Oregon LCFS: Economic Impacts

November 16, 2010

1

Today's Discussion

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

2

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

3

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

4

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)

5

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

6

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.

7

Measuring Macro Impacts of LCFS

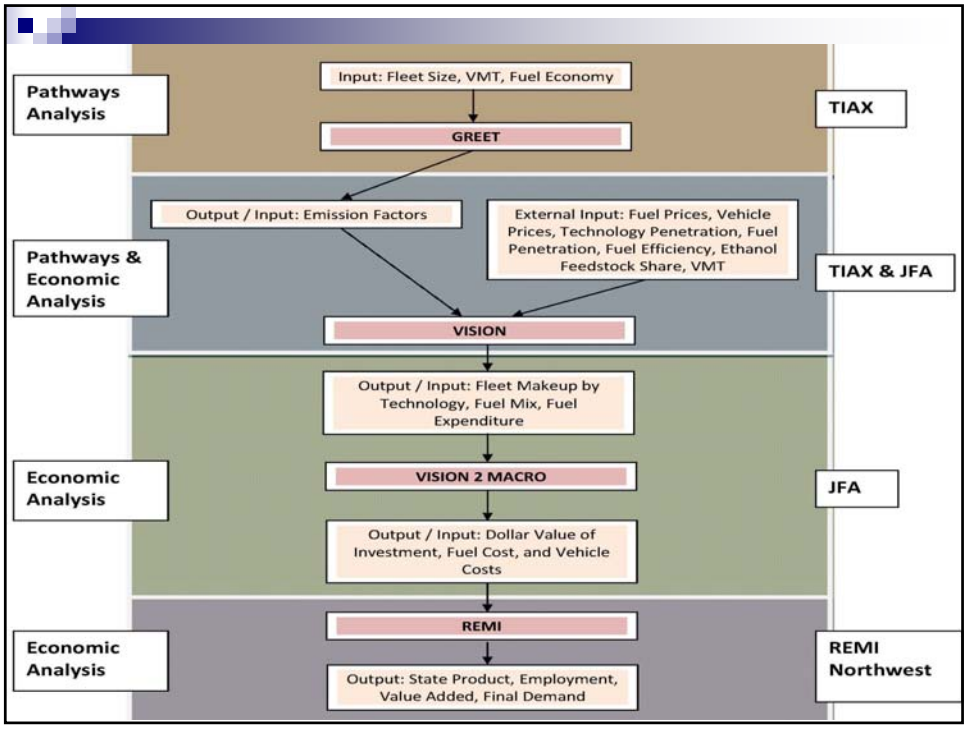
- Decreased Demand for Petroleum
- Increased Demand for Alternative Fuels
- Increased In-State Fuel Production
- Increased Capital Investment
- Changes in Household/Commercial Expenditures

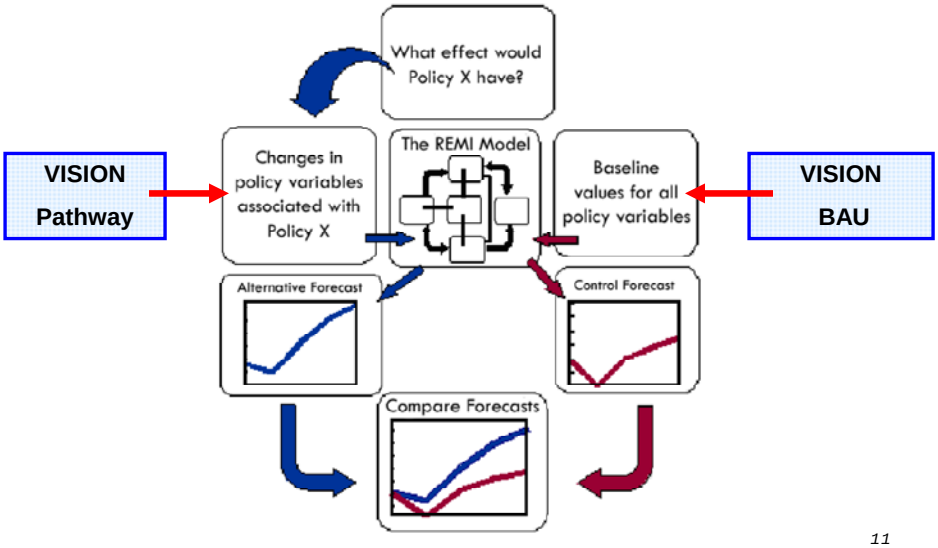
8

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.

