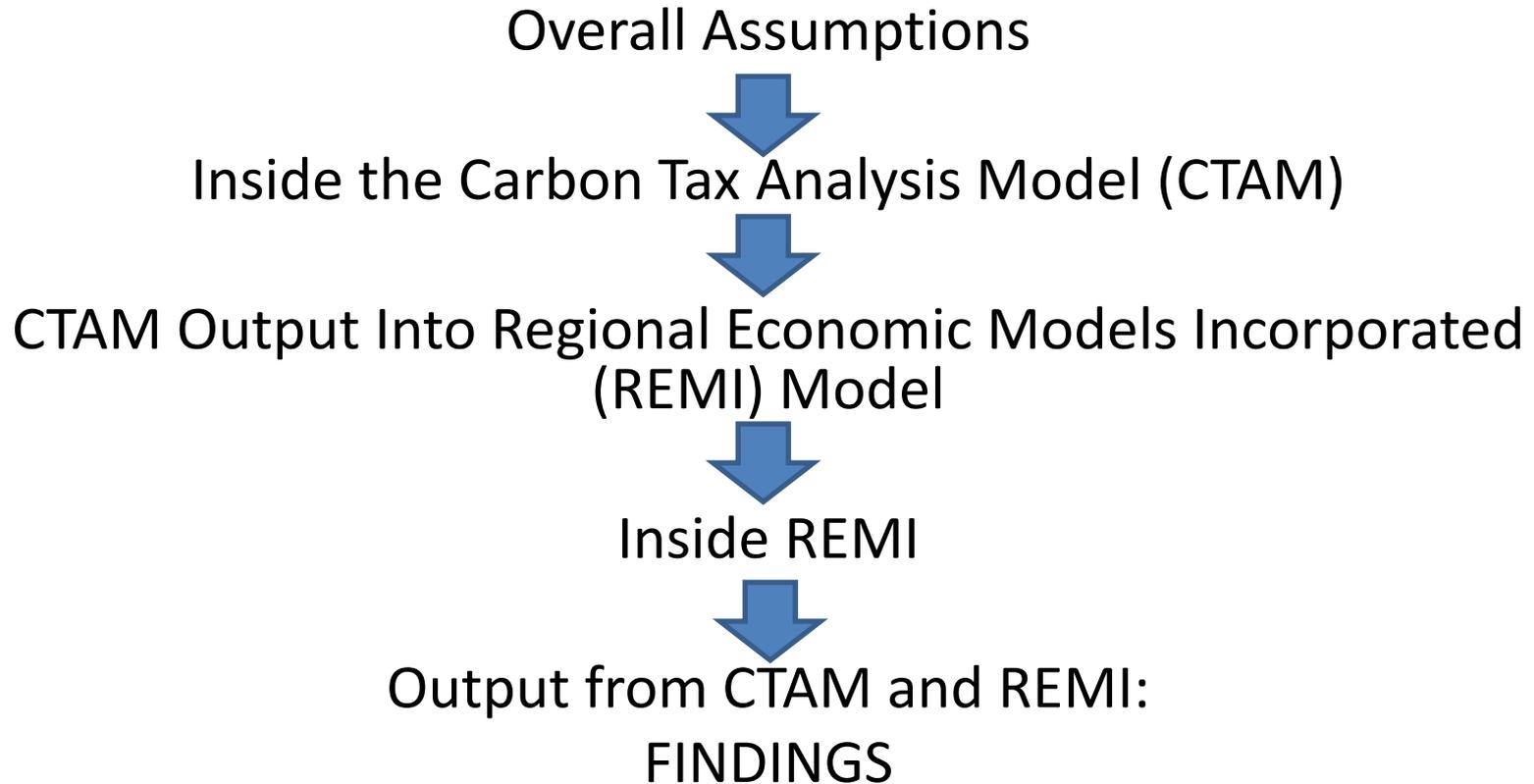# Modeling Carbon Pricing

Carbon Emissions Reduction Task Force Presentation

OFM Forecasting and Research
October 28, 2014

Overview of the Modeling Process

Overall Assumptions

⬇

Inside the Carbon Tax Analysis Model (CTAM)

