Managing Greenhouse Gas Emissions in California

California Climate Change Center
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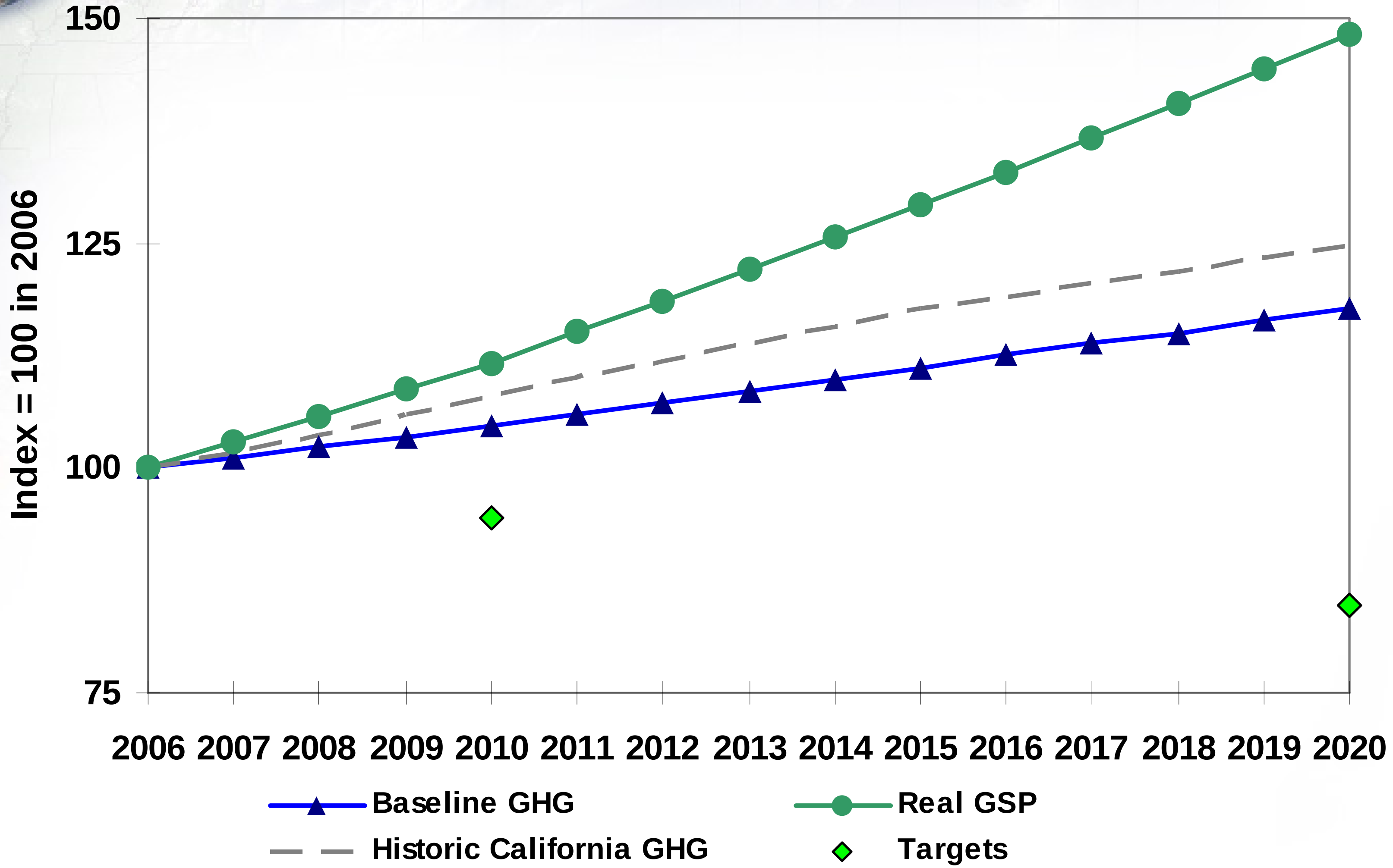
Objectives

1. Improve visibility for policy makers.
2. Rigorously estimate direct and indirect impacts and identify adjustment effects (BEAR).
3. Promote empirical standards for policy research and dialogue.

Doing Nothing is Not an Option



Source: Author's estimates from the BEAR Model.

Why a state model?

1. California needs research capacity to support its own policies
    - A first-tier world economy
2. California is unique
    - Both economic structure and emissions patterns differ from national averages
3. California stakeholders need more accurate information about the adjustment process
    - National assessment masks extensive interstate spillovers and trade-offs

Why a General Equilibrium Model?

