Economic Assessment for Climate Action in California

Overview of the BEAR Model

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Why use an economic model?

- Most human-induced environmental change originates in economic activity.
- Environmental effects of policy will largely result from economic responses.
- Thus, to understand environmental incidence, we need to understand economic behavior.

Why a state model?

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

Why use 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.

GE models, supported by detailed data, can elucidate these linkages and improve visibility for policy makers.

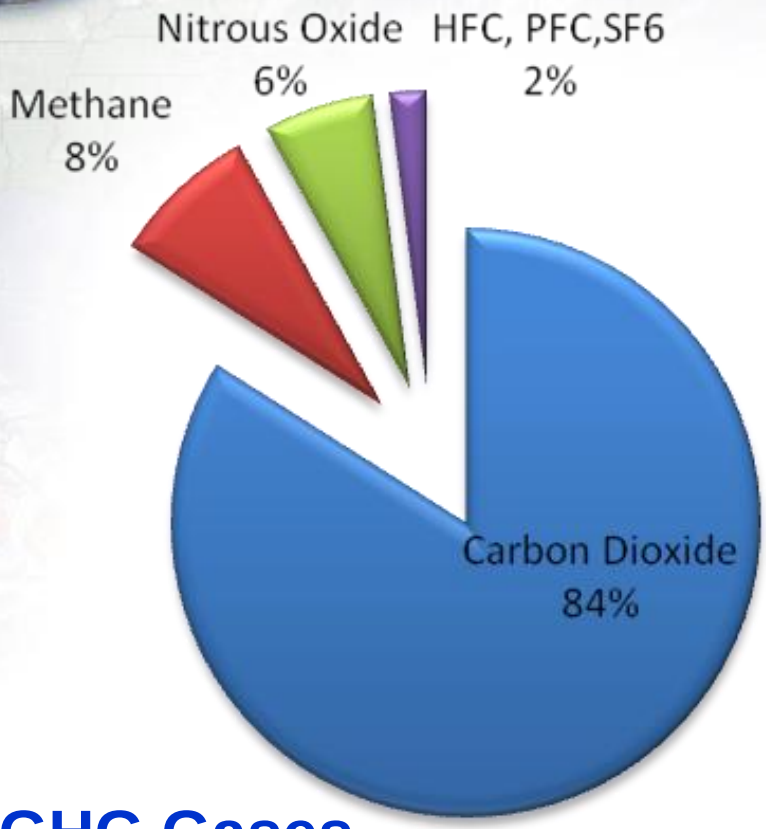
Model Structure

Three Components: Data, Model, Scenarios

1. Detailed economic and emissions data
   - Three activity aggregations: 165, 50, and 10 sectors/commodities
   - 10 household groups (by tax bracket)
   - detailed fiscal accounts
   - 14 emission categories

1. Berkeley Energy And Resource (BEAR) Model – a dynamic GE forecasting model
2. Three Scenario Horizons – BEAR solves annually to 2020, 2050, and 2080

