

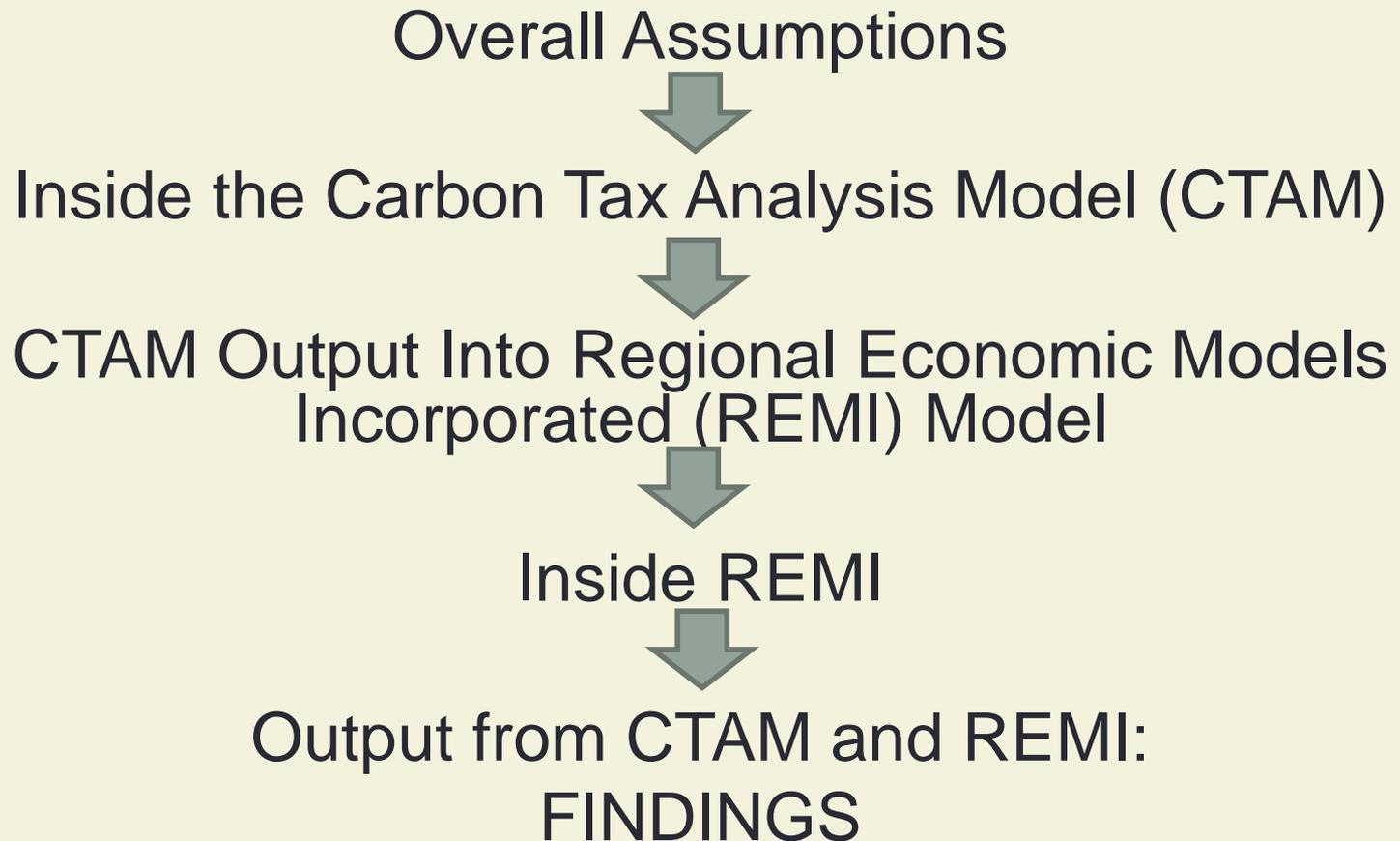
The Economic Effects of Carbon Pollution Pricing in Washington State

**OFM Office of Forecasting and Research
December 23, 2014**

Executive Summary

- Policy impacts on statewide income, employment and output are negligible. This is largely due to carbon charge revenue recycling to other purchases within Washington and program size relative to the statewide economy.
- Detailed industry employment changes are here:
 - <http://governor.wa.gov/documents/EmploymentChangeDuetoCarbonPricing2035.pdf>
- By 2020, carbon-related prices rise an additional estimated 3.9 percent for gasoline, 8.8 percent for natural gas and 8.2 percent for electricity due to the policy changes. By 2035, these changes are 9.9, 21.3 and 15.1 percent, respectively.
- The gas price change is smaller than historic price volatility.

Overview of the Modeling Process



Assumptions for Carbon Tax Analysis Model (CTAM)

Previous Modeling (October)

- ❑ Emission reduction targets for 2020 and 2035
- ❑ Uses Energy Information Administration's 2014 Annual Energy Outlook (AEO) Pacific region energy consumption and price forecasts for electricity, gasoline and diesel.
- ❑ Cap/trade structure with 100% auction of allowances.
- ❑ No model of secondary market or other allowances.
- ❑ No additional complementary policies.
- ❑ No additional emissions reductions from revenue spending options.

Additional Assumptions in Current Model (December)

- ❑ Update AEO outlook to reflect Washington prices for gasoline, electricity and diesel.
- ❑ Centralia emissions reflect current timeline for plant operation
- ❑ Modest innovation change included (fuel emissions fall 5 percent 2015 to 2025)
- ❑ Carbon pricing is \$12.94/metric ton in 2016 increasing .60/year until 2020 and \$2/year after to align CTAM with Ecology emissions estimates.