1. *Complexity* - Given the complexity of today's economy, policy makers relying on intuition and rules-of-thumb alone are assuming substantial risks.
2. *Linkage* - Indirect effects of policies often outweigh direct effects.
3. *Political sustainability* - Economic policy may be made from the top down, but political consequences are often felt from the bottom up. These models identify stakes and stakeholders *before* policies are implemented.

Model Structure

The modeling facility consists of two components:

1. Detailed economic and emissions data (2003)
   - 125, 170 sectors
   - 10 household groups (by tax bracket)
   - detailed fiscal accounts
   - 14 emission categories
2. Berkeley Energy And Resource (BEAR) Model – a dynamic GE forecasting model

Economy-Environment Linkage

Economic activity affects pollution in three ways:

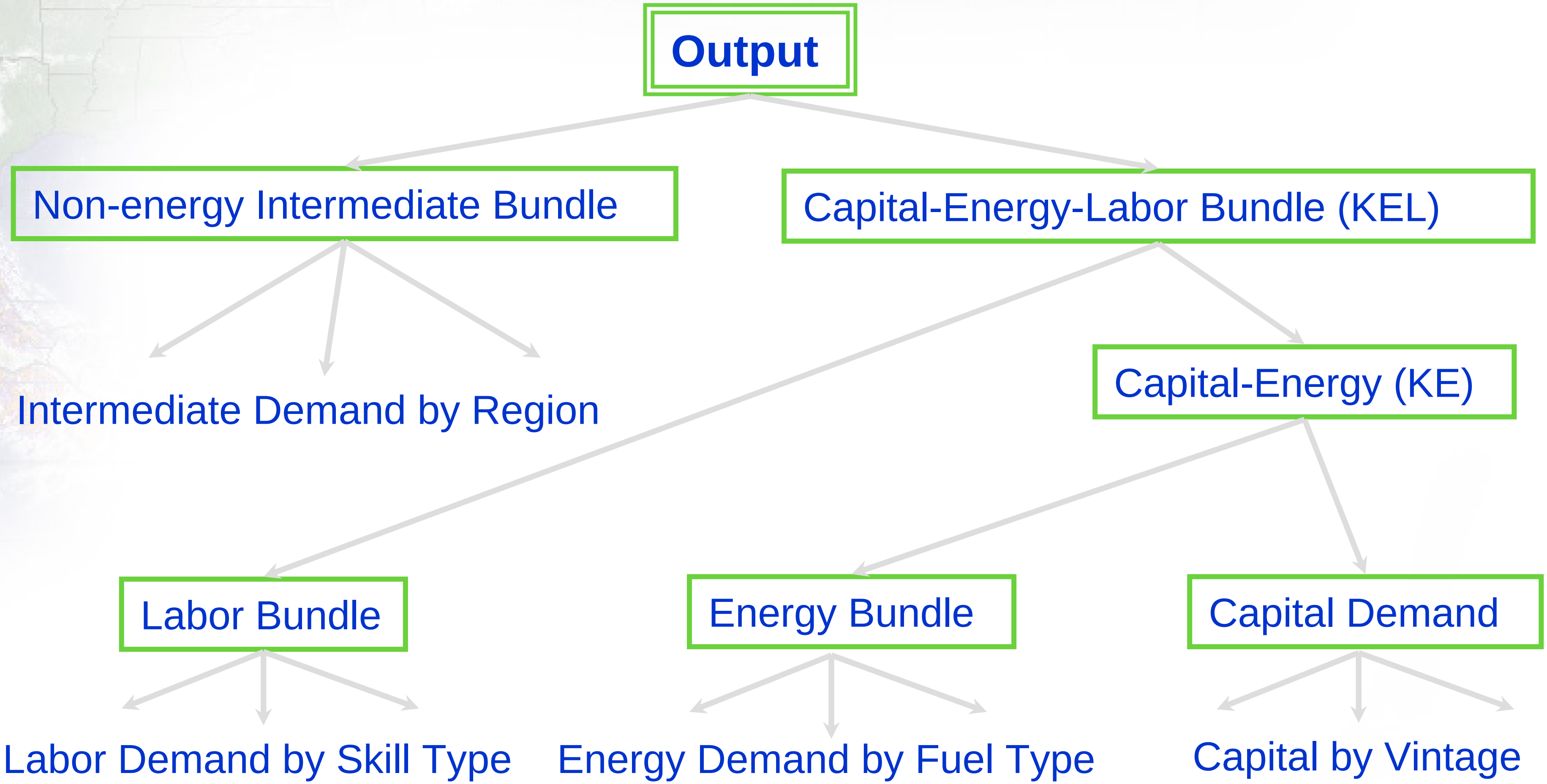
1. *Growth* – aggregate growth increases resource use
2. *Composition* – changing sectoral composition of economic activity can change aggregate pollution intensity
3. *Technology* – any activity can change its pollution intensity with technological change

All three components interact to determine the ultimate effect of the economy on environment.