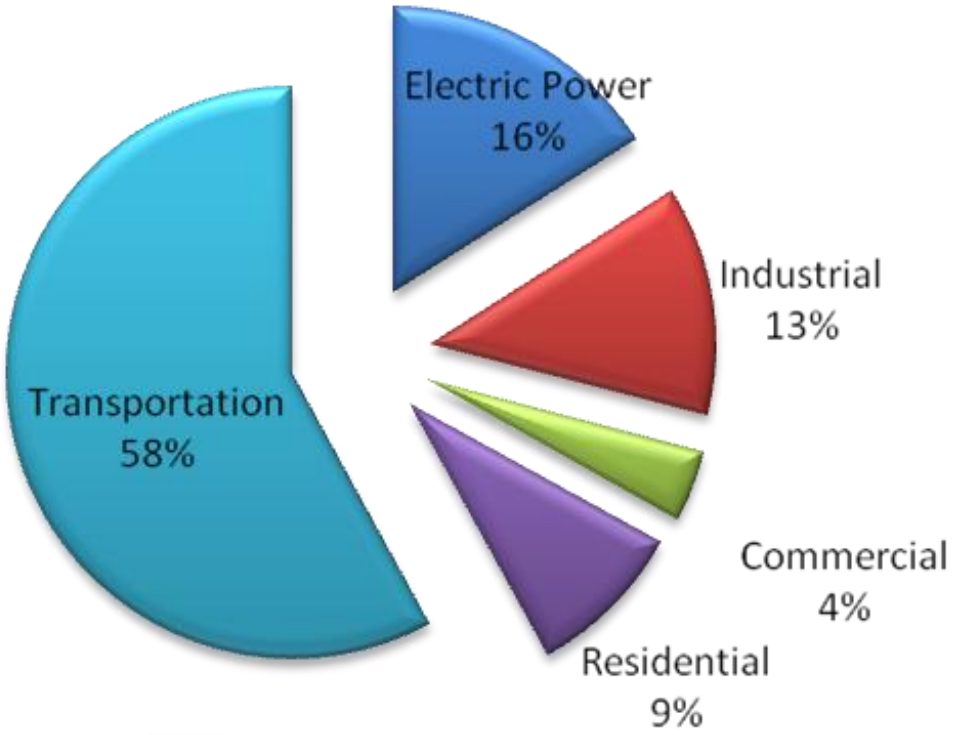
Climate Change and Carbon Fuel



GHG Gases

(CO2 equivalent shares)

CO2 Sources



Source: CEC

Economy-Environment Linkage

Economic activity affects emissions in three ways:

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

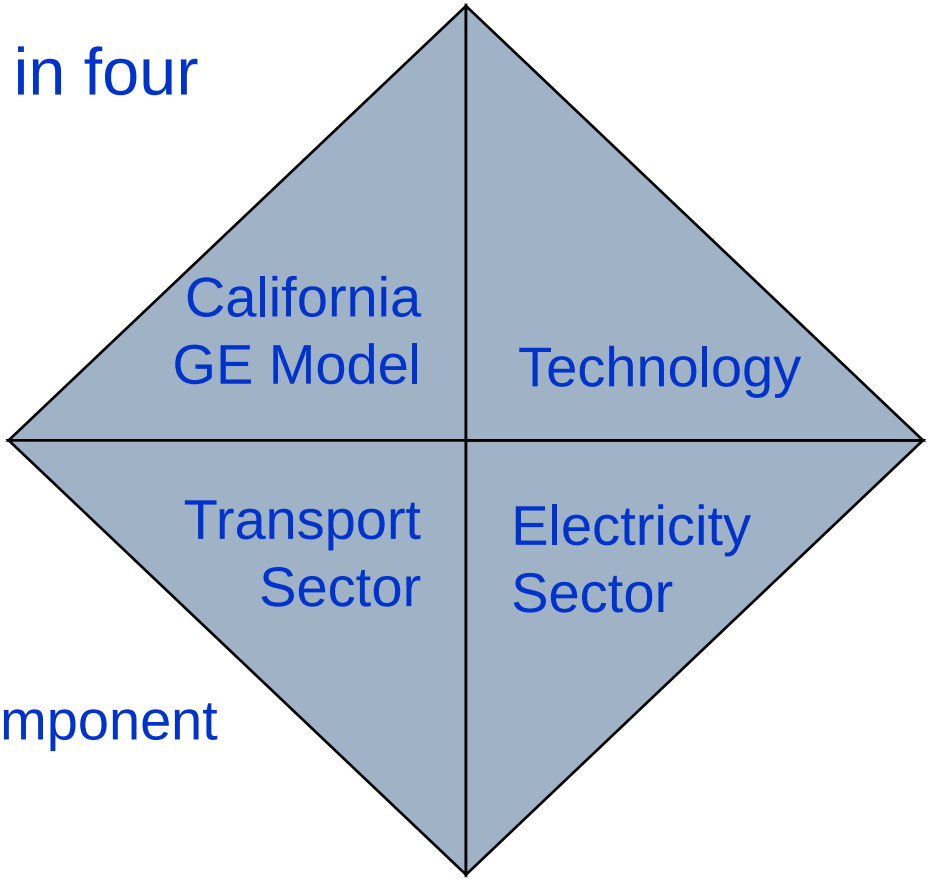
All three components interact to determine the ultimate effect of the economy on environment.