Revenue Recycling Policy Assumptions

- ❑ 40% Transportation
- ❑ 40% Education
- ❑ 10% Working Families Tax Rebate
- ❑ 3% Affordable Housing
- ❑ 3% Manufacturing (B&O tax cut)
- ❑ 3% Forestry and Rural (B&O tax cut)
- ❑ 1% Administration

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 and Washington adjustments

Allocate energy consumption across industries



Determine carbon emissions per industry



Distribute cost of these emissions per industry

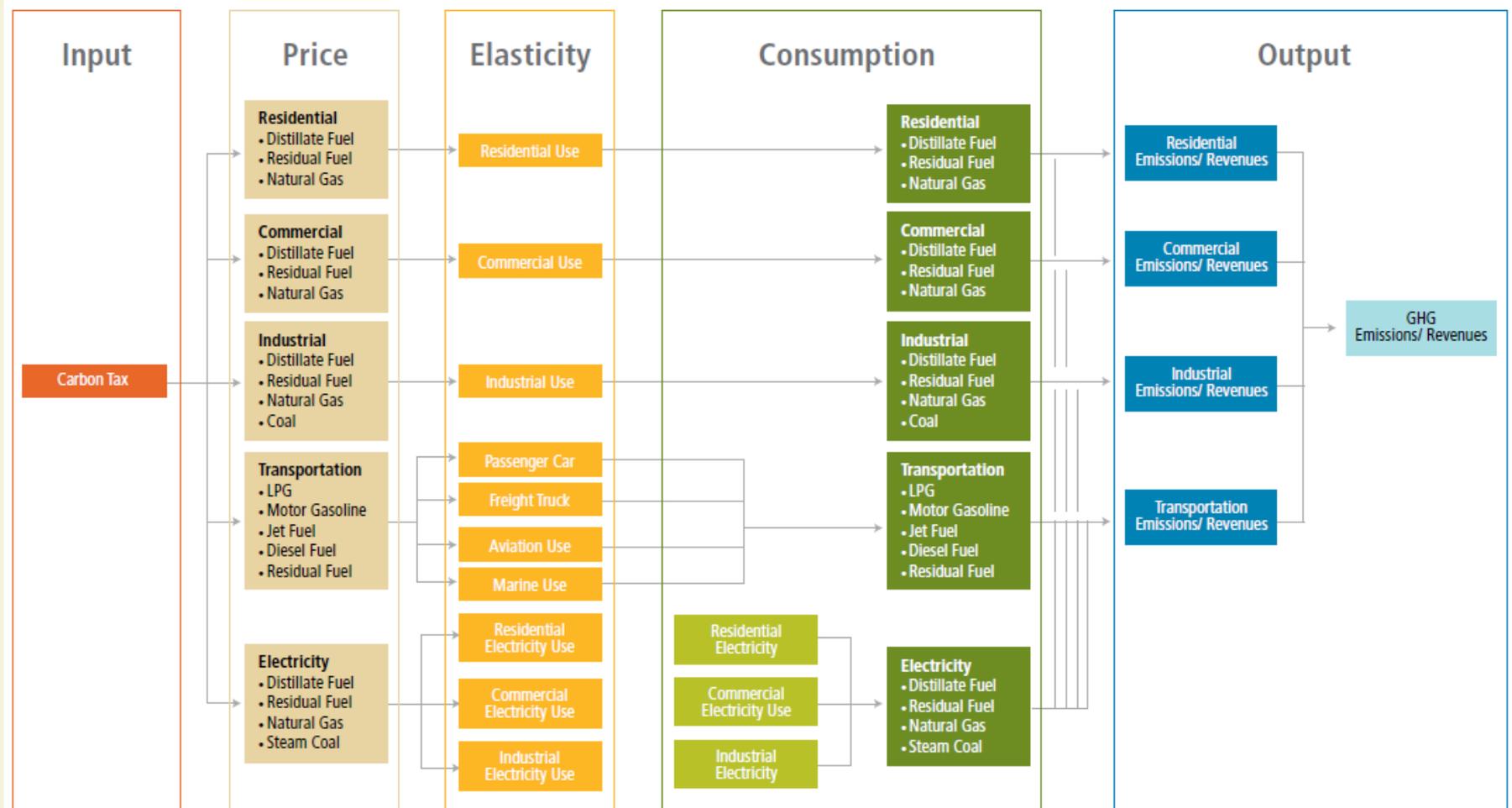


Integrate "Revenue Recycling" into costs and prices



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

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 and policy 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