Salient Energy Features

- Production
  - Input, output, and consumption based pollution modeling
  - Nested CES for energy sources
  - Extensively parameterized for efficiency/productivity
- Consumption
  - ‘technology” of consumption/pollution
  - detailed residential and transport modules
- Energy
  - differentiated and flexible generation portfolios
  - CES fuel substitution and vintage capital
  - energy trading

Nested Production Structure



Economic Data 1

California Social Accounting Matrix (2003)

An economy-wide accounting device that captures detailed income-expenditure linkages between economic institutions. An extension of input-output analysis.

- 170 sectors/commodities
- Three factor types
  - Labor (2+ occupational categories)
  - Capital
  - Land
- Households (10 by tax bracket)
- Fed, State, and Local Government (very detailed fiscal instruments, 45 currently)
- Consolidated capital account
- US and ROW trading partners

Economic Data 2

<u>Satellite Accounts</u>

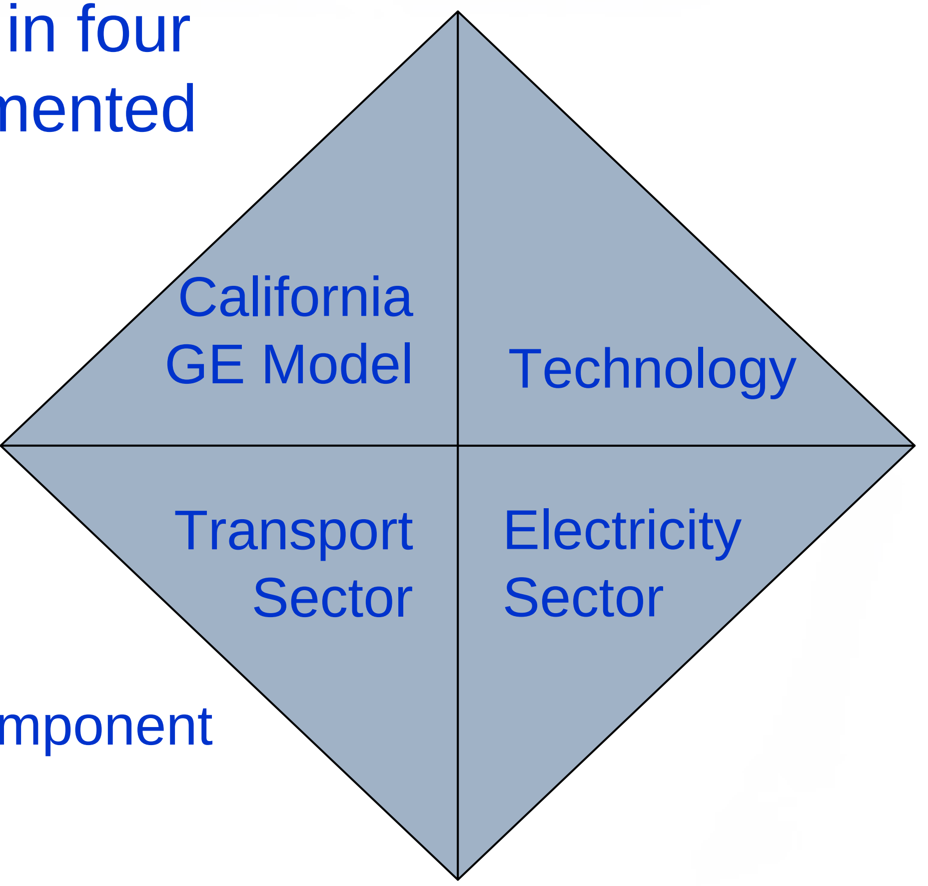
- Employment
- Econometrically estimated parameters
- Trends for calibration
  - Population and other labor force composition
  - Independent macro trends (CA, US, ROW, etc.)
  - Productivity growth trends
  - Exogenous prices (energy and other commodities)
  - Baseline ("business as usual") pollution growth

