


Oregon LCFS: Economic Impacts

October 14, 2010

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Today's Discussion

- Micro Economics – VISION Modeling
- Macro Economics – REMI Modeling
- Scenario Analysis
- Direct Cost Inputs
- Preliminary Macro Results
- What We Learned So Far

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Who Am I

- Mike Lawrence, President, Jack Faucett Associates
- Energy & Transportation Economist
- Measured Economic Impacts of Transportation Carbon Policy Across US
- Experience in Converting Policy Into Micro Economic Impacts and Macro Economic Impacts
- Support Federal, State and Local Decision Makers
- Experienced in Western States and Oregon Energy & Transportation Policy

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Goal of This Analysis

- Describe the Micro and Macro Economic Impacts of LCFS Scenarios
- Translate These Micro Impacts Into Macro Economic Impacts In Oregon
- Learn How Different Pathways and Assumptions Change the Results

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Tools For LCFS Analysis

- GREET – Carbon Factor Analysis (DEQ)
- VISION – Perpetual Vehicle Inventory and Micro Impacts (TIAX & JFA)
- VISION to MACRO – Translate Micro VISION Outputs Into Macro Model Inputs (JFA)
- REMI PI+ - Premier Macro Economic Model Available (REMI Northwest, Adam Rose USC)

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VISION Model

- Developed By Argonne National Lab/DOE
- Database and Projection of the Vehicle Fleet Including Vintage, Technology, Efficiency, VMT
- Key Inputs – EIA AEO Forecasts, LCFS Pathway Design, Fuel/Vehicle Technology
- Key Outputs – Future Fleet Composition by Technology, Efficiency, Fuel Type and MPG

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VISION to Macro (VtM)

- Developed by JFA
- VISION Provides Changes in Fuel and Vehicle Sales Based on Selected Pathway
These are Micro Impacts
- VtM Develops the Direct Macro Impacts Associated With Micro Changes Such As Capital, Equipment, Distribution, etc.

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Measuring Macro Impacts of LCFS

- Decreased Demand for Petroleum
- Increased Demand for Alternative Fuels
- Increased In-State Fuel Production
- Increased Capital Investment
- Changes in Household/Commercial Expenditures

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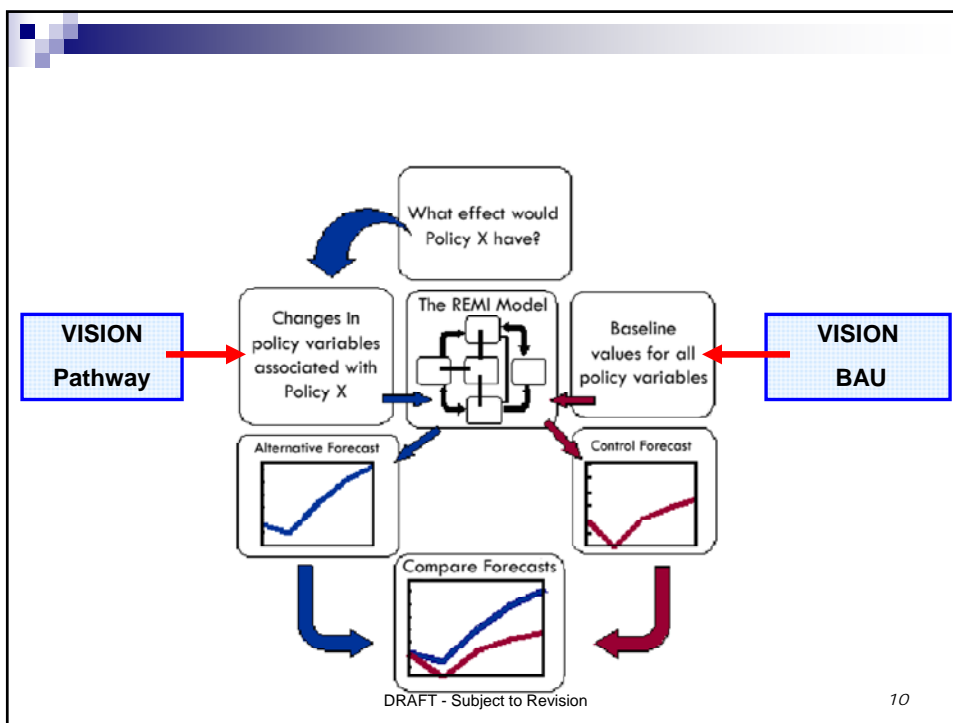
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REMI Policy Insight Plus (PI+)

- Developed by Regional Economic Models, Inc.
- Includes Input/Output (I/O) Model, Computable General Equilibrium (CGE) Model, Economic Geography (EG) Model
- Provides Change in State Product, Value Added, Output, Employment, Income, etc.

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The Oregon Economy Today

- Gross State Product - \$147 Bil (2005\$)
- Personal Income - \$140 Bil (2010 \$)
- Employment – 1.6 Million (non-Farm)
- Population – 3.86 Million

Source: Department of Administrative Services, Office of Economic Analysis, September 2010

Key Features to Remember

- Scenario Analysis Measures the Change from The Baseline (BAU from USDOE)
- Macro Analysis measures Indirect and Induced Impacts from Known Direct Impacts
- Importing Petroleum Sends Dollars Out of Oregon While Consuming Oregon Produced Products Keeps Oregon \$ in Oregon,

Scenario Analysis – Not Forecasting

Not attempting to predict the future

- Great uncertainties exist
- LCFS pathways are scenarios, not projections or predictions of future behaviors

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Oregon LCFS Scenarios A-D

- A: Maximizing in-state biofuels production
 - All cellulosic biofuels
- B: Maximizing in-state biofuels production
 - Blend of feedstocks
- C: Same as B, but...
 - No ILUC assumed
- D: High Electric Vehicle (EV) growth
 - And CNG for the heavy duty fleet