How we Forecast

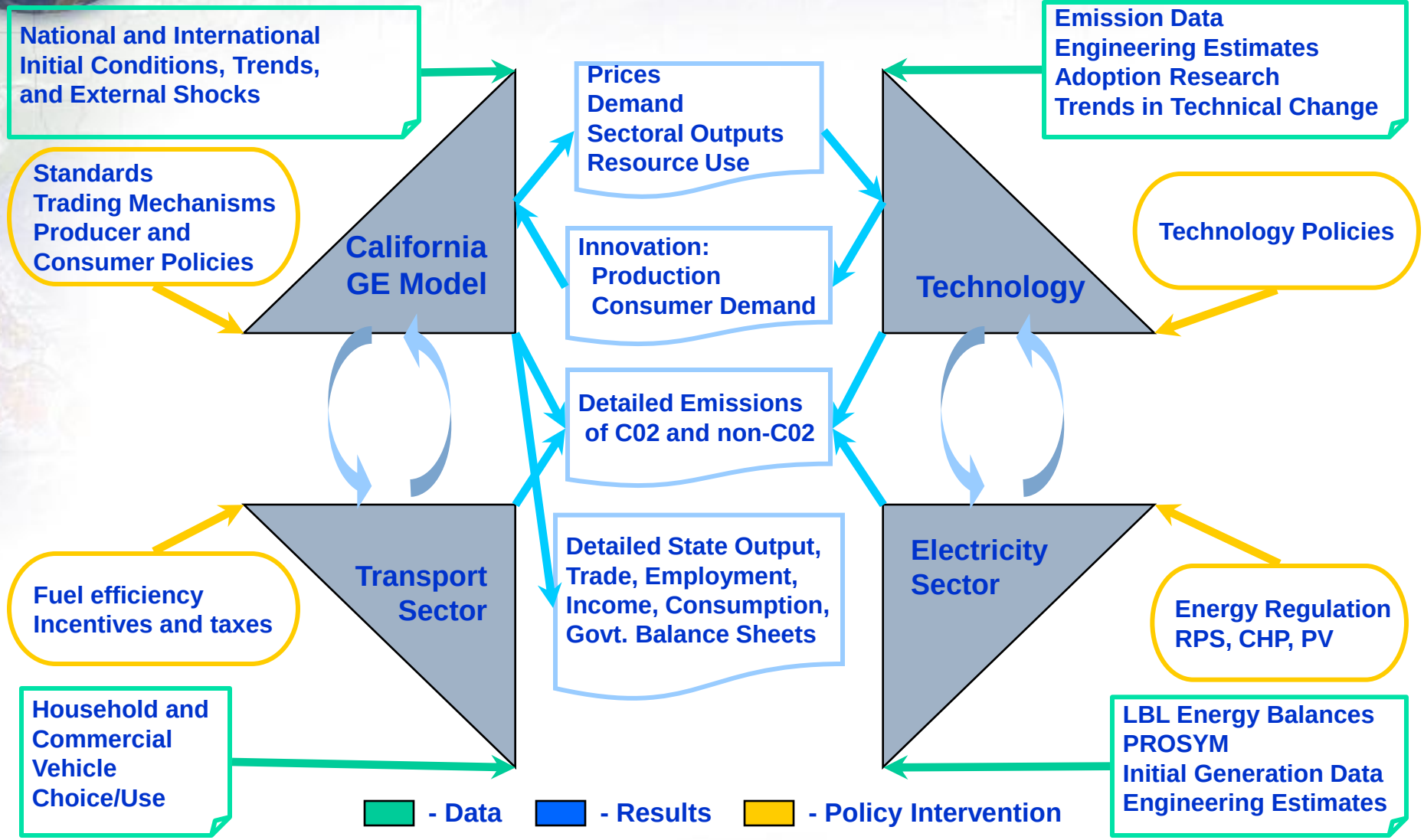
BEAR is being developed in four components.