⬇

CTAM Output Into Regional Economic Models Incorporated (REMI) Model

⬇

Inside REMI

⬇

Output from CTAM and REMI:
FINDINGS

Assumptions for Modeling in the Carbon Tax Analysis Model (CTAM)

- Emission reduction targets for 2020 and 2035
- Cap/trade structure with 100% auction of allowances
- No trading of allowances, offsets or other opportunities to reduce compliance costs
- No new innovations (though Energy Outlook data incorporates some)
- Additional complementary policies excluded
- Additional emissions reductions from revenue spending excluded
- Two Scenarios: $12/metric ton first year then:
  - Lower price increasing $.60 per year to 2020 and $2 per year after (CA)
  - Higher price increasing $8 per year

Inside the CTAM Model

CTAM translates emission levels into consumption and prices using...
- Relationship between prices and consumption (called elasticities)
- Energy price and demand forecasts from US Energy Information Administration 2014 Energy Outlook

Allocate energy consumption across industries

⬇

Determine carbon emissions per industry

⬇

Distribute cost of these emissions per industry

⬇

Integrate "Revenue Recycling" into costs and prices

⬇

Calculate net revenue and cost due to emissions (used in REMI)

Revenue Recycling Assumptions

- 30% to Working Families Tax Credit

- 15% B&O tax cut to trade exposed industries

- 40% B&O tax cut to construction sector

- 10% Public Utilities Tax cut to electric power generation, transmission, and distribution

- 5% to state General Fund

A More Complete View into the Carbon Tax Analysis Model
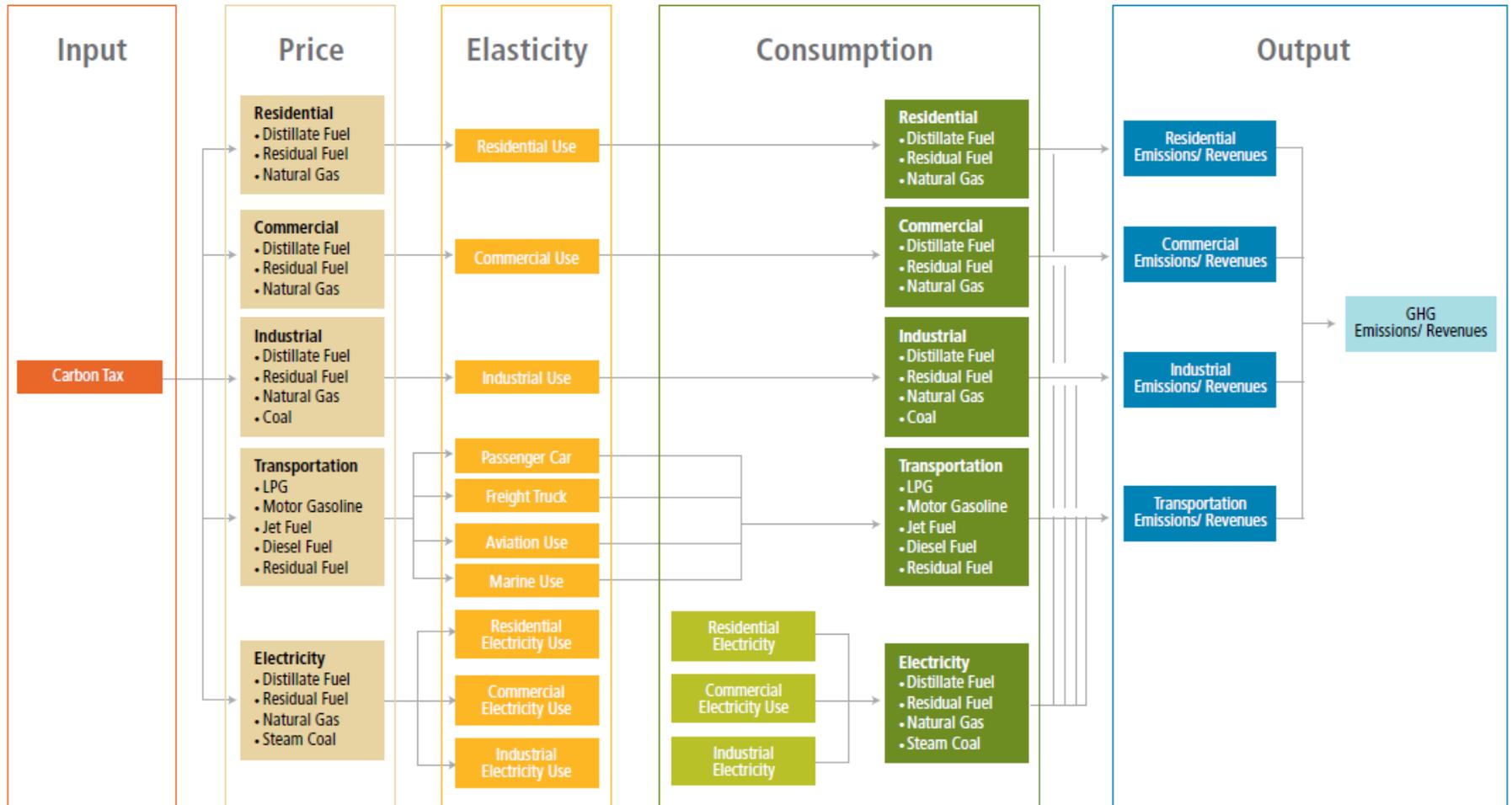
Source: Nystrom and Zaidi, "Environmental Tax Reform in California," March 3, 2014.