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Oregon LCFS Scenarios E-H

- E: One-Pool Scenario
 - EER Applied for Diesel, some electric & CNG
- F: High Fuel Price Scenario
 - Same as C, but assumes high fuel prices
- G: Low Fuel Price Scenario
 - Also same as C, but assumes low fuel prices
- H: Out of State Biofuels Supply
 - Same as A, but no new production in Oregon

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Selected Macro Economic Results

- All results are comparisons to BAU
- Change in **Gross State Product**
- Change in **Personal Income**
- Change in **Employment**
- Measured State-wide and for Individual Economic Sectors

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Key Assumptions

- Fuel Price Projections
 - AEO (DOE)
- Fleet Fuel Efficiency
- New Capital Spending
 - Refining Facilities
 - Equipment
 - Infrastructure

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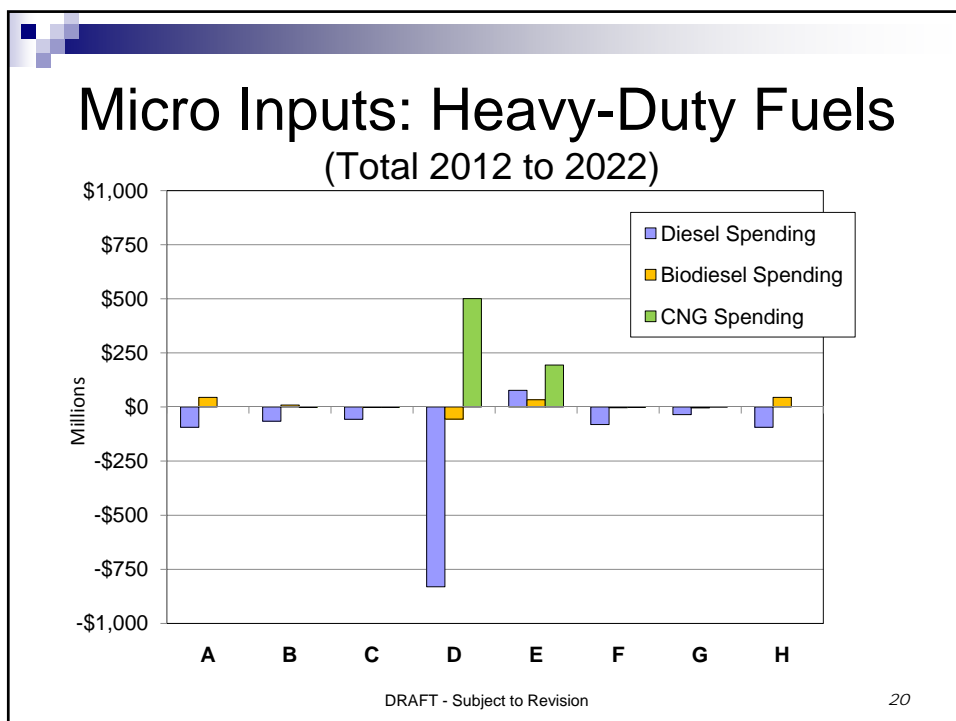
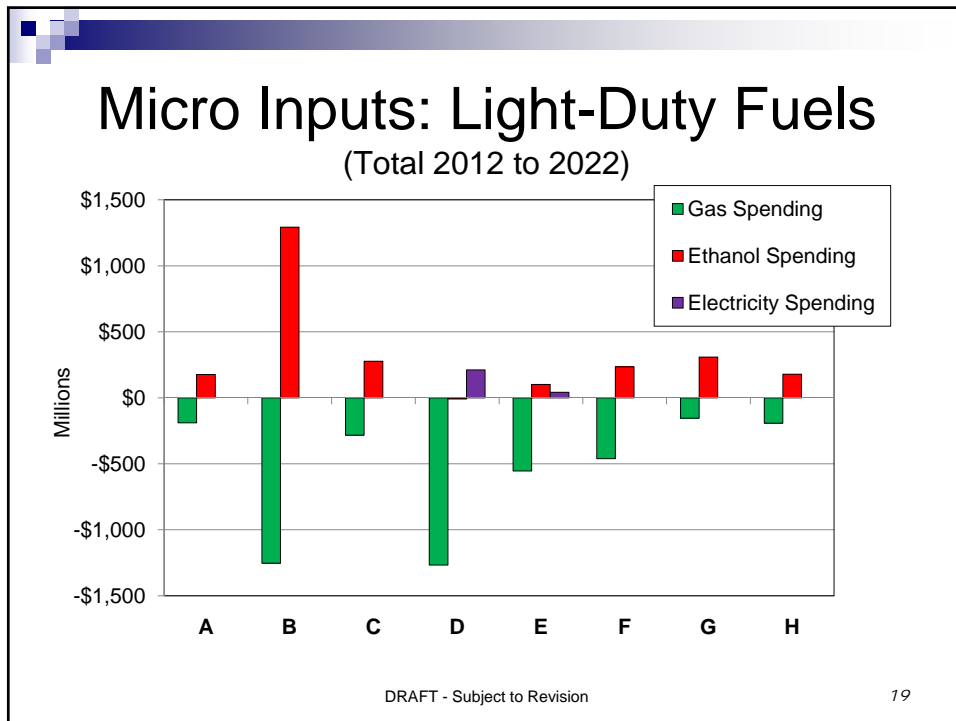
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Inputs to REMI PI+

- Fuel Expenditures
- Vehicle Costs
 - Price premium for EVs, alternate fuel vehicles
- Biofuels Infrastructure
 - Production, Storage, Distribution, Fueling
- CNG Infrastructure
 - Storage, Distribution, Fueling
- Electric Vehicle Infrastructure
 - Home and Public Charging Stations