9





The Oregon Economy Today

- Gross State Product - $131 Bil (2010$)
- Personal Income - $142 Bil (2010 $)
- Total Employment – 2.1 Million
- Population – 3.89 Million

Source: Oregon Department of Administrative Services, Office of Economic Analysis, September 2010 & REMI PI+ Model

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

13

Scenario Analysis – Not Forecasting

Not attempting to predict the future

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

14

Business As Usual for 2022

- Energy Consumption Grows by 33%
- Employment Is Expected to Grow by 12%
- State Product to Grow by in Real Terms By 44%
- Oregon Population Grows from 1.25% of Nation to 1.34%

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

16

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

17

Selected Macro Economic Results

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

18

Key Assumptions

- Fuel Price Projections
  - AEO (DOE)
- Fleet Fuel Efficiency
- New Capital Spending:
  - Equipment
  - Materials
  - Infrastructure

19

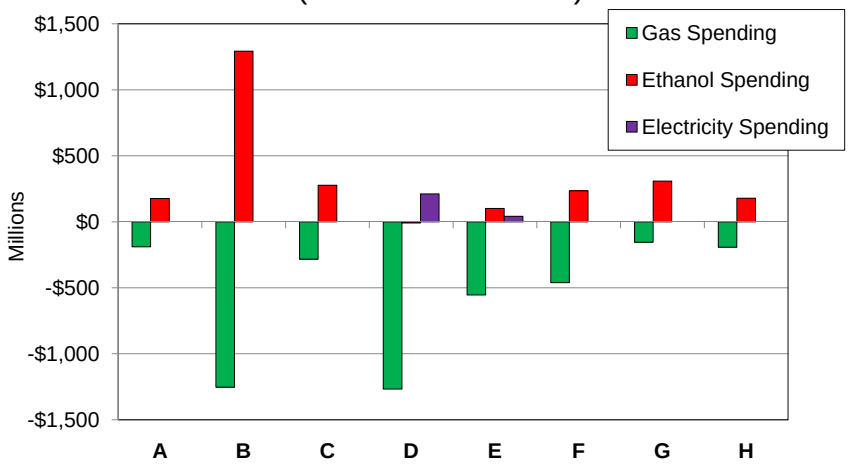
Inputs to REMI PI+

- 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

20

Micro Inputs: Light-Duty Fuels

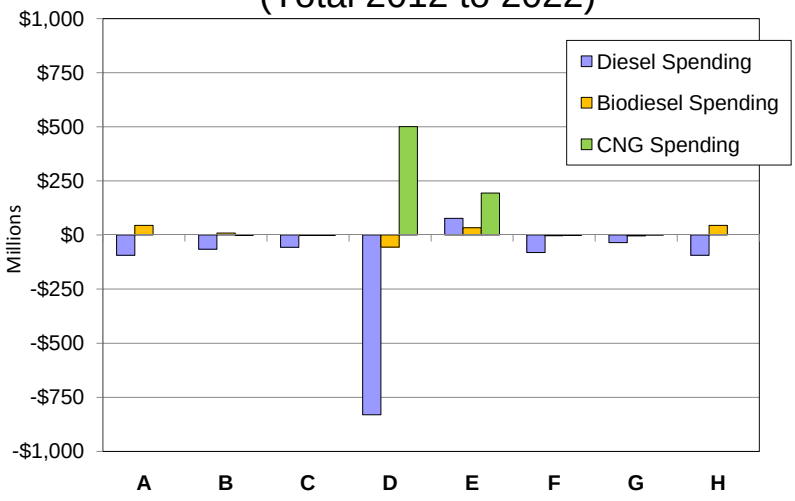
(Total 2012 to 2022)



21

Micro Inputs: Heavy-Duty Fuels

(Total 2012 to 2022)