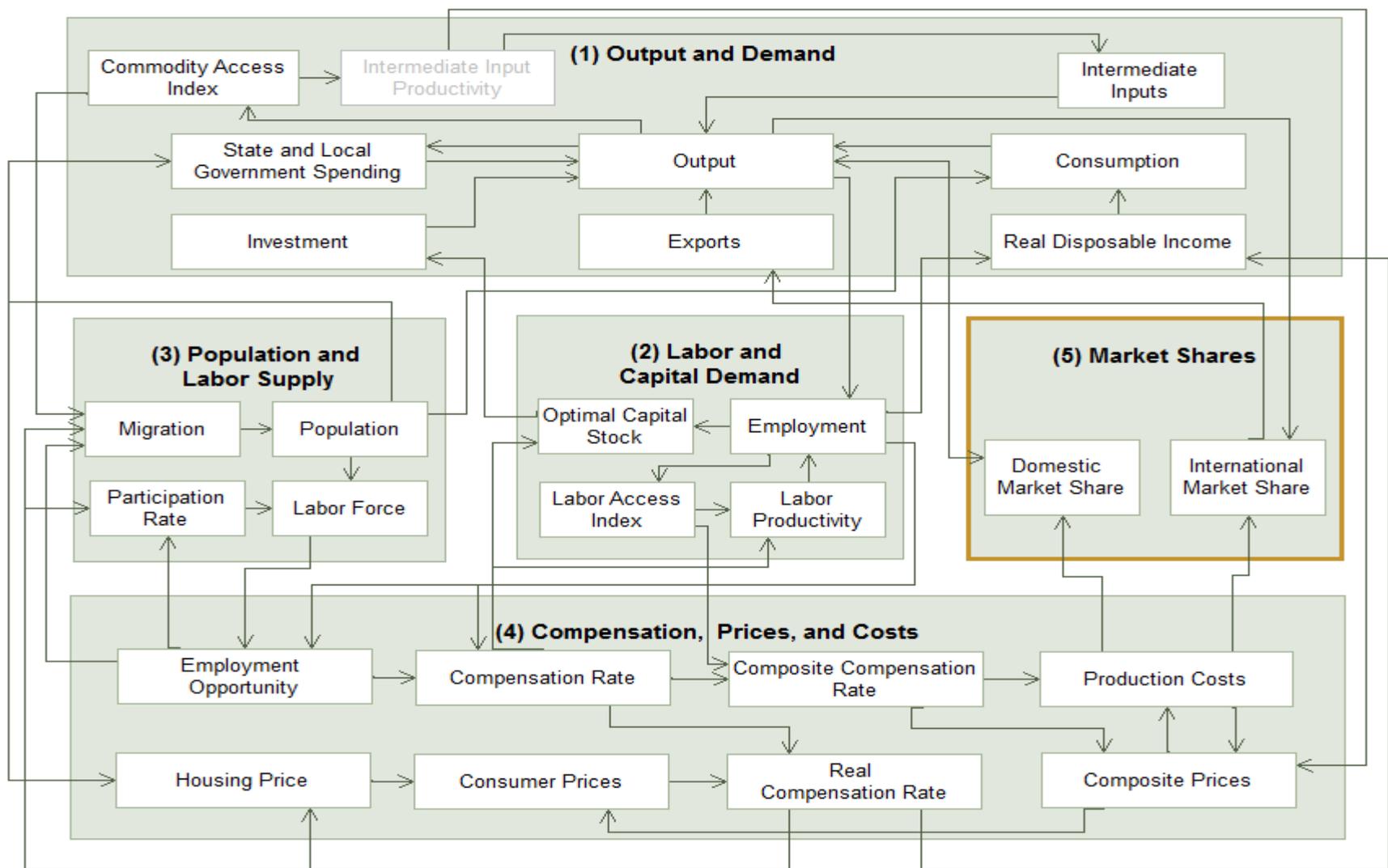


Changes in Industry and Household Purchases



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

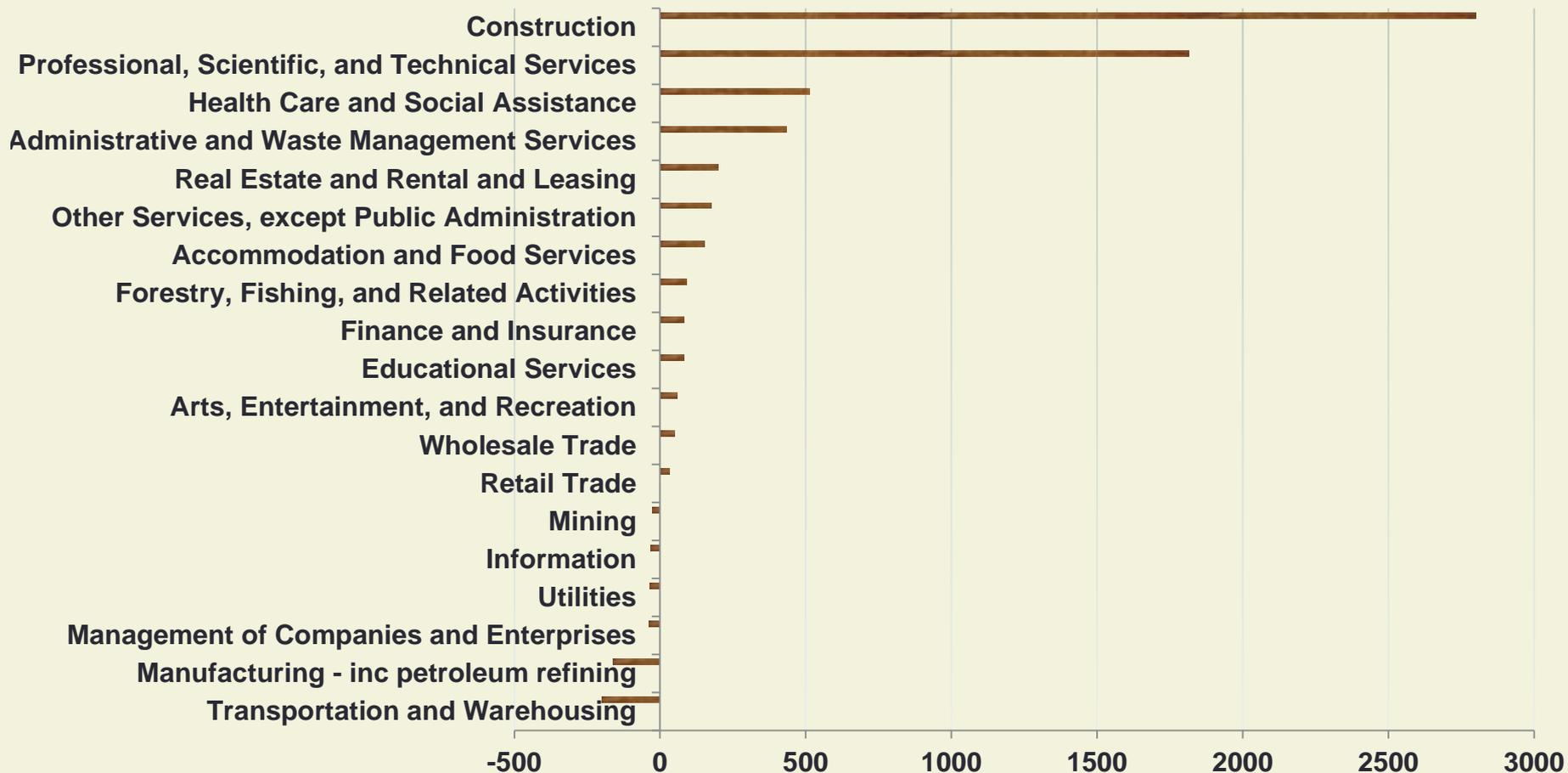
⁽¹⁾ Policy Scenario ⁽²⁾ Difference from Baseline ⁽³⁾ (Percent Difference)	2016 Policy Vs Baseline Difference	2020 Policy Vs Baseline Difference	2035 Policy Vs Baseline Difference
Gas Price (Inflation-Adjusted)	\$3.39 ⁽¹⁾ \$0.12 ⁽²⁾ (3.54%) ⁽³⁾	3.43 \$0.13 (3.94%)	4.51 \$0.41 (9.96%)
Disposable Personal Income (Billions, Nominal)	\$342.46 \$0.46 (0.13%)	\$419.04 \$0.50 (0.12%)	\$793.97 \$2.55 (0.32%)
Inflation-Adjusted Disposable Personal Income(Billions)	\$289.12 \$-0.10 (-0.03%)	\$326.15 \$-0.21 (-0.06%)	455.40 \$-0.13 (-0.03%)
Employment (Thousands of Jobs)	3,452.87 4.05 (0.12%)	3,636.07 2.52 (0.07%)	4,138.96 10.63 (0.26%)
Inflation-Adjusted Gross State Product	\$398.12 \$0.59 (0.15%)	\$419.04 \$0.40 (0.09%)	\$625.27 \$1.36 (0.22%)

Private Non-Farm Employment: Jobs Gained Over Baseline

Year	Net Jobs Gained Over Baseline
2016	4,045 (.12%)
2020	2,521 (.07%)
2026	5,510 (.14%)
2035	10,633 (.26%)

Note: Jobs created per year in REMI cannot be added across years.