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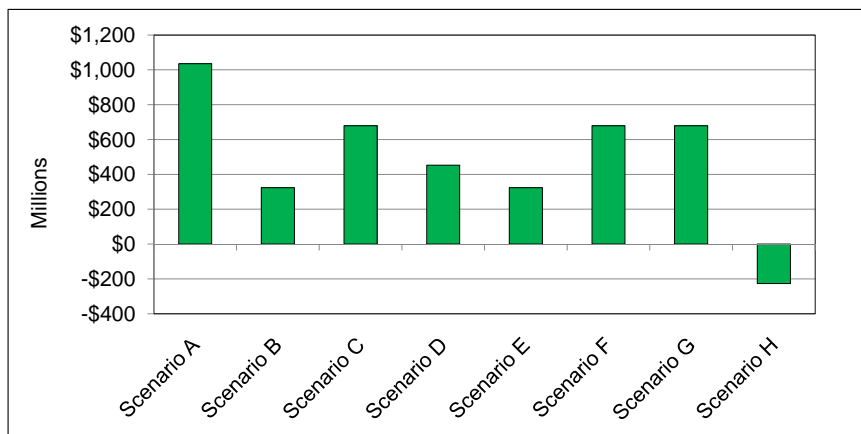
Scenario D: Explaining the Drop in Fuel Spending

- Electricity 4X more fuel-efficient (DOE)
 - 120+ miles per “gallon” (energy equivalent to gasoline gallon)
- Electricity price advantage vs. gasoline
 - 15% lower price per “gallon” in 2012, 35% lower in 2022
- EVs need less energy, pay a lower price
- CNG: no efficiency gain, but cheap
 - 40-50% of diesel price at pump

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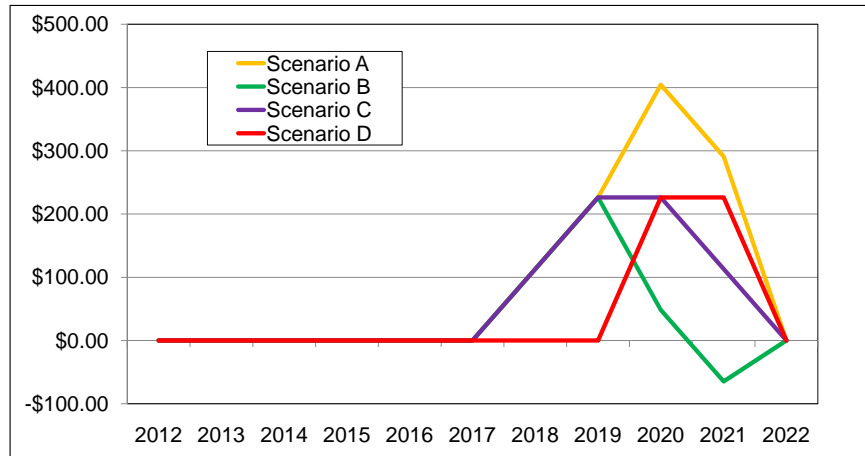
Micro Inputs: Plant Spending by Scenario, 2012 – 2022



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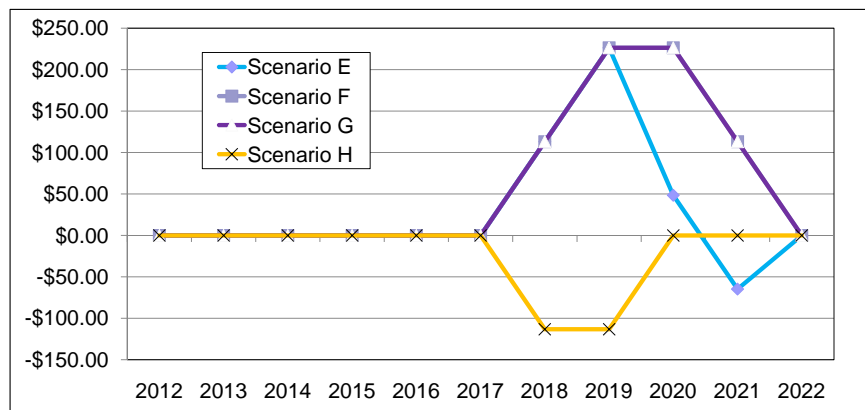
Micro Inputs: Plant Spending (Scenarios A, B, C, D)



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Micro Inputs: Plant Spending (Scenarios E, F, G, H)



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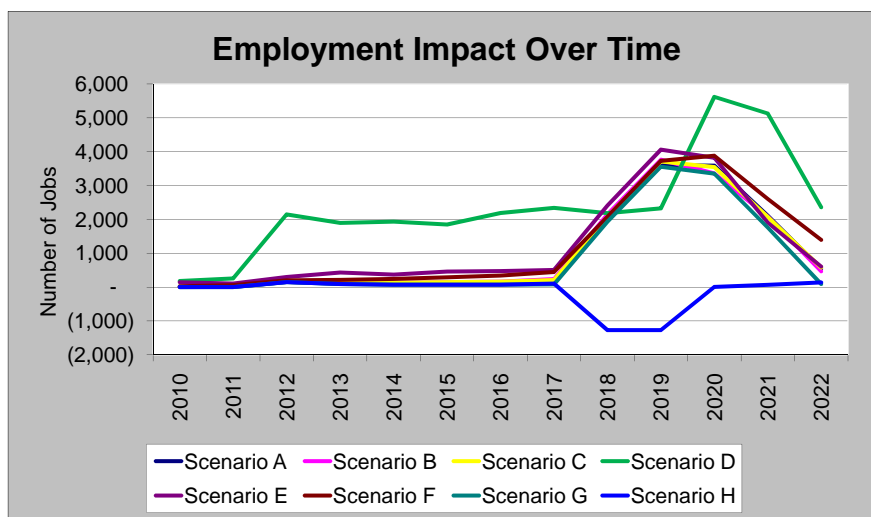
Oregon LCFS Results: General Notes