How we Forecast

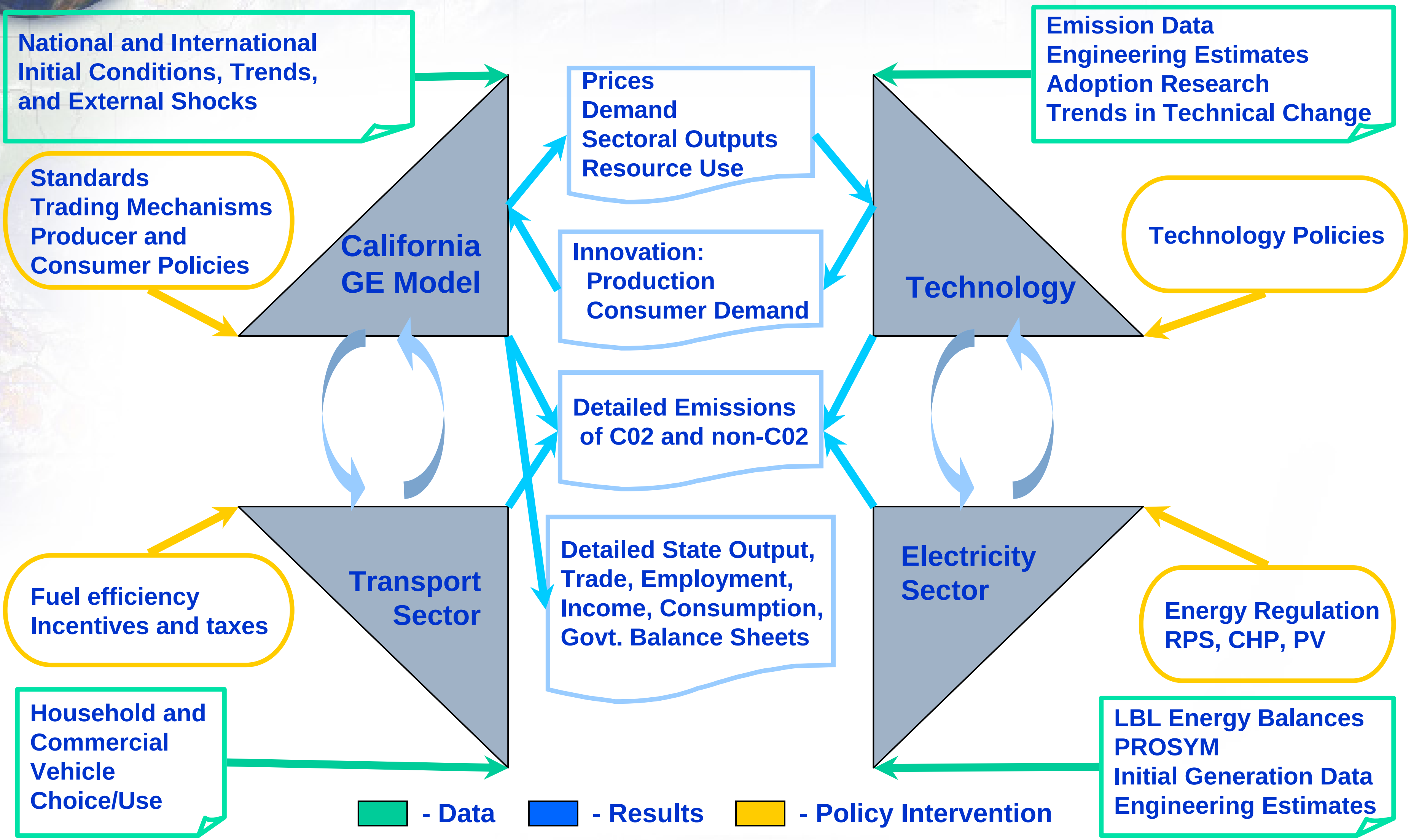
BEAR is being developed in four components and implemented over two time horizons.

Components:

1. Core GE model
2. Technology module
3. Electricity modeling
4. Transportation component



Detailed Methodology



What is a General Equilibrium Model?

- Detailed market and non-market interactions in a consistent empirical framework.
- Linkages between behavior, incentives, and policies reveal detailed demand, supply, and resource use responses to external shocks and policy changes.