Jobs Gained / Lost Relative to Baseline



Two-Digit NAICS Industry Code, Average Change 2016 to 2035

Additional industry-level detail at:

<http://governor.wa.gov/documents/EmploymentChangeDuetoCarbonPricing2035.pdf>

Gasoline, Natural Gas and Electricity Prices

Baseline vs. Policy Scenario

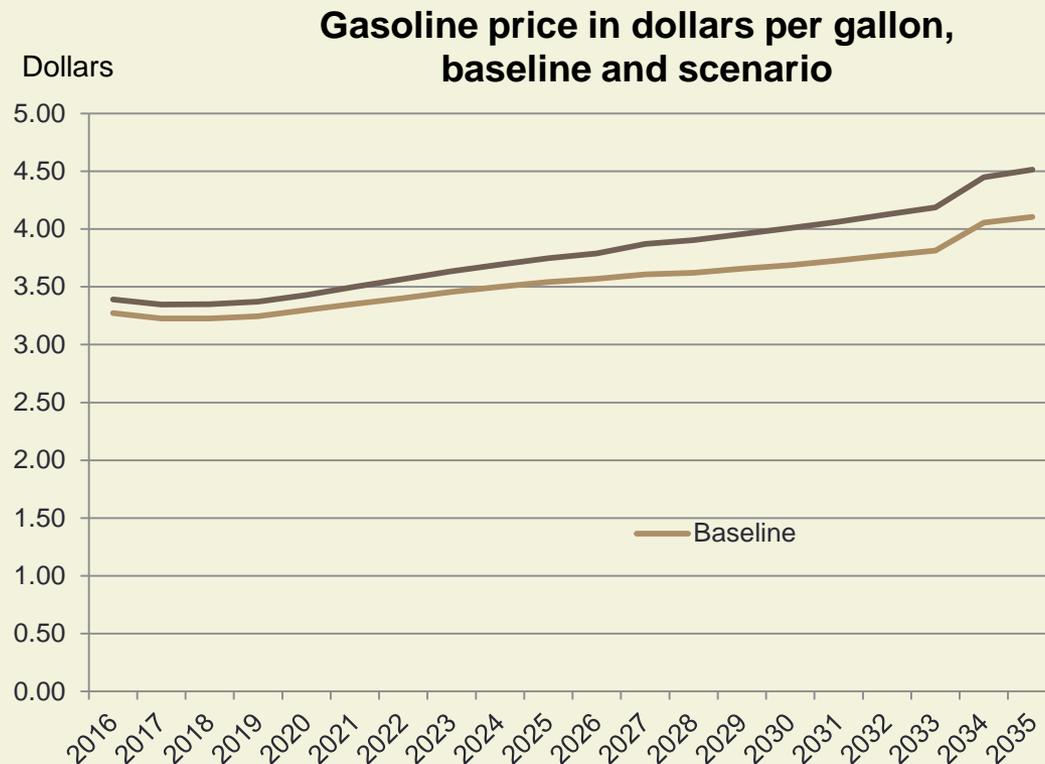
	Gasoline: 2012 \$/gal		Natural gas: 2012\$/therm		Electricity: 2012 cents/Kwh	
	Baseline	Scenario	Baseline	Scenario	Baseline	Scenario
2016	3.27	3.39	0.77	0.84	7.14	7.73
2017	3.23	3.35	0.80	0.87	7.09	7.67
2018	3.23	3.35	0.85	0.93	7.04	7.60
2019	3.24	3.37	0.88	0.95	6.97	7.53
2020	3.30	3.43	0.87	0.95	6.88	7.44
2021	3.35	3.50	0.89	0.97	6.80	7.35
2022	3.40	3.57	0.89	0.99	6.75	7.34
2023	3.46	3.64	0.91	1.01	6.69	7.32
2024	3.50	3.69	0.92	1.03	6.64	7.30
2025	3.54	3.75	0.93	1.05	6.63	7.33
2026	3.57	3.79	0.92	1.05	6.60	7.33
2027	3.61	3.87	0.92	1.07	6.60	7.45
2028	3.62	3.90	0.92	1.09	6.61	7.50
2029	3.66	3.96	0.95	1.12	6.61	7.52
2030	3.69	4.01	0.97	1.16	6.64	7.57
2031	3.73	4.06	0.99	1.19	6.78	7.75
2032	3.77	4.13	1.00	1.21	6.83	7.83
2033	3.81	4.19	1.03	1.25	6.80	7.81
2034	4.06	4.45	1.11	1.34	6.85	7.88
2035	4.10	4.51	1.14	1.38	6.93	7.98
Percent Change Scenario 2035 to baseline 2035		9.96		21.31		15.10

- Source: Commerce CTAM Model
- Actual prices include 10 digits. Calculations vary due to rounding.

Gasoline Price Trajectories

Baseline Vs. Policy Scenario

Gasoline: 2012 \$/gal		
	Baseline	Scenario
2016	3.27	3.39
2017	3.23	3.35
2018	3.23	3.35
2019	3.24	3.37
2020	3.30	3.43
2021	3.35	3.50
2022	3.40	3.57
2023	3.46	3.64
2024	3.50	3.69
2025	3.54	3.75
2026	3.57	3.79
2027	3.61	3.87
2028	3.62	3.90
2029	3.66	3.96
2030	3.69	4.01
2031	3.73	4.06
2032	3.77	4.13
2033	3.81	4.19
2034	4.06	4.45
2035	4.10	4.51

