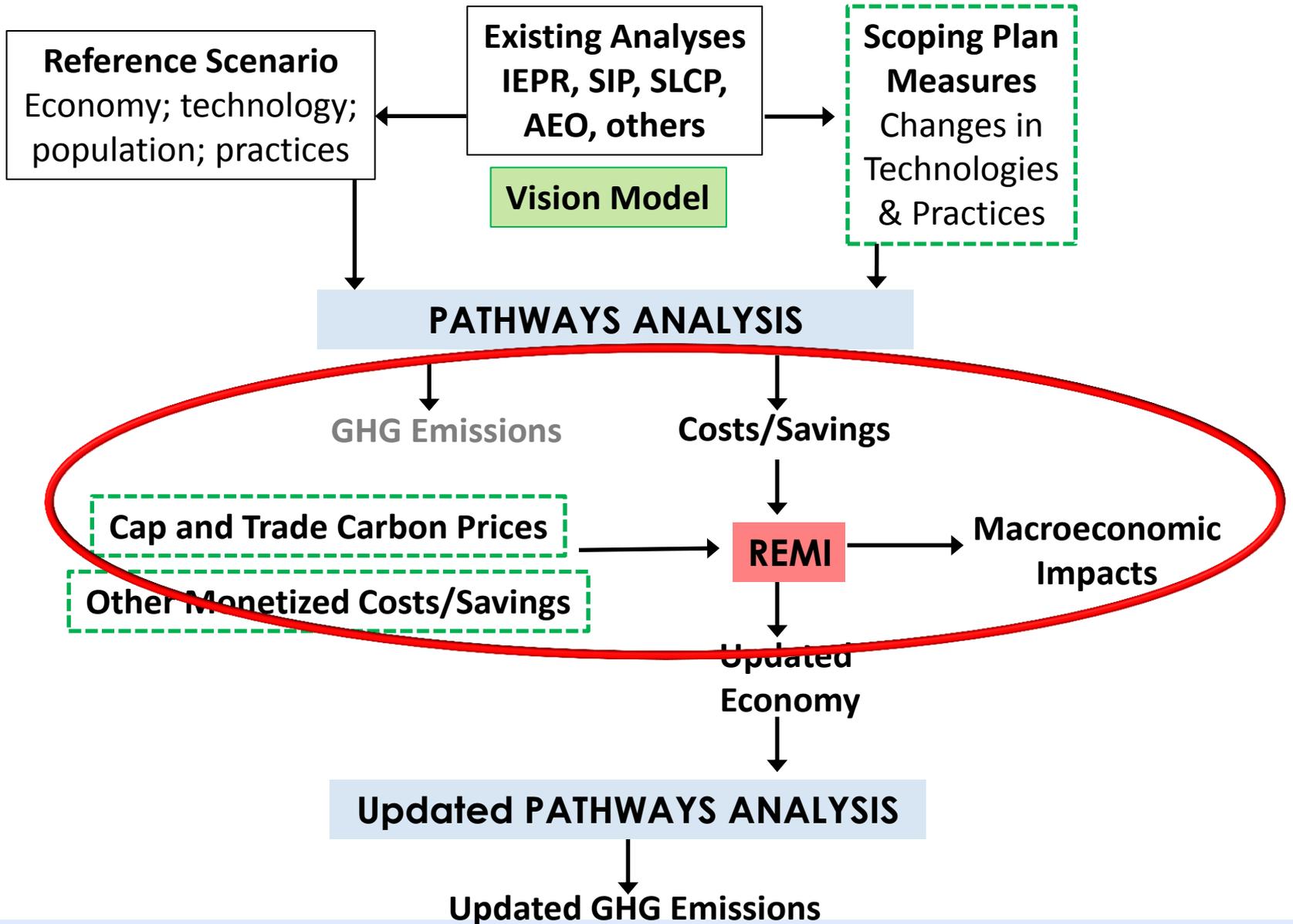
Areas of Cost Uncertainty

Alternative 1

See slide 21 for details on measures within Alternative 1

- ▣ Heat Pumps and Early Retirement of Space Heaters
 - ▣ Cost does not include any incentive payment for early retirement
- ▣ Additional ZEVs and Early Retirement of LDVs
 - ▣ Cost does not include any incentive payment for early retirement
- ▣ Industrial, Oil & Gas, and Refining Measure
 - ▣ Capital costs are not included