# Inside the Regional Economic Models Incorporated (REMI) Model

- REMI is an industry-standard econometric model used by many state agencies, private companies, and researchers
- Revenue changes by industry (160 sectors) for baseline, high and low scenarios
- REMI combines spending equations with the input/output table of industry sales and purchases

CTAM Revenue Output Including
B&O Reductions and Household Tax Credits

Changes in Industry and Household Purchases

Resulting Output, Income, and Employment Impacts

A More Complete View into REMI Model
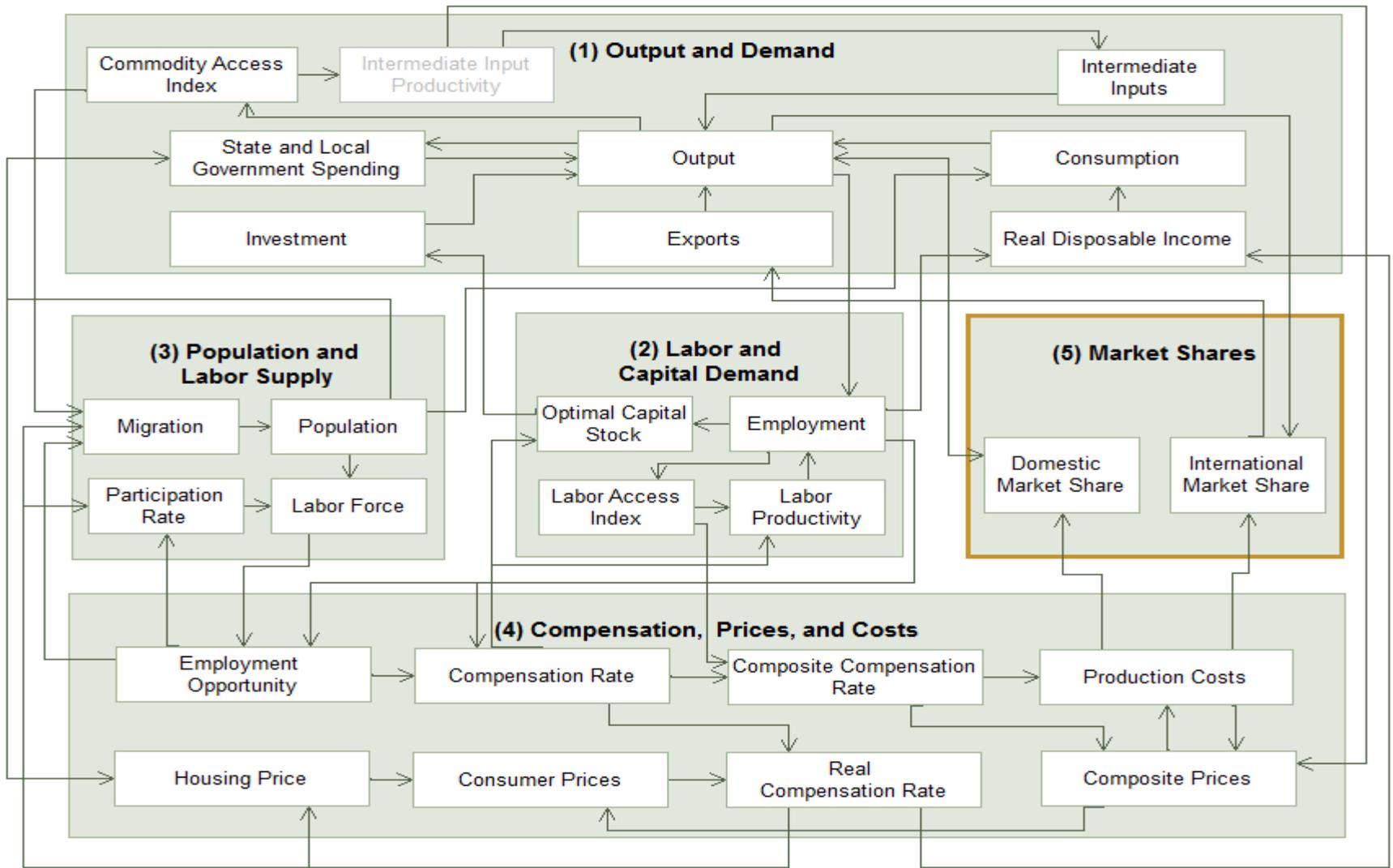
Source: Nystrom and Zaidi, "Environmental Tax Reform in California," March 3, 2014.