- Period of analysis: 2012 through 2022
- Most fuels adoption in last 2 – 4 years (2019 and later)
- Biofuels plant construction completed just before in-state biofuels use grows
- Other infrastructure grows with, or just ahead of, fuel use (charging stations, trucks, fueling station upgrades)
- Generally little impact in first 5 years

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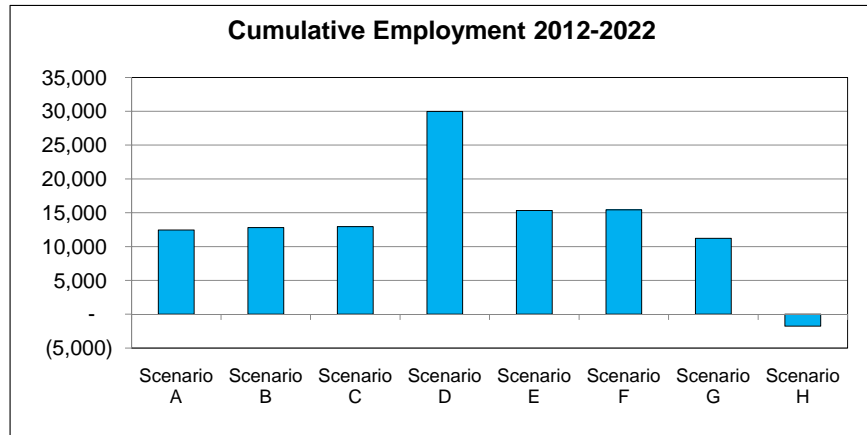
Macro Outputs - Employment



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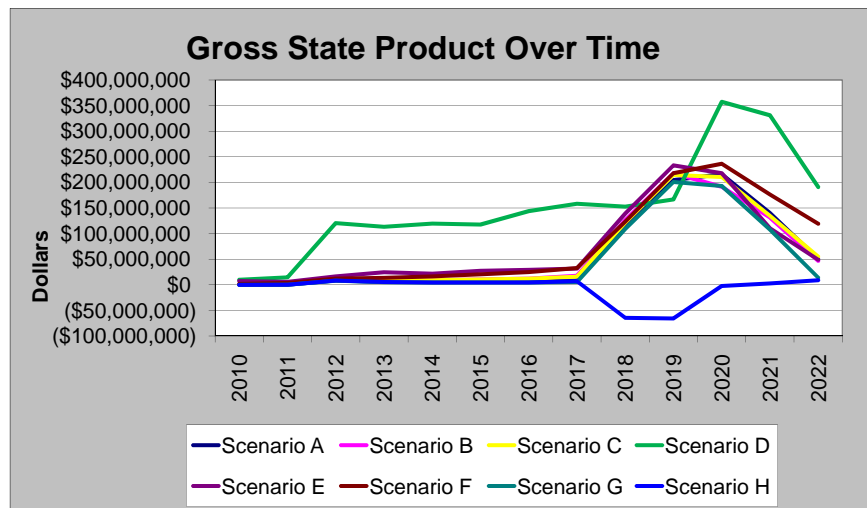
Macro Outputs - Employment



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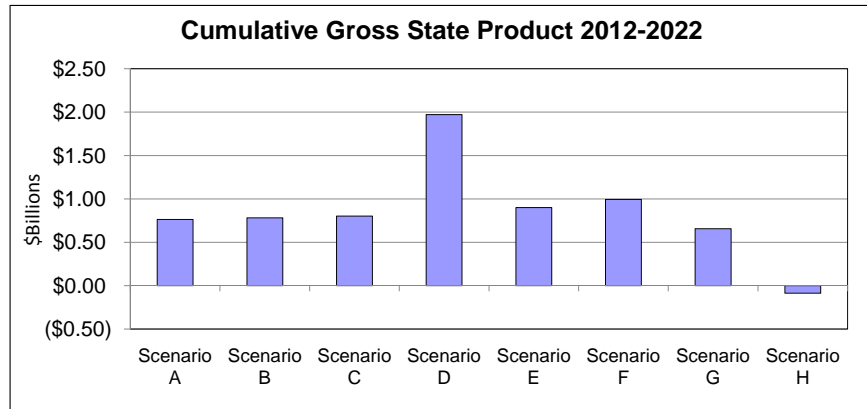
Macro Outputs – State Product



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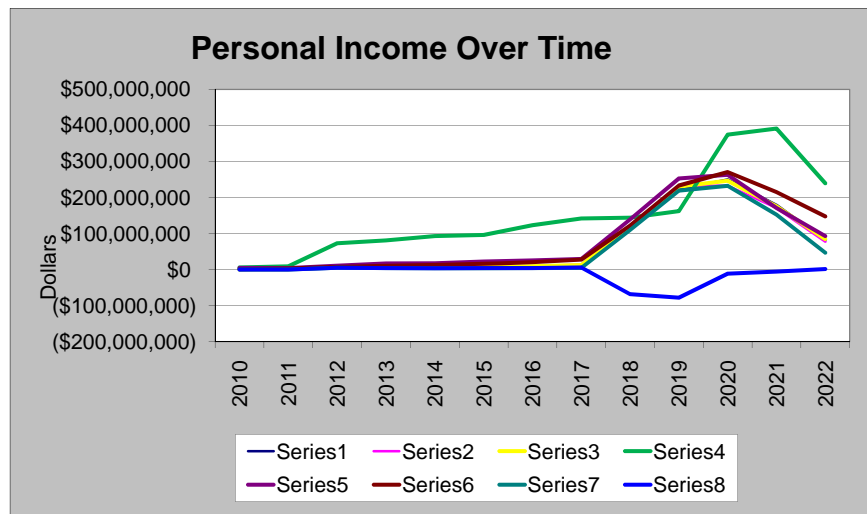
Macro Outputs – State Product