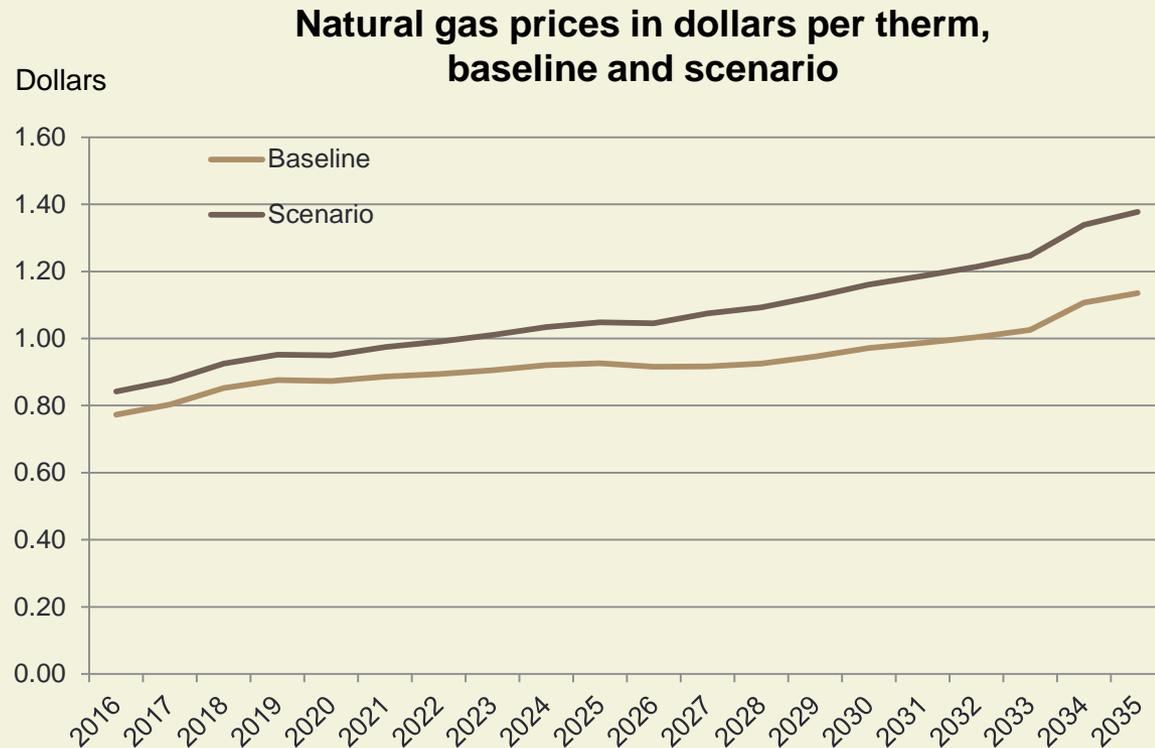


- Source: Commerce CTAM Model
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Natural Gas Price Trajectories

Baseline Vs. Policy Scenario

Natural gas: 2012\$/therm		
	Baseline	Scenario
2016	0.77	0.84
2017	0.80	0.87
2018	0.85	0.93
2019	0.88	0.95
2020	0.87	0.95
2021	0.89	0.97
2022	0.89	0.99
2023	0.91	1.01
2024	0.92	1.03
2025	0.93	1.05
2026	0.92	1.05
2027	0.92	1.07
2028	0.92	1.09
2029	0.95	1.12
2030	0.97	1.16
2031	0.99	1.19
2032	1.00	1.21
2033	1.03	1.25
2034	1.11	1.34
2035	1.14	1.38

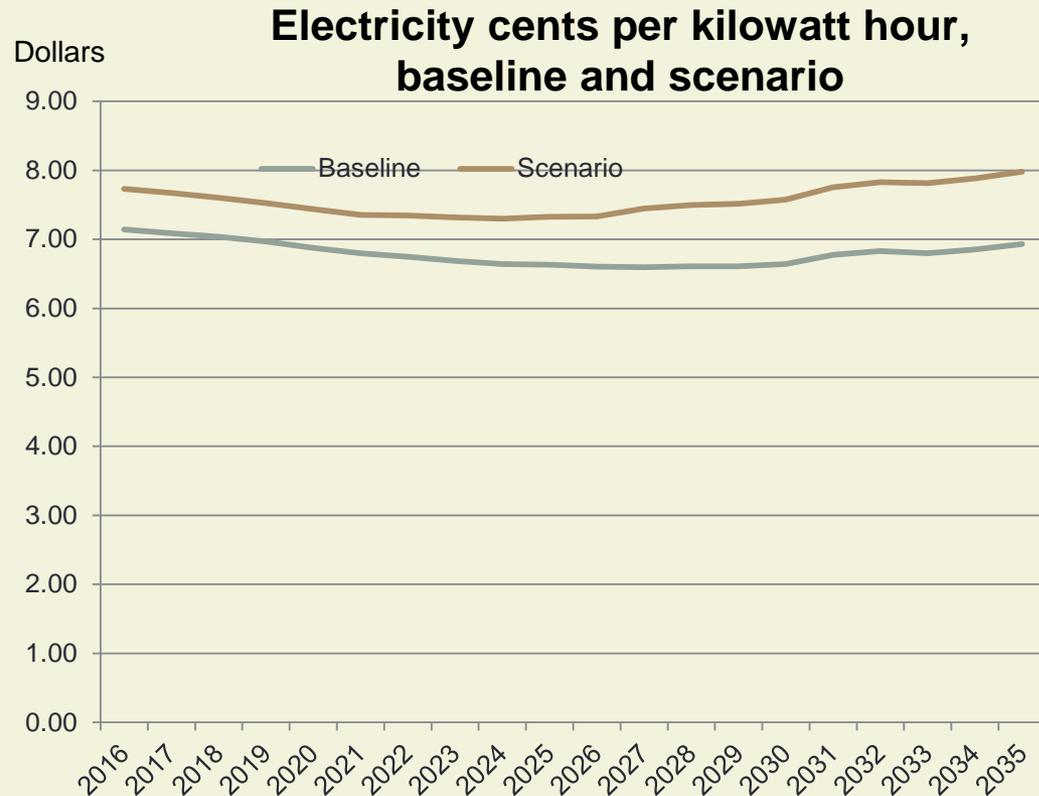


- Source: Commerce CTAM Model
- Actual prices include 10 digits. Calculations vary due to rounding.