Components:

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



Detailed Methodology



Specific Sectors

1. Most sectors are modeled in similar fashion, with detailed intermediate use, labor, capital, and energy value added.
2. A few emissions intensive sectors are modeled differently to take account of their particular industry structure.

Electric Power

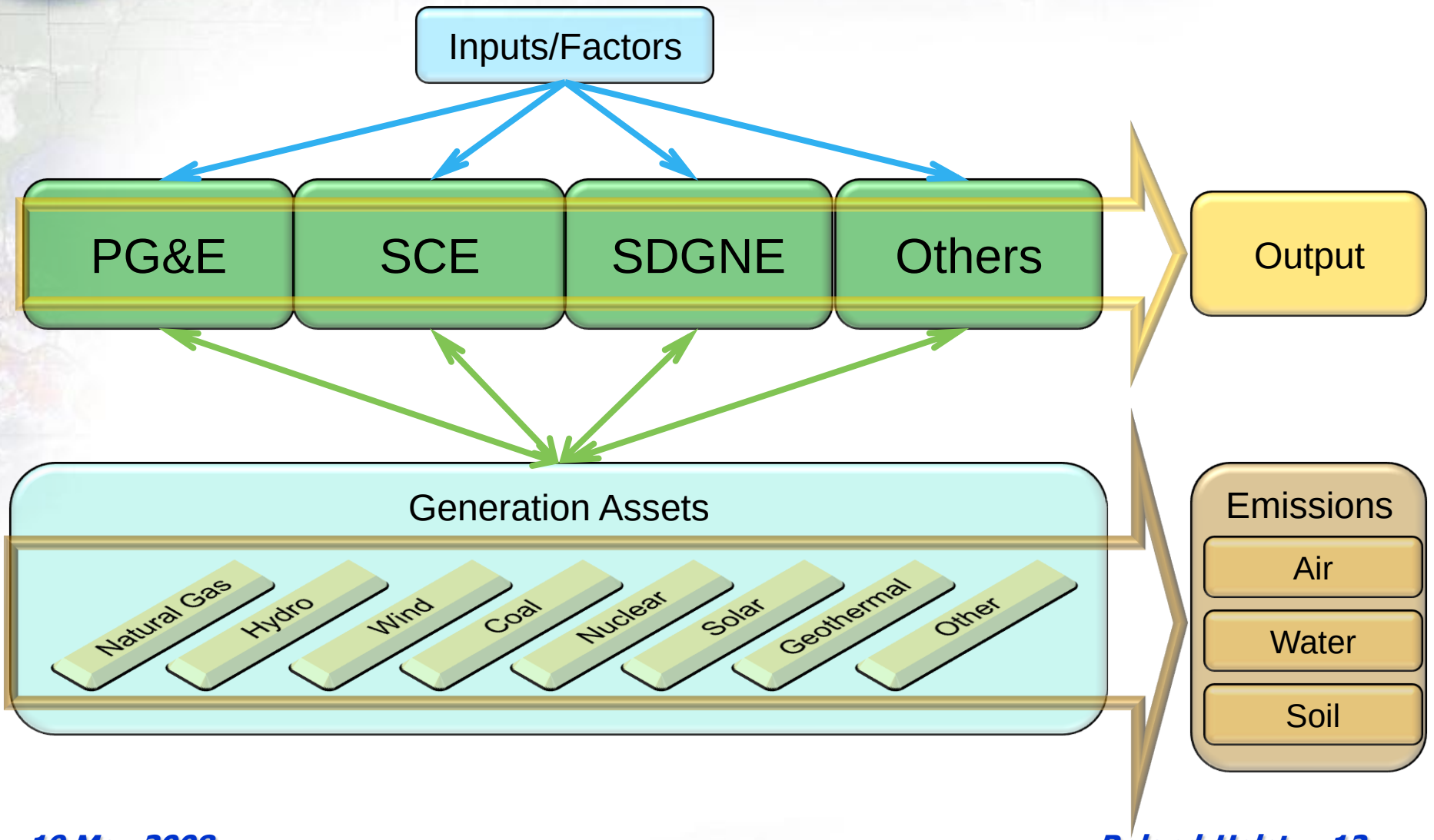
Distinctive features:

1. A portfolio of production technologies
2. Rigid output prices
3. Excess capacity

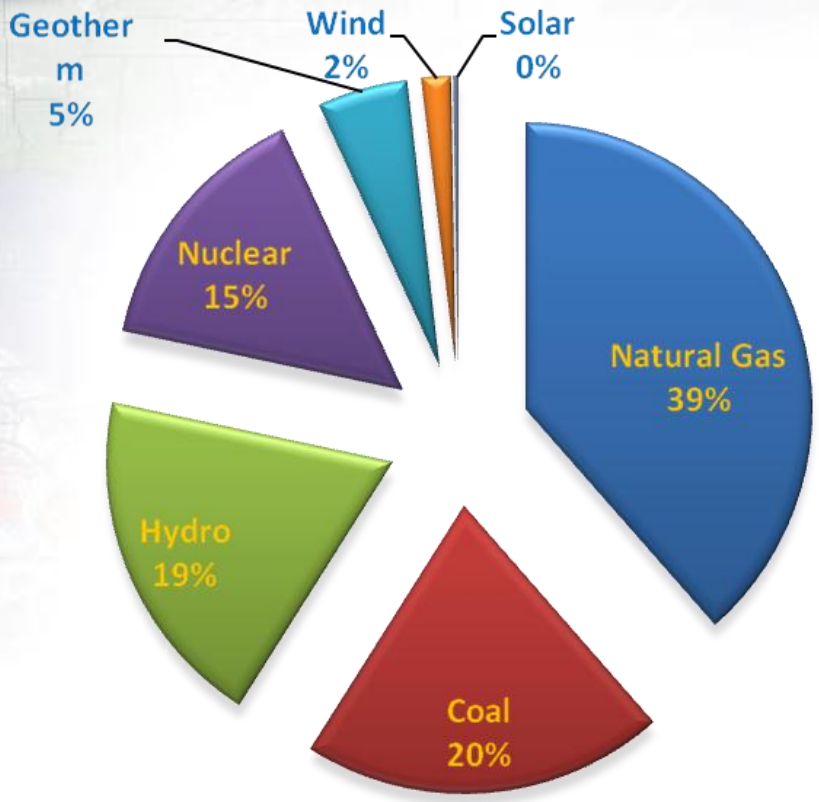
Modeling strategy:

1. Rigid prices, demand-driven market
2. Producers choose:
    1. Short run: capacity utilization rate
    2. Long run: Capacity (contracts, investment)