Electricity Sector Modeling

- Power generation accounts for a significant percentage of C02 emissions within California.
- Based on detailed producer data from CEC/PIER/PROSYM, we model technology and emissions in California's electricity sector
  - Eight generation technologies
  - Eleven fuels

Transportation Modeling

- The transport sector accounts for up to 48% of California C02 emissions
- To meet our emission goals, patterns of vehicle use and technology adoption need to be better understood:
- You can contribute to this effort:

www.carchoice.org

Time Horizons

BEAR is being developed for scenario analysis over two time horizons:

1. **Policy horizon**: 2005-2025

   Detailed structural change:

   1. 125, 170 sectors
   2. 10 household income groups
   3. Labor by occupation and capital by vintage

2. **Climate horizon**: 2005-2100

   Aggregated:

   1. 10 sectors
   2. 3 income groups
   3. labor and capital

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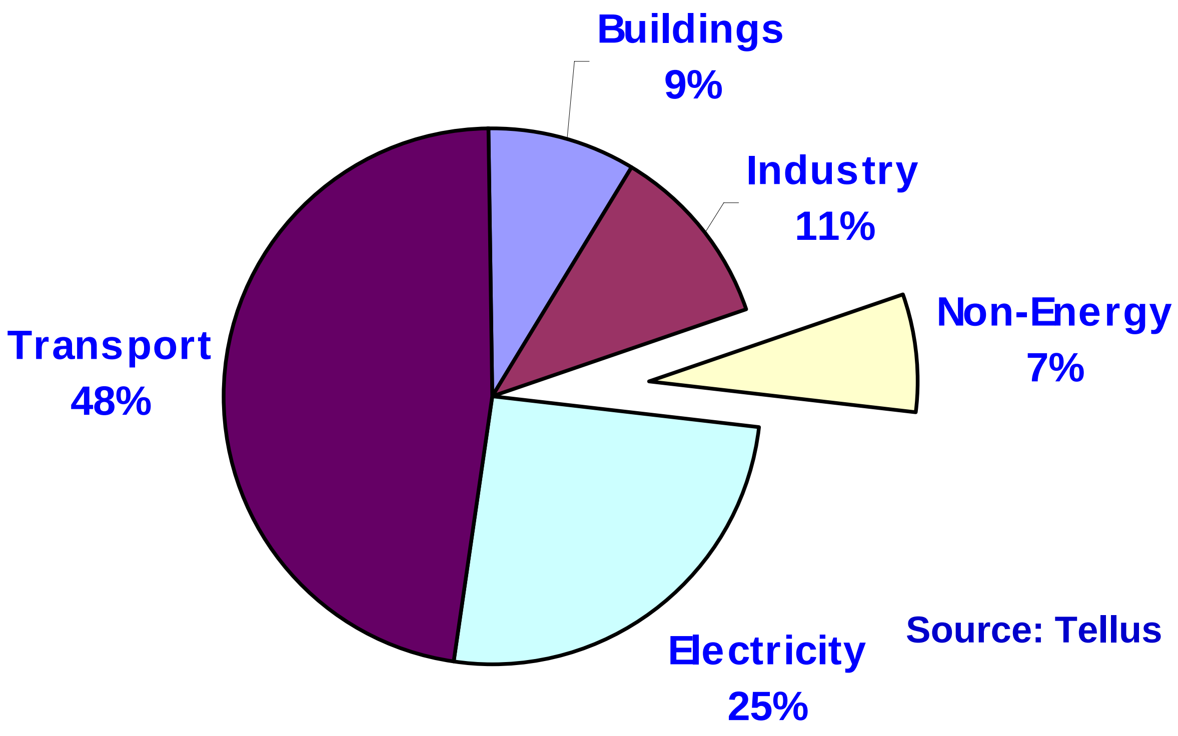
GHGs are about Energy