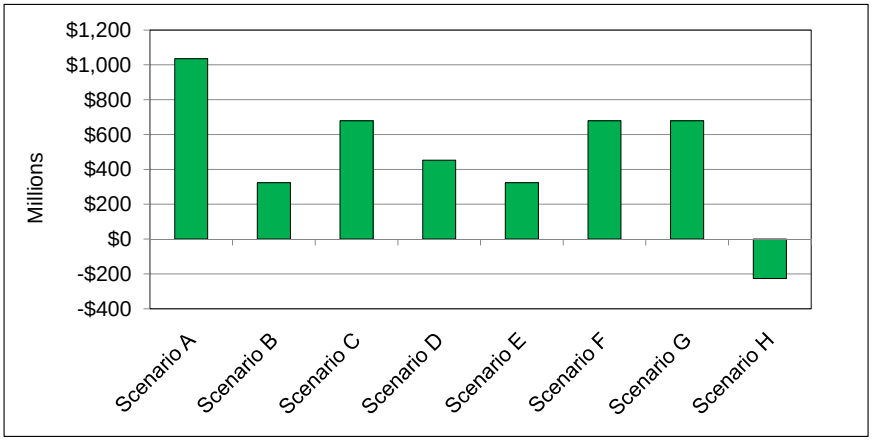
22

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

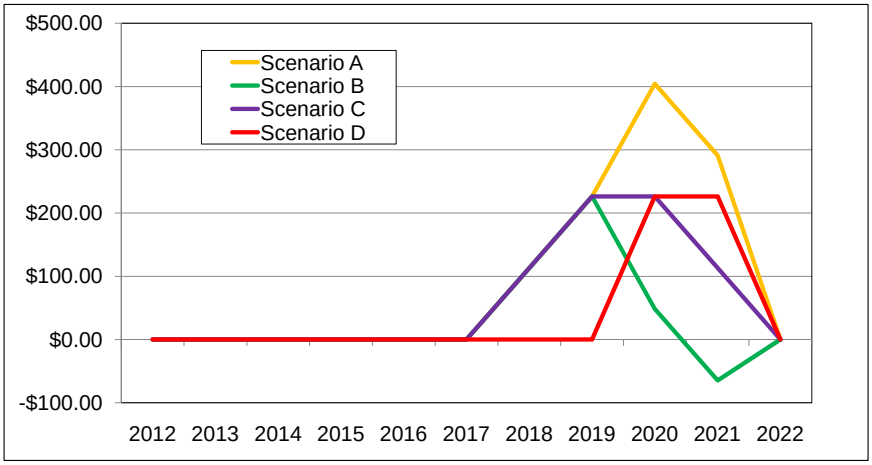
23

Micro Inputs: Plant Spending by Scenario, 2012 – 2022



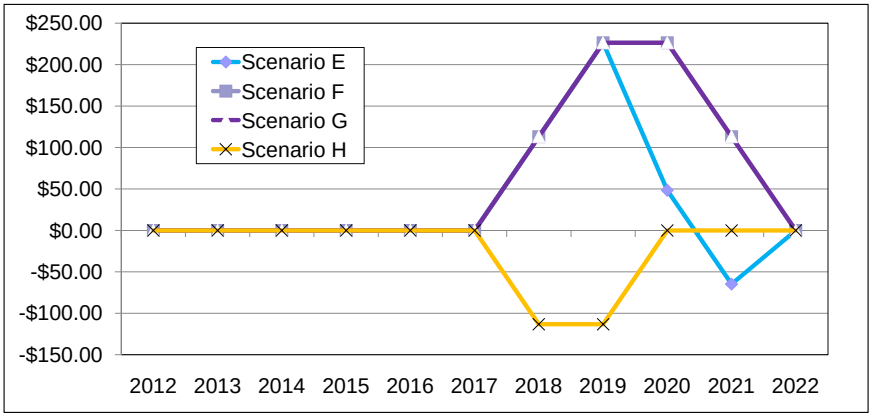
24

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



25

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



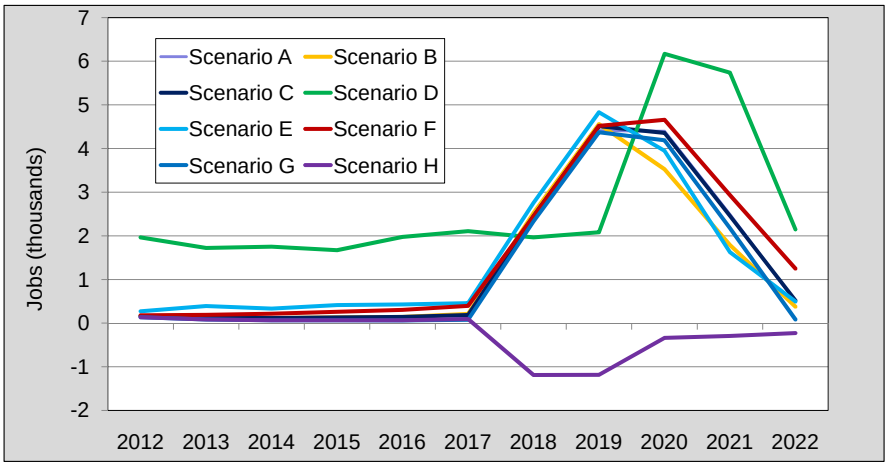
26

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