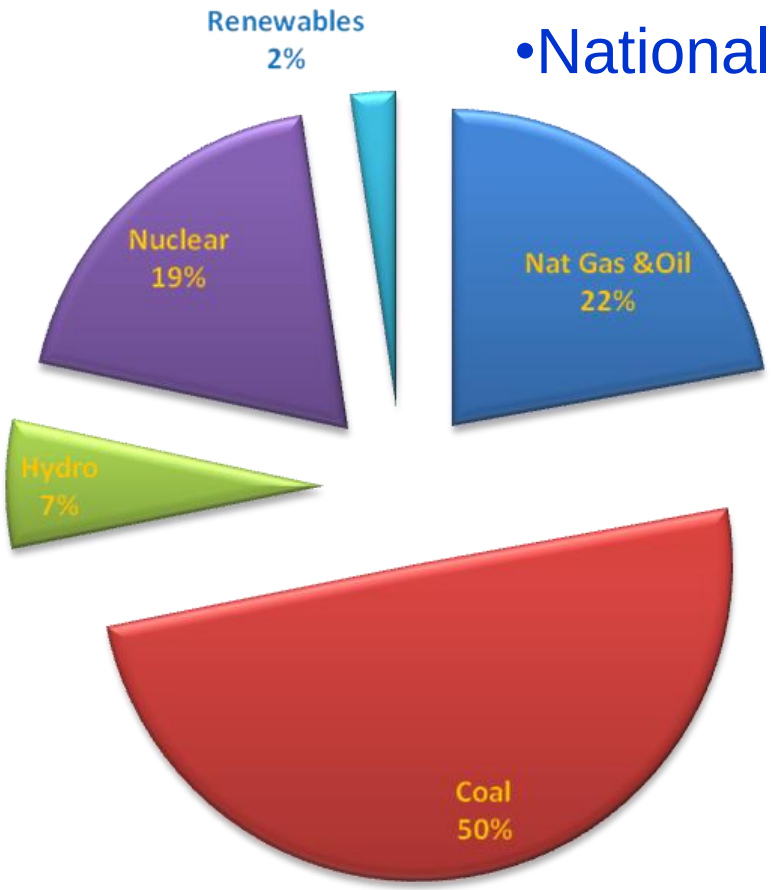
Electricity Sector



Generation Portfolio, 2005

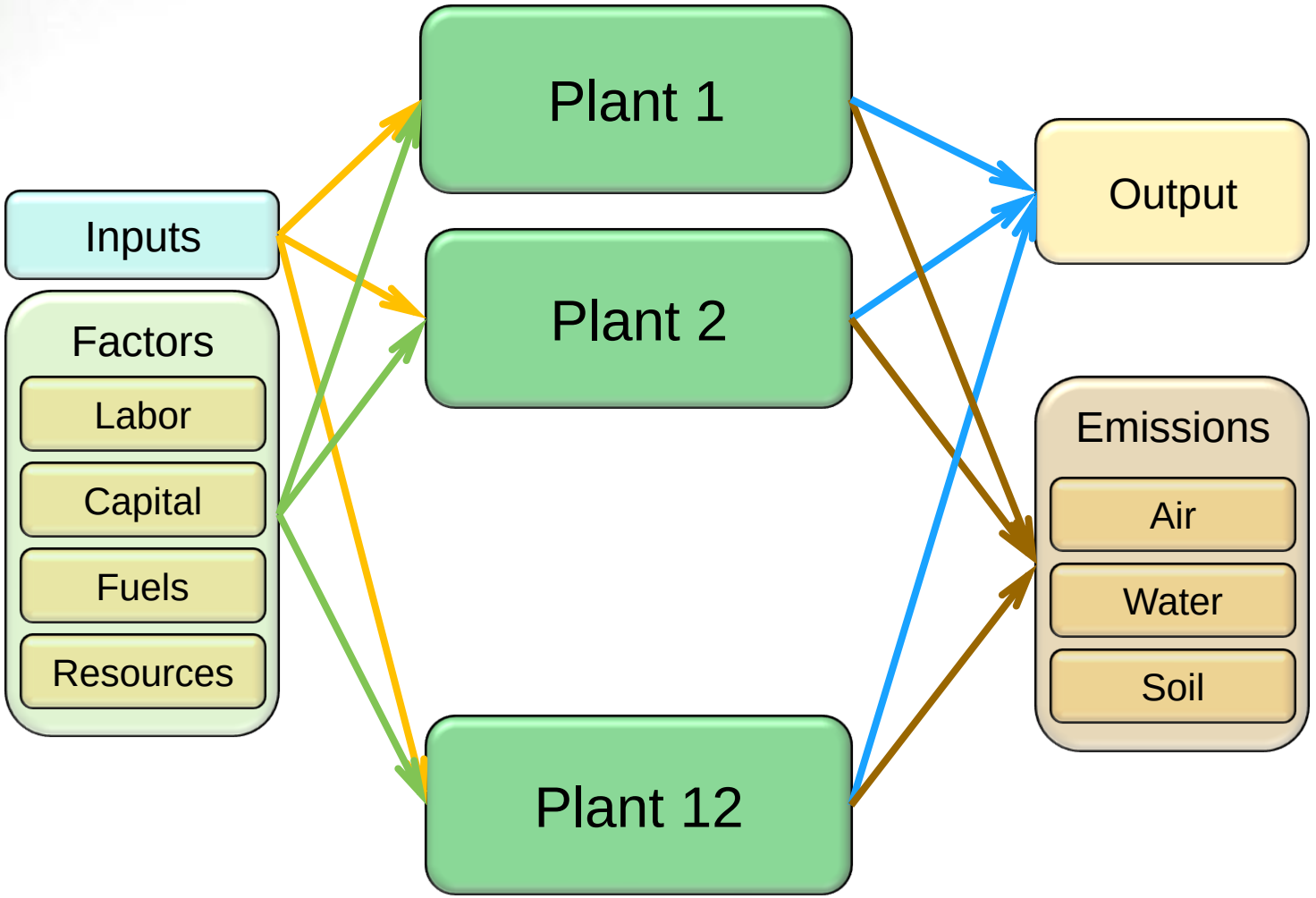


•California



•National

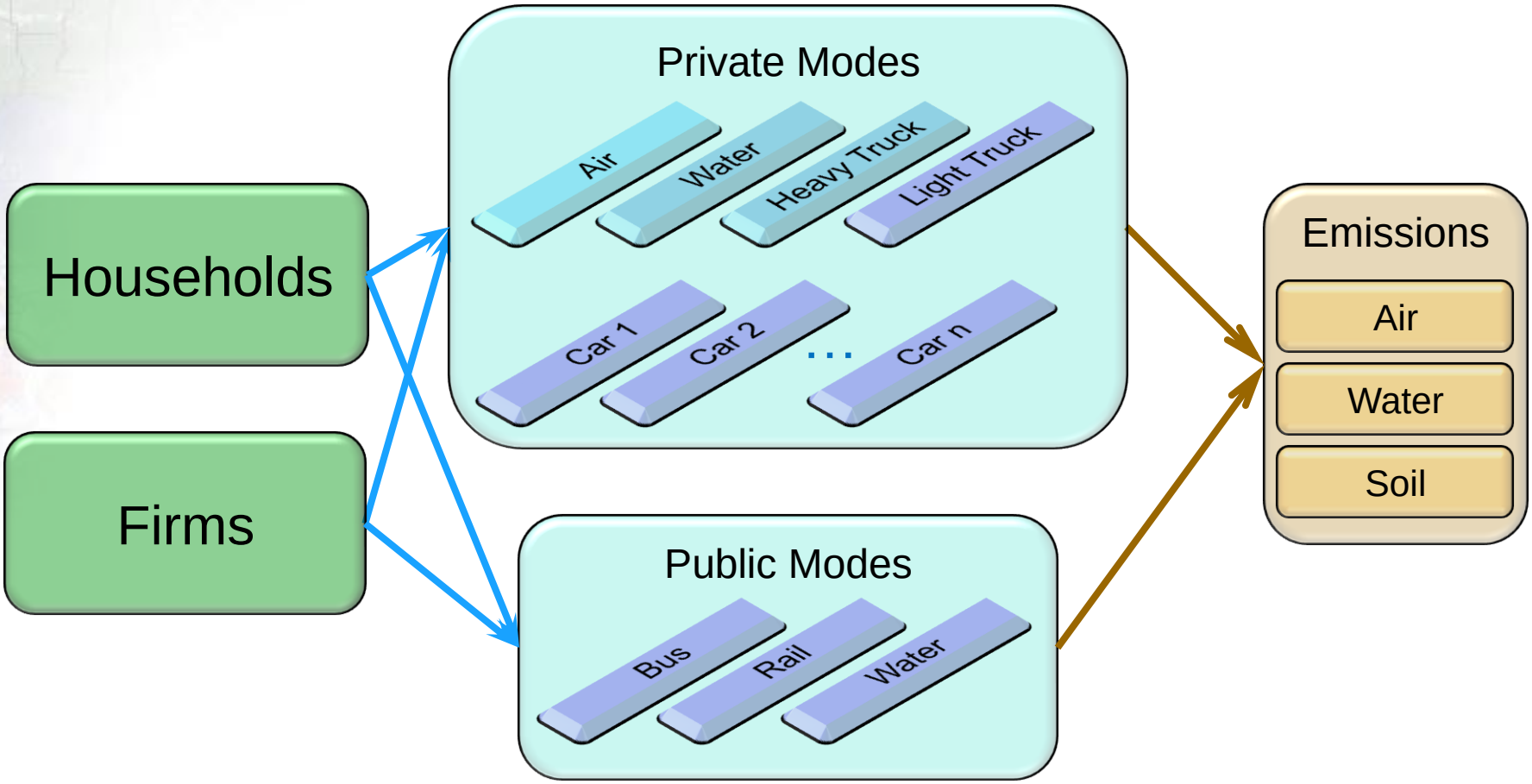
Oil Refining and Cement



Transportation Demand

- The transport sector accounts for over 40% of California C02 emissions
- To elucidate the path to our emission goals, patterns of vehicle use and adoption need to be better understood
- We are currently with demand systems that take explicit account of public/private modal choice and a larger universe of vehicle alternatives.

Transport Choice



Modeling Cap and Trade

1. BEAR models emissions endogenously, in proportion to energy use (or other process emission) by energy source
2. This permits detailed sectoral estimation of tradable emission rights schemes (Cap and Trade)
3. All major program characteristics, such as coverage, allocation rules, offsets, and safety valves, can be modeled on a sector by sector, annual basis

Cap and Trade Target Sectors

(from the 50 Sector BEAR aggregation)

- **Group 1: First Tier Emitters**