Results: Economic Impact

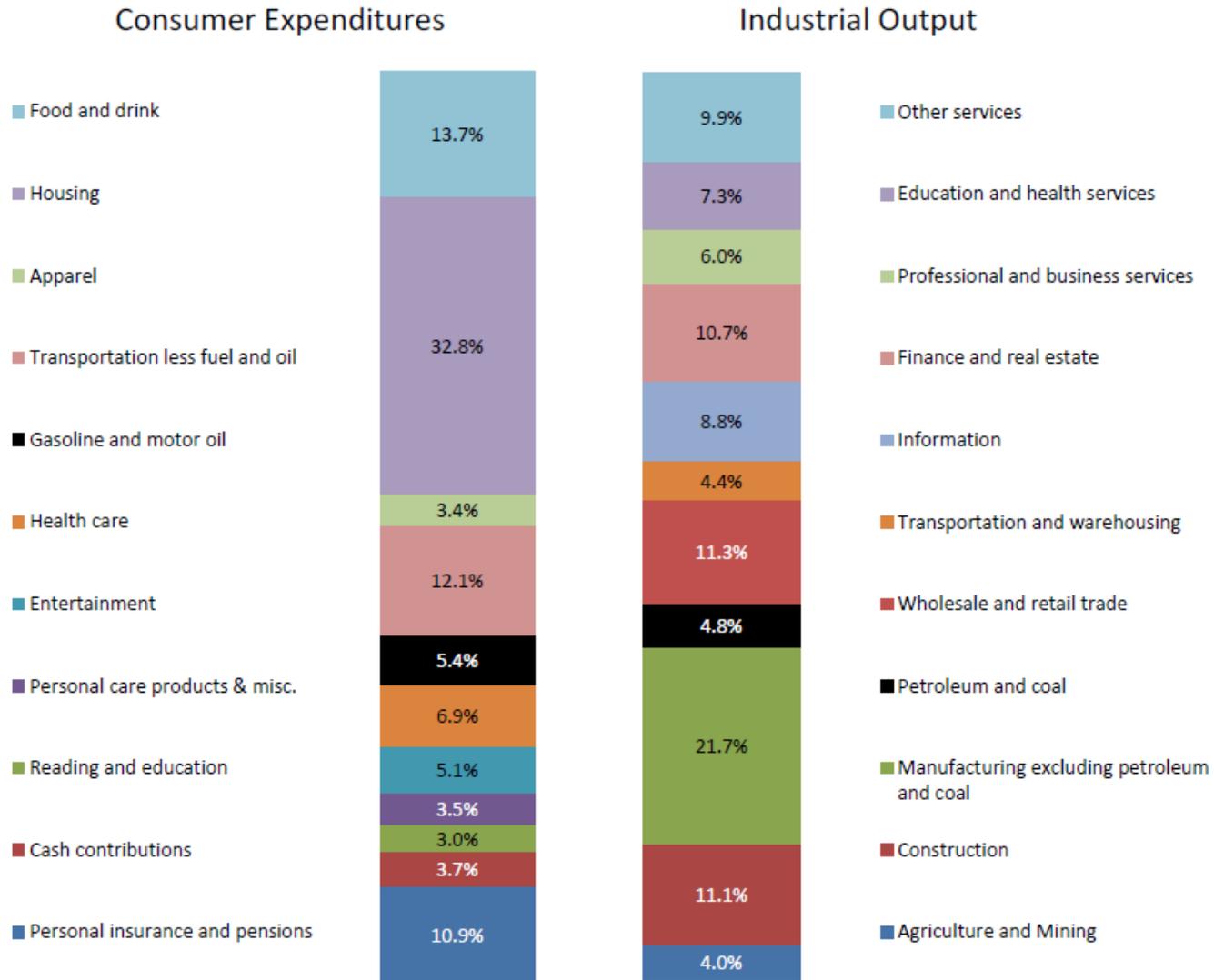| Change from 2015-2035	Baseline	Low Price Scenario Change from Baseline	High Price Scenario Change from Baseline
Gasoline Prices	21.4%	9.8%	37.5%
Personal Income	141.7%	.6	1.3
Employment	16.2%	.3	.8
Gross State Product	60.3%	.4	1.3