Electricity Price Trajectories

Baseline Vs. Policy Scenario

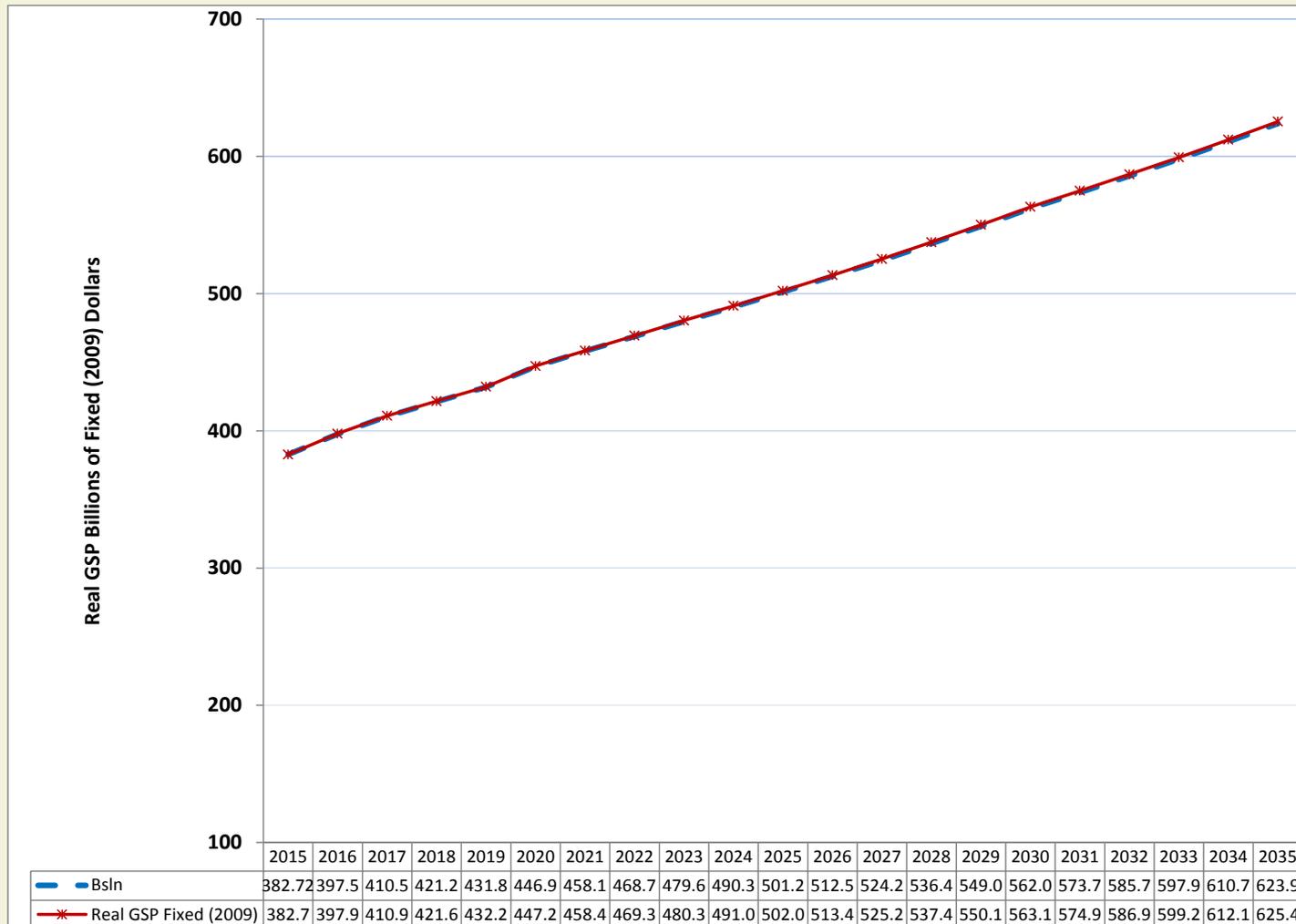
Electricity: 2012 cents/Kwh		
	Baseline	Scenario
2016	7.14	7.73
2017	7.09	7.67
2018	7.04	7.60
2019	6.97	7.53
2020	6.88	7.44
2021	6.80	7.35
2022	6.75	7.34
2023	6.69	7.32
2024	6.64	7.30
2025	6.63	7.33
2026	6.60	7.33
2027	6.60	7.45
2028	6.61	7.50
2029	6.61	7.52
2030	6.64	7.57
2031	6.78	7.75
2032	6.83	7.83
2033	6.80	7.81
2034	6.85	7.88
2035	6.93	7.98



- Source: Commerce CTAM Model
- Actual prices include 10 digits. Calculations vary due to rounding.

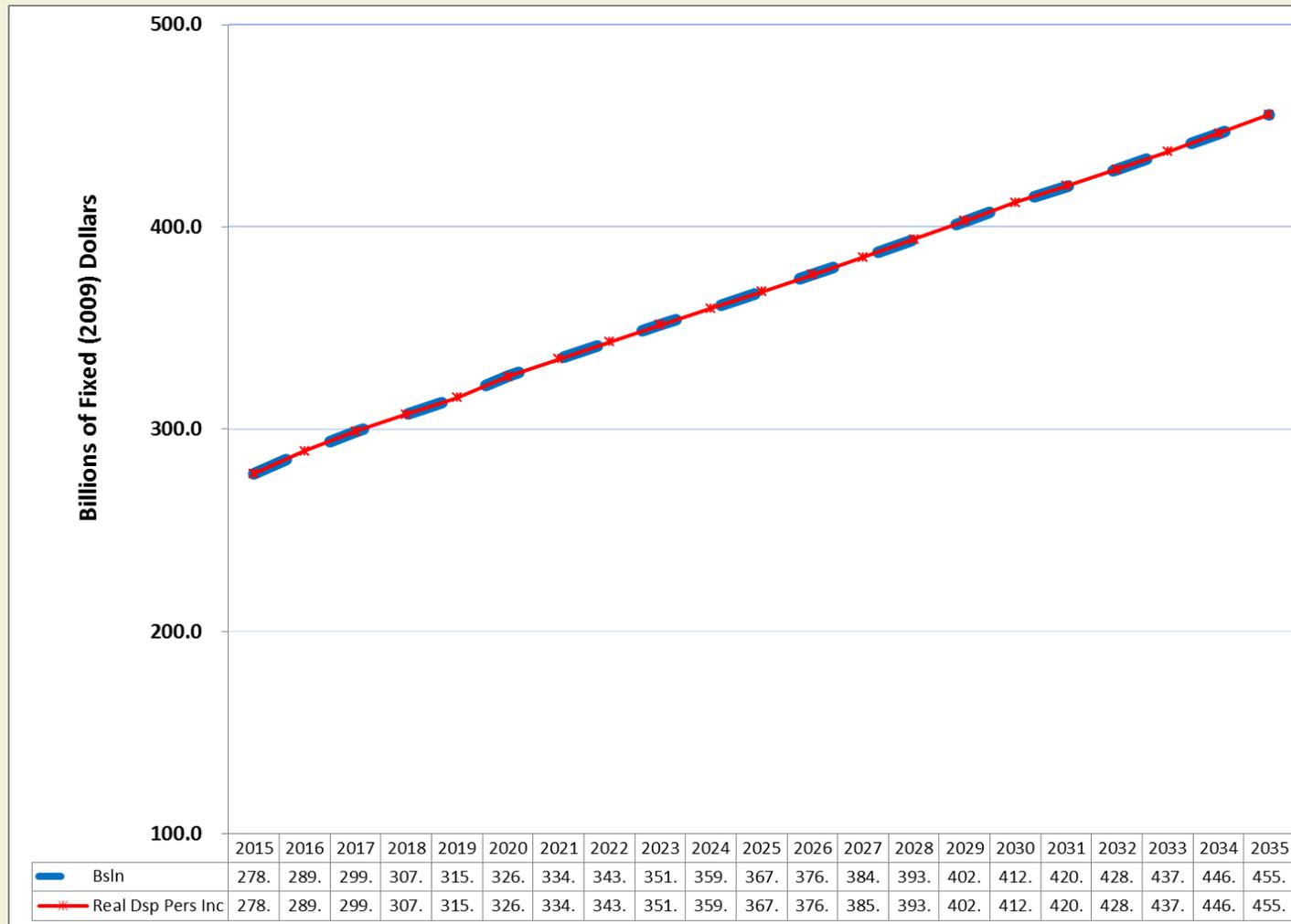
Washington Private Non-Farm Employment

Baseline (Blue) Vs. Policy Scenario (Red)