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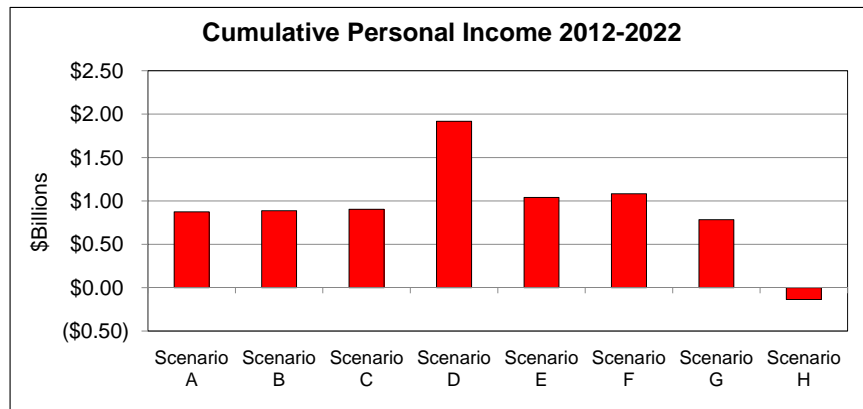
Macro Outputs – Personal Income



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Macro Outputs – Personal Income



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In-State Biofuels Scenarios: Similar Impacts

- Scenarios A, B, C, E, F and G: Similar Projections (Six Closely Grouped Lines)
 - Small Impacts through 2017
 - Large Impacts in 2018-2021 from ethanol plant construction
 - Falling impacts in 2022 – plant construction finished; other impacts minor
- 15-20% difference from highest to lowest

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Outliers: Other Fuels and Out-of-State Supply

- Scenario H: The below-zero line
 - Assumes one *less* biofuels plant than the baseline scenario; little to offset this loss
- Scenario D: The high-impact line
 - CNG fueling infrastructure and EV chargers start early
 - Extra spending on new vehicles – plus an ethanol plant

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Pared Macro Outputs

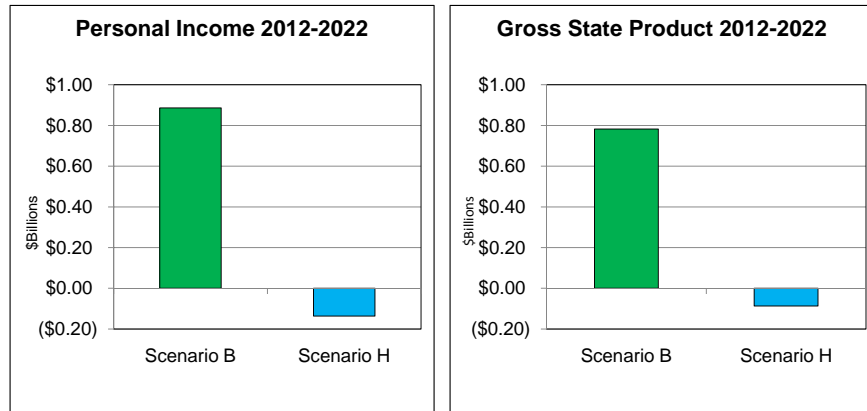
Special graphic comparison of specific scenarios

- In-State vs. Out-of-State Biofuels Supply
- Low vs. High Fuel Prices
- Impact of ILUC
- EV/CNG Scenario vs. Biofuels
- Four Similar Biofuels Scenarios Compared

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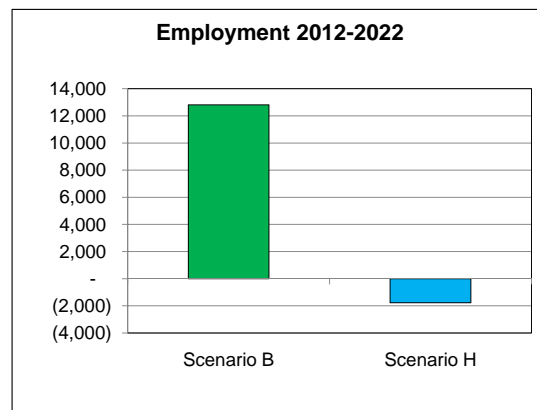
In-State (Scenario B) vs. Out-of-State (Scenario H) Biofuels:



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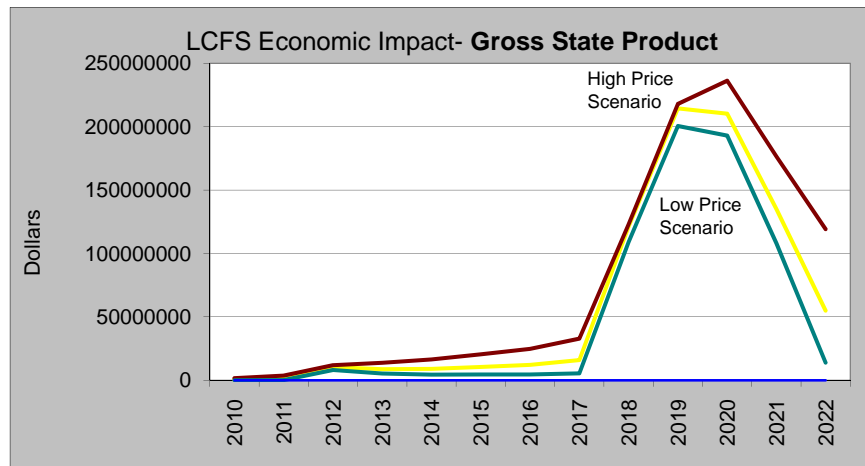
In-State vs. Out-of-State Biofuels