Income, Employment and GSP differences in percentage points.

Industry Employment Changes: Gainers & Losers

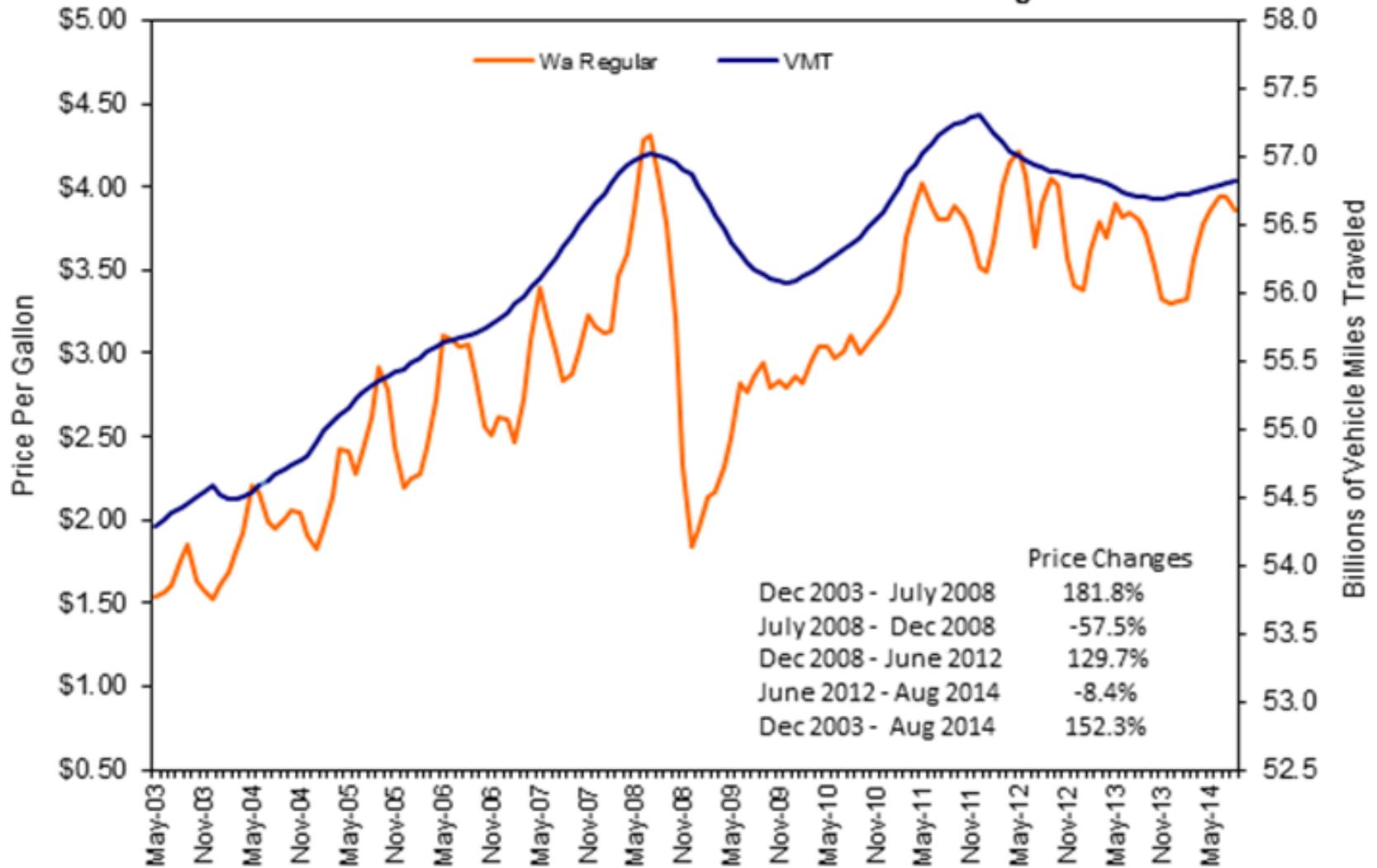|	Low Price Change from Baseline 2015-2035	High Price Change from Baseline 2015-2035
Top 5 Job Gainers		
Basic chemical manufacturing	80	289
Electric power generation, transmission, and distribution	110	367
Support activities for mining	9	32
Iron and steel mills and ferroalloy manufacturing	11	34
Dairy product manufacturing	17	-
Construction	-	7,630
Bottom 5 Job Losers		
Natural gas distribution	-8	-19
Apparel manufacturing; Leather and allied product manufacturing	-2	2
Pipeline transportation	-1	-18
Pesticide, fertilizer, and other agricultural chemical manufacturing	0	-43
Textile mills and textile product mills	-29	-30

Why the Effect on Income, Output and Employment are Relatively Small

Relative Scale of Gasoline and Related Products

Consumer Expenditures

- Food and drink — 13.7%
- Housing — 32.8%
- Apparel — 3.4%
- Transportation less fuel and oil — 12.1%
- Gasoline and motor oil — 5.4%
- Health care — 6.9%
- Entertainment — 5.1%
- Personal care products & misc. — 3.5%
- Reading and education — 3.0%
- Cash contributions — 3.7%
- Personal insurance and pensions — 10.9%

Industrial Output

- Other services — 9.9%
- Education and health services — 7.3%
- Professional and business services — 6.0%
- Finance and real estate — 10.7%
- Information — 8.8%
- Transportation and warehousing — 4.4%
- Wholesale and retail trade — 11.3%
- Petroleum and coal — 4.8%
- Manufacturing excluding petroleum and coal — 21.7%
- Construction — 11.1%
- Agriculture and Mining — 4.0%

Sources: Consumer Expenditure Survey and Washington I/O Model

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Cost of Gasoline and Vehicle Miles Traveled in Washington State

Price Changes

Dec 2003 - July 2008	181.8%
July 2008 - Dec 2008	-57.5%
Dec 2008 - June 2012	129.7%
June 2012 - Aug 2014	-8.4%
Dec 2003 - Aug 2014	152.3%

Sources: US Energy Information Administration and Washington Department of Transportation

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Technical Lessons Learned from the Modeling

- Revenue recycling choices are key
- Fuel price elasticities (Δprice/Δgallons) drive a lot of this work
- These models never include dramatic innovation. Need expert panels, specialized models and other ways to highlight these factors.