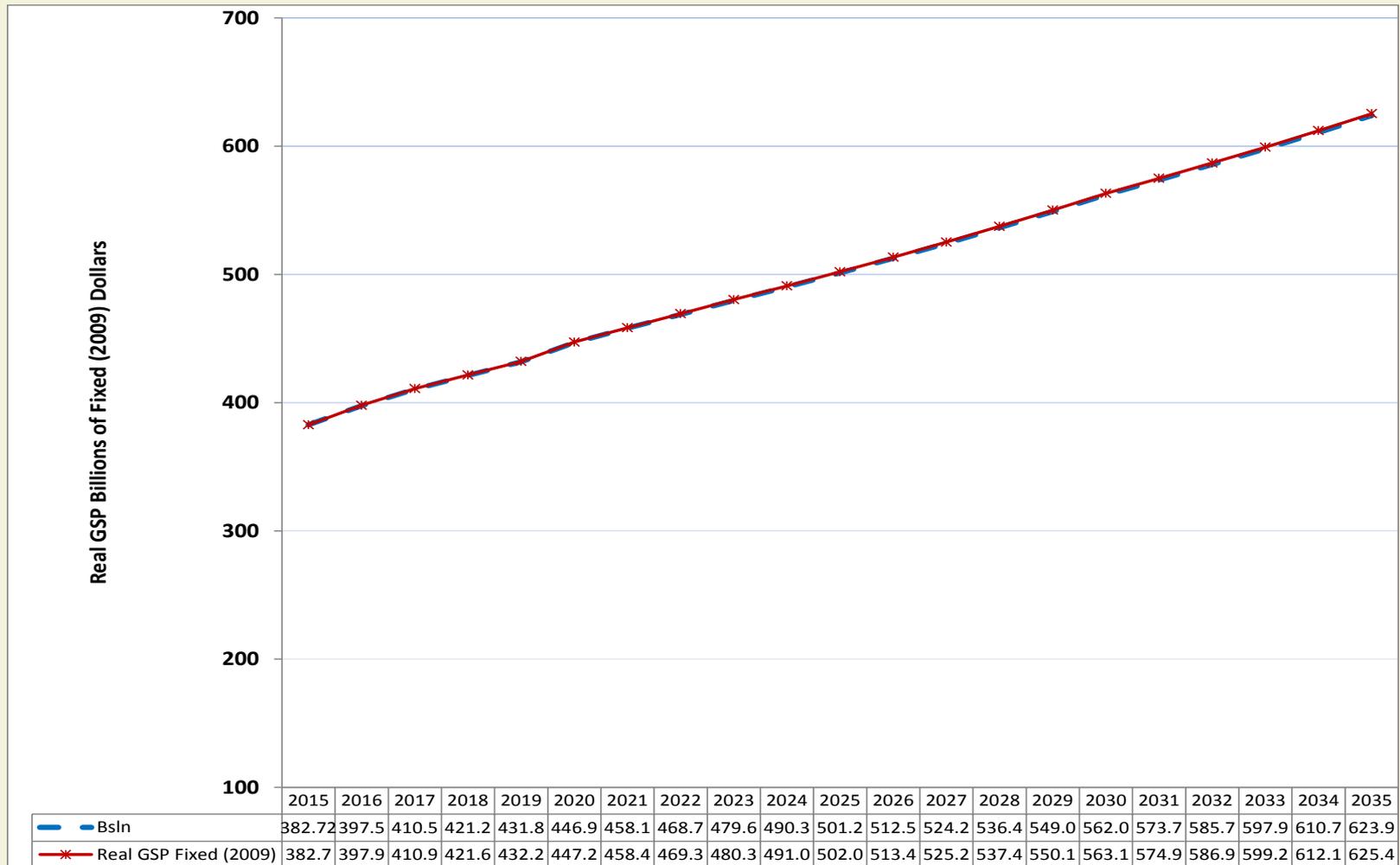
Washington Inflation-Adjusted Disposable Personal Income

Baseline (Blue) Vs. Policy Scenario (Red)