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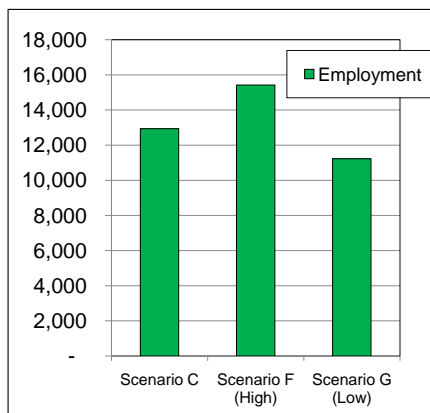
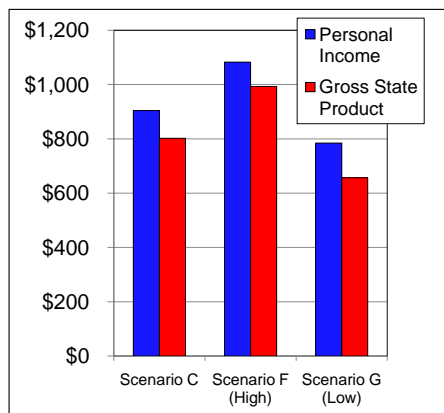
Effect of Different Fuel Price Projections – Scenarios C, F and G



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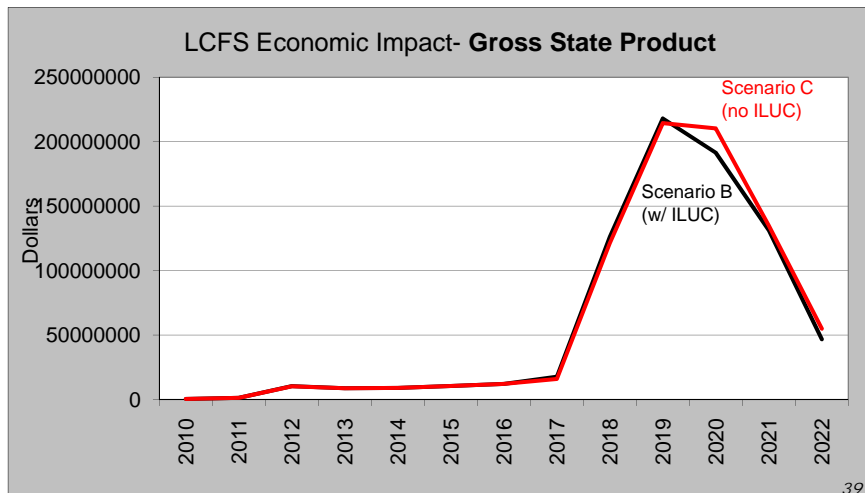
Effect of Different Fuel Price Projections – 2012 to 2022



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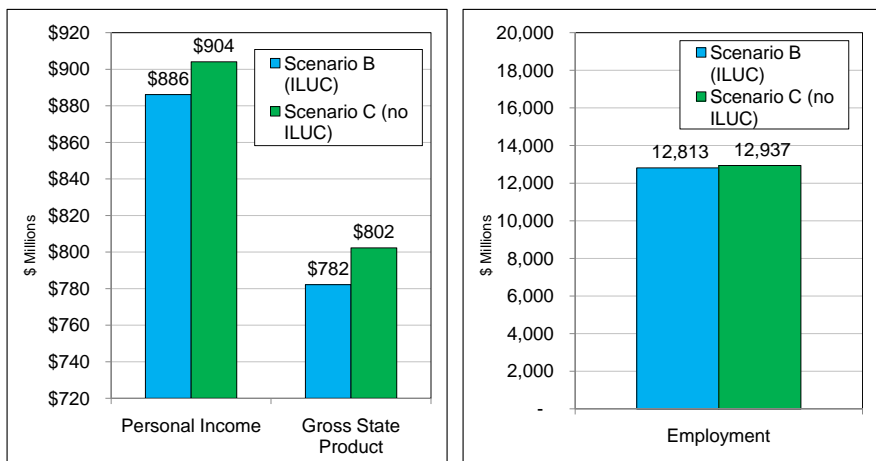
Effect of ILUC on In-State Biofuels Scenario