C02 Emissions by Source



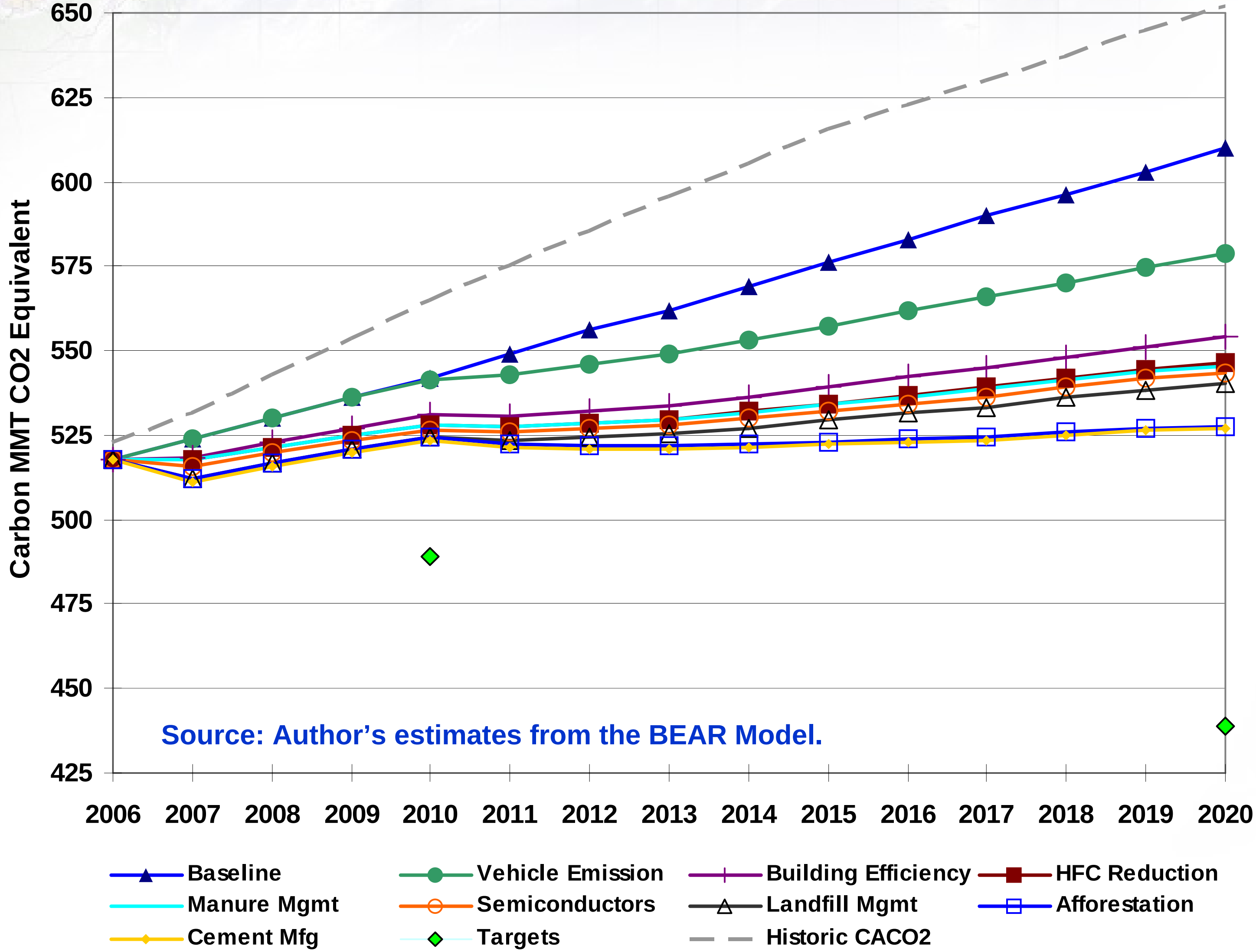
Source: Tellus

Nationally, electricity generation is responsible for 34 percent of all GHG emissions and 40 percent of all CO2 emissions.

Climate Action Policies Analyzed

1. Building Efficiency
2. Vehicle Emission Standards
3. HFC Reduction
4. Manure Management
5. Semiconductors
6. Landfill Management
7. Afforestation
8. Cement Manufacturing

Only Eight Measures Achieve Half of California's GHG Targets



Climate Action with Growth

	GHG MMT	Percent of Goal	GSP Millions	Jobs
2010	-19	-35	4,950	8,340
2020	-83	-49	58,800	20,350

Source: Author's estimates from the BEAR Model.

Three Economic Principles

1. Demand Shifting: New demand is more likely to be for California goods and services.
2. Benefits Exceed Costs: Direct adjustment costs seem high to stakeholders in the short term, but these are usually outweighed by many indirect statewide benefits.
3. Early Action Pays: Conversion costs are fixed, but benefits compound like interest.

Innovation, Efficiency, Growth

The Growth-Environment tradeoff is a fallacy, and in California we can prove this.

- California is the world's premiere innovation economy.
- Efficiency is a potent stimulus for economic growth.
- Energy, transportation, and others can join IT, Biotech, and California's knowledge-intensive state industries to establish global standards for more sustainable economic growth.

Thank you.