SCOPING PLAN ECONOMIC ANALYSIS



REMI Model

- ▣ Dynamic forecasting and policy analysis tool
- ▣ Models economic changes over time
- ▣ Allows firms and individuals to change their behavior in response to changing economic conditions
- ▣ Estimates comprehensive economic and demographic effects of policies
 - ▣ Employment impacts
 - ▣ Business impacts
 - ▣ Impacts to individuals
 - ▣ Impacts on California Gross Domestic Product
 - ▣ Investment impacts

PATHWAYS to REMI

The expenditures for the PATHWAYS sectors are disaggregated among the REMI consumer, commercial and industrial sectors.

Pathways Sectors	REMI Sectors
Households	Consumer Sectors
Light Duty Vehicles	
Agriculture	Commercial and Industrial Sectors
Oil & Gas Extraction	
Refining	
Other Industrial	
Commercial	
Freight Transport	
Transportation, Communications, & Utilities (TCU)	

Example: Household Energy Efficiency

- ▣ PATHWAYS output
 - ▣ Change in household capital expenditure
 - ▣ Change in household spending of electricity and natural gas
 - ▣ Relative to the reference scenario
- ▣ REMI input
 - ▣ Adjust spending in household appliance category and retail trade
 - ▣ Adjust spending in household electricity
 - ▣ Electricity power generation, transmission, and distribution
 - ▣ Adjust spending in household natural gas
 - ▣ Natural gas distribution

Carbon Price Modeling

- ▣ Estimate annual emissions obligation of covered sectors
- ▣ Adjust firm production costs to incorporate carbon pricing at estimated auction floor price and Allowance Price Containment Reserve price
- ▣ Return of value
 - ▣ Draft Scoping Plan Scenario - Cap-and-Trade
 - ▣ Assumes \$2 billion in auction proceeds are appropriated to sectors that currently receive GGRF funds
 - ▣ Remaining value is returned to individuals in California
 - ▣ Alternative 2 - Carbon tax
 - ▣ Alternative 2 was not modeled
 - ▣ ARB requests stakeholder input on potential return of tax revenue under a carbon tax

Estimated Carbon Prices

Estimated Carbon Prices (\$ 2015)	2020	2025	2030
Auction Floor Low Carbon Price	\$15.40	\$19.70	\$25.20
Reserve Price High Carbon Price	\$72.10	\$79.70	\$85.20

The estimated carbon prices are used to model the impact of the Cap-and-Trade Program in the Draft Scoping Plan Scenario

Estimated Employment Impacts in 2030 Relative to Reference Scenario

Scenario	Absolute Change (Thousand Jobs)	Percentage Change
Reference Scenario	23 million projected jobs in 2030	
Scoping Plan Scenario Low Carbon Price	-24.9	-0.11%
Scoping Plan Scenario High Carbon Price	-73.2	-0.31%
Alternative 1	-101.9	-0.43%

As modeled in REMI, California employment impacts are estimated to result in less than half a percent reduction in employment levels in 2030.

Estimated Impact on GDP in 2030 Relative to Reference Scenario

Scenario	Absolute Change (Billion \$ 2015)	Percentage Change
Reference Scenario	\$3.423 trillion projected GDP in 2030	
Scoping Plan Scenario Low Carbon Price	-\$6.8	-0.20%
Scoping Plan Scenario High Carbon Price	-\$19.5	-0.57%
Alternative 1	-\$14.4	-0.43%

As modeled in REMI, the impact to California GDP of the GHG reduction scenarios is estimated to be small relative to the size of the California economy

Stakeholder Input and Next Steps

- ▣ Request for Stakeholder Input
 - ▣ Structure of carbon tax
 - ▣ Return of revenue under a carbon tax
 - ▣ Inclusion of administrative costs in the modeling
- ▣ Next Steps
 - ▣ Estimate the impact of carbon tax scenario Alternative 2
 - ▣ Continue to refine modeling estimates
 - ▣ Close the 5 MMT GHG emissions gap in Alternative 1
 - ▣ Incorporate AB 197 requirements
 - ▣ Analyze economic impact on Disadvantaged Communities

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