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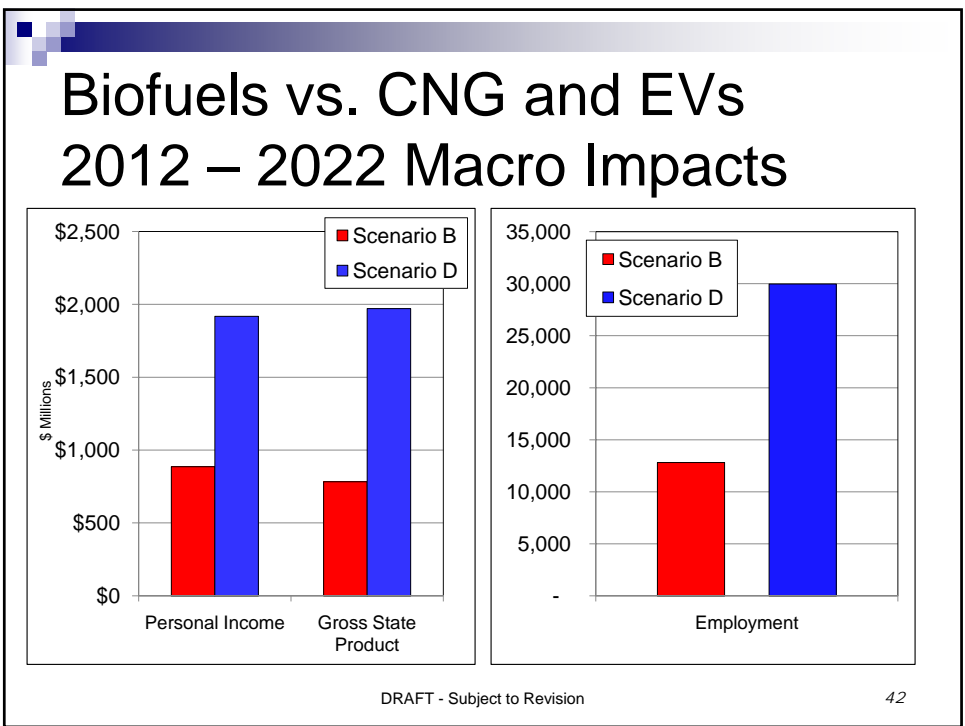
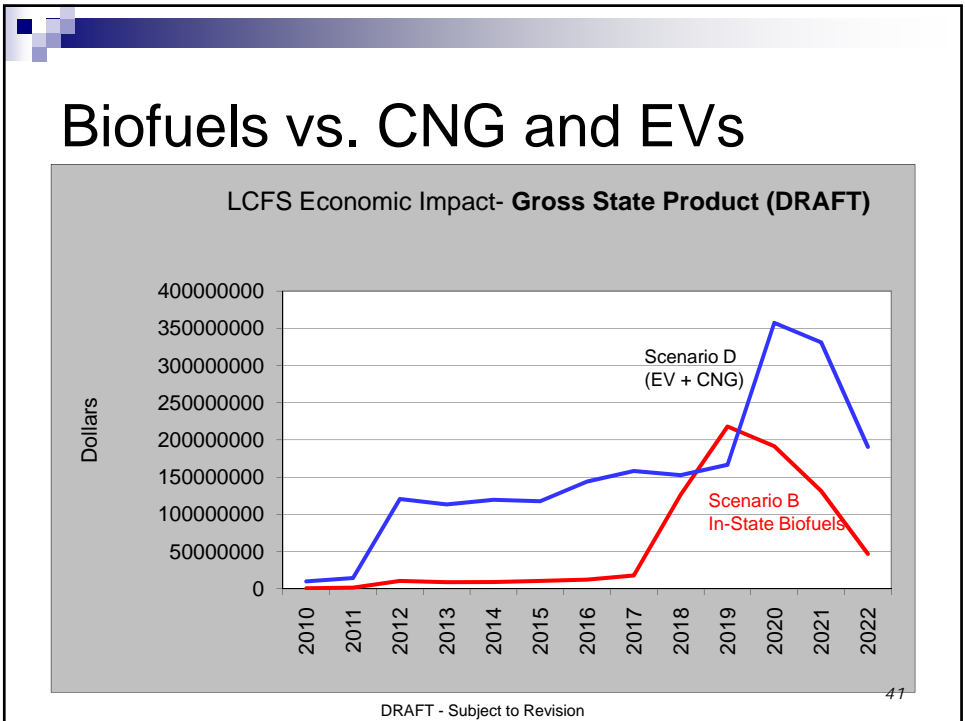
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Effect of ILUC on In-State Biofuels Scenario

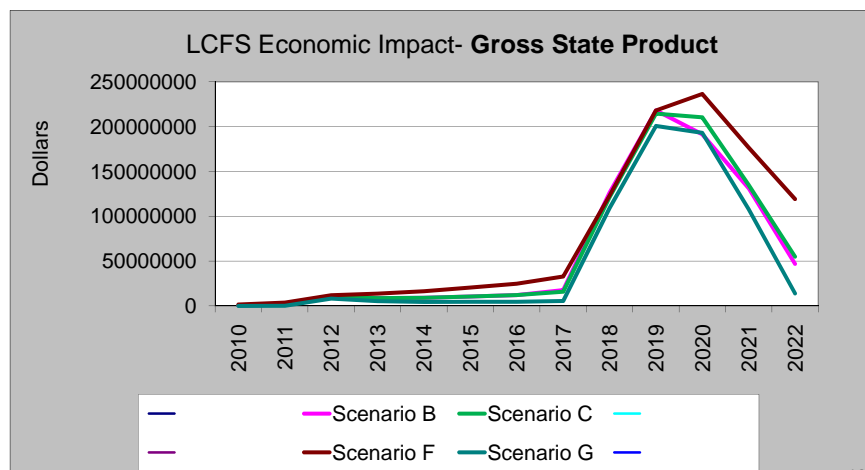


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Maximum Biofuels: Four Scenarios – the Same Pathway



Maximum Biofuels: Four Scenarios – the Same Pathway

- Scenarios B, C, F and G:
 - Maximize in-state biofuels production
 - Multiple feedstocks – cellulose, corn, etc.
 - Out-of-state supply added to reach LCFS goal
- How they Differ
 - B includes ILUC (indirect land-use change)
 - F assumes higher fuel prices (\$5/gal by 2020)
 - G assumes lower fuel prices (\$2/gal by 2020)

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Maximum Biofuels: Four Scenarios – the Same Pathway

What do These Four Scenarios Show?

- As modeled, fuel price variation has greater impact than ILUC Sensitivity
 - B & C (ILUC comparison) are close; F & G (fuel price comparison) are further apart
- Variation in capital spending on plants has greater impact than fuel price variation

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Selected Industry Impact

- REMI PI+ Provides Impacts over 70 Economic Sectors in Oregon, Including
 - Employment
 - Output
 - Value Added
- Sector Analysis is Underway

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Discussion Session

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Macro Impacts Example: More Consumption of In-State Biofuels

- Impacts Felt Across the Economy:
 - Forestry Sector incomes rise
 - Agriculture Sector incomes rise
 - Household & Commercial Expenditures change
 - Petroleum Expenditures fall
 - Actors in Each Sector Change Behavior

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Macro Impacts Example: A New Ethanol Plant

■ Construction

- Capital Spending
- Labor Spending (Construction Workers, Engineers, Architects) → Consumer Income → Consumer Spending
- Fuel Expenditures

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Macro Impacts Example: A New Ethanol Plant

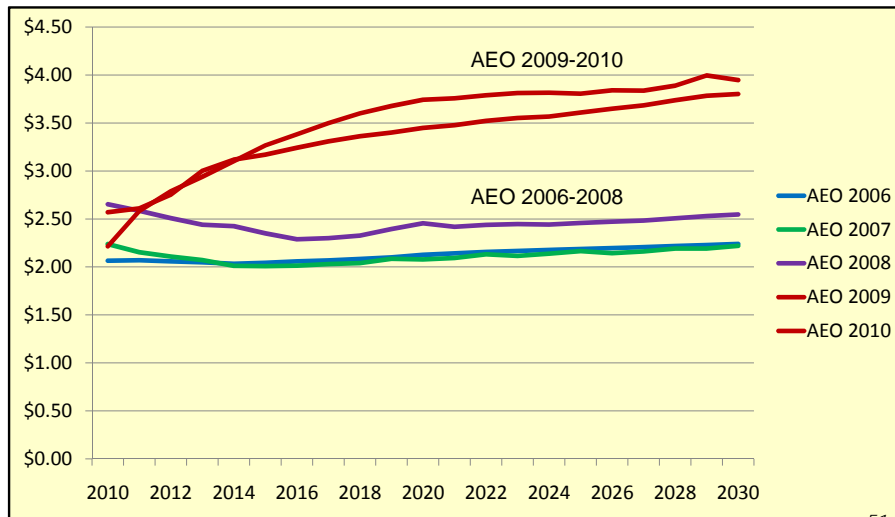
■ Operations

- Water Consumption
- Feedstock Consumption → Agriculture Sector Income
- Labor Spending → Consumer Income → Consumer Spending

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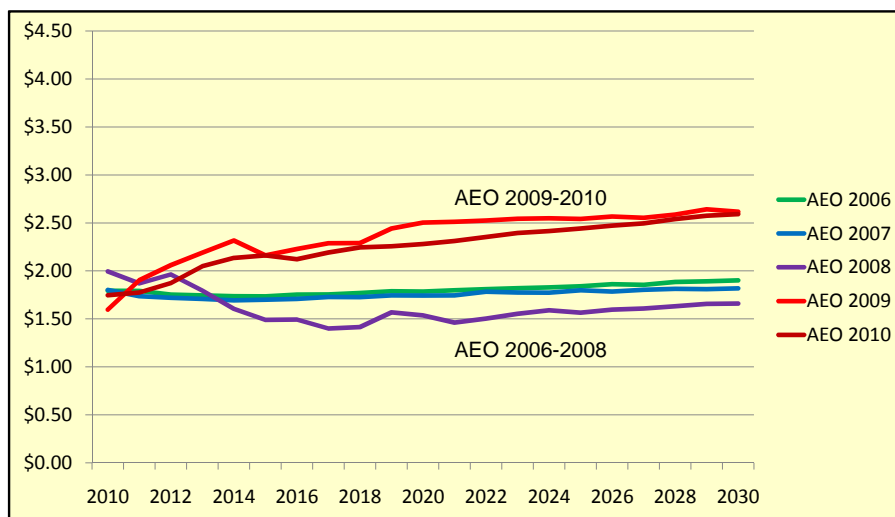
AEO Gas Price Forecasts Vary



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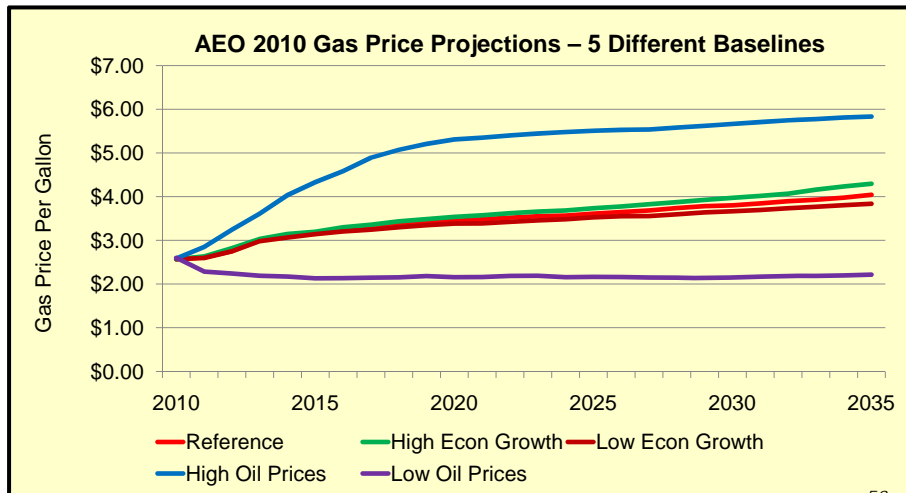
AEO Ethanol Price Forecasts Vary



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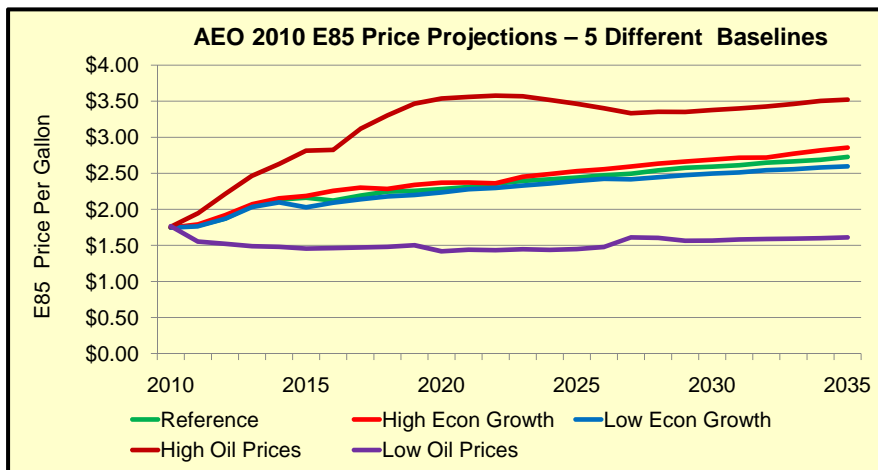
Growth and Oil Price Assumptions Determine Gas Price Projections



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E85 Prices are Similarly Sensitive to Assumptions



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