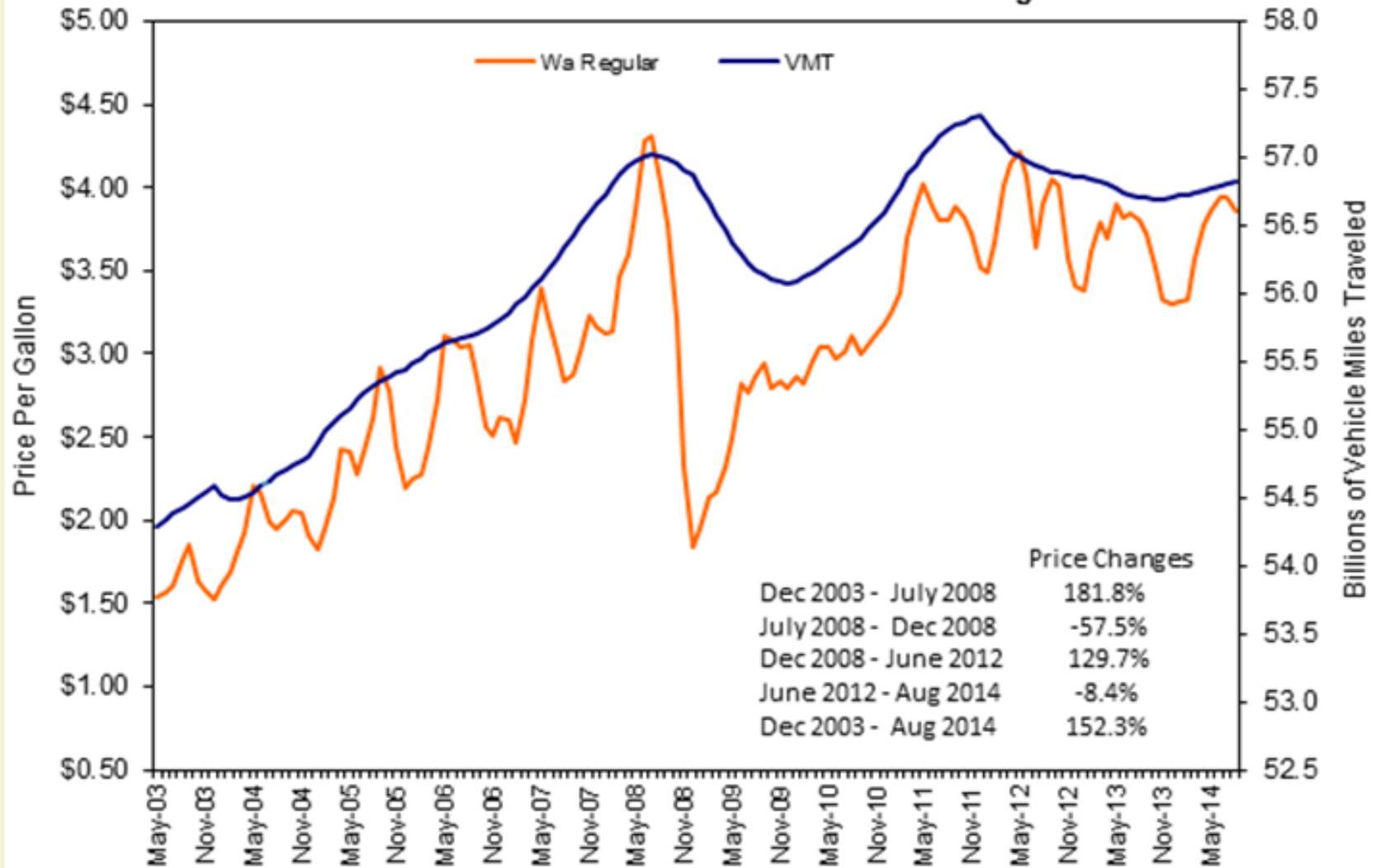


Washington Real Gross State Product

Baseline (Blue) Vs. Policy Scenario (Red)



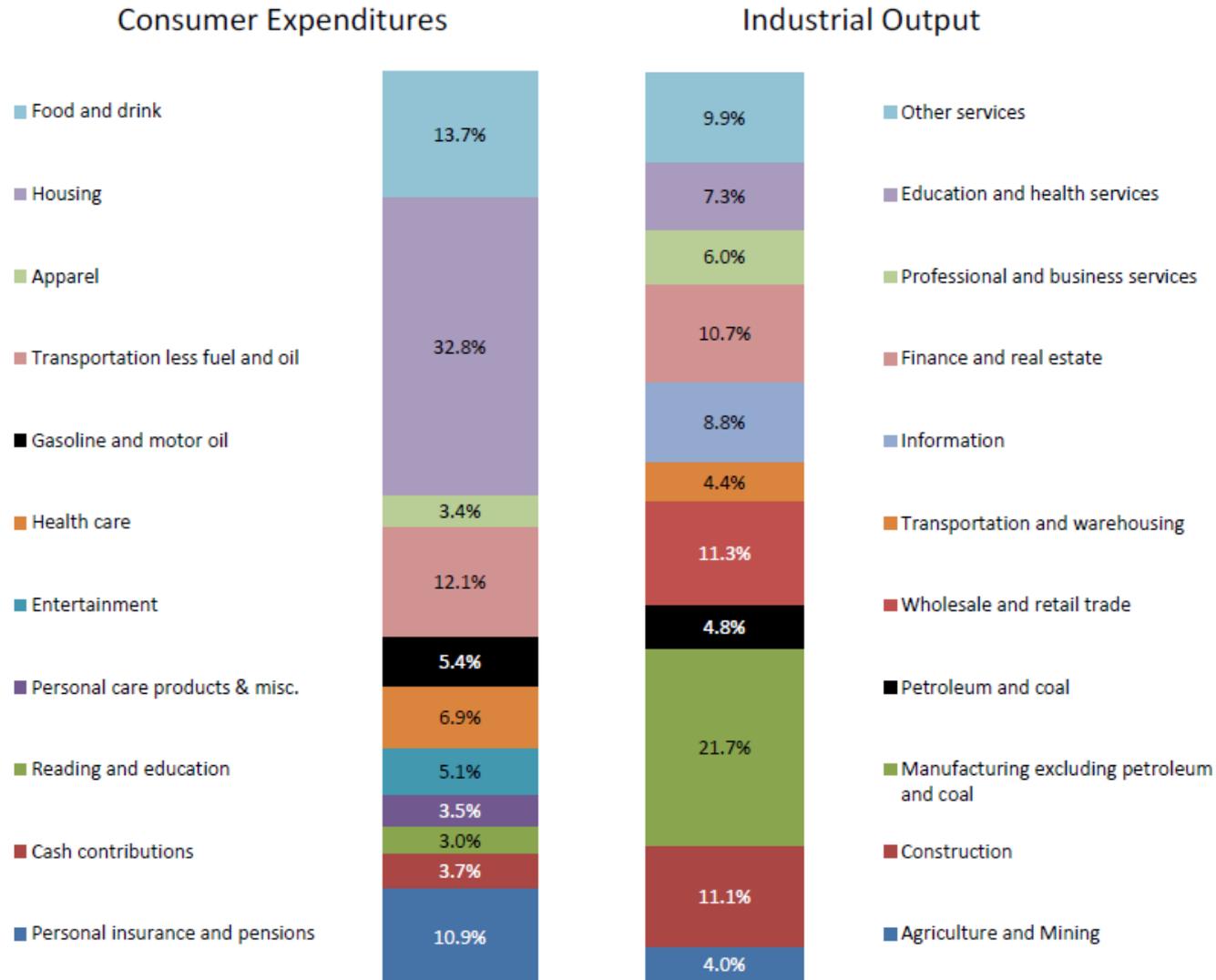
Cost of Gasoline and Vehicle Miles Traveled in Washington State



Sources: US Energy Information Administration and Washington Department of Transportation

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

Relative Scale of Gasoline and Related Products



Sources: Consumer Expenditure Survey and Washington I/O Model