A04DistElc Electricity Suppliers
A17OilRef Oil and Gas Refineries
A20Cement

- **Group 2: Second Tier Emitters**

A01Agric Agriculture
A12Constr Transport Infrastructure
A15WoodPlp Wood, Pulp, and Paper
A18Chemicl Chemicals
A21Metal Metal Manufacture and Fab.
A22Aluminm Aluminium Production

- **Group3: Other Industry Emitters**

A02Cattle Cattle Production
A03Dairy Dairy Production
A04Forest Forestry, Fishery, Mining, Quarrying
A05OilGas Oil and Gas Extraction
A06OthPrim Other Primary Activities
A07DistElec Generation and Distribution of Electricity
A08DistGas Natural Gas Distribution
A09DistOth Water, Sewage, Steam
A10ConRes Residential Construction
A11ConNRes Non-Residential Construction
A13FoodPrc Food Processing
A14TxtAprl Textiles and Apparel
A16PapPrnt Printing and Publishing
A19Pharma Pharmaceuticals
A23Machnry General Machinery
A24AirCon Air Conditioner, Refrigerator, Manufacturing
A25SemiCon Semiconductors
A26ElecApp Electrical Appliances
A27Autos Automobiles and Light Trucks
A28OthVeh Other Vehicle Manufacturing
A29AeroMfg Aeroplane and Aerospace Manufacturing
A30OthInd Other Industry

Modeling Standards

- Because of its detailed sectoral and household structure, BEAR can estimate the effects of a wide spectrum of standards programs
- Both industrial product/process (e.g. RPS, PV) and household adoption/use (e.g. Pavley, appliance) standards can be modeled dynamically for detailed product categories

Modeling Incentives and Fees

- Intertemporal schemes for adoption finance and other incentives and or fees can also be explicitly incorporated in BEARs dynamic framework, with annual accounting for adjustment costs and benefits
- Detailed information about linkage and incidence effects reveals distributional effects and identifies

Modeling Innovation

- Innovation for energy efficiency has been the most growth-positive source of GHG mitigation potential for the California, both to reduce its own emissions and for leadership in global technology markets
- BEAR incorporates innovation explicitly scenario analysis, including investment costs and productivity/efficiency benefits, at the individual sectoral/product level and annually over time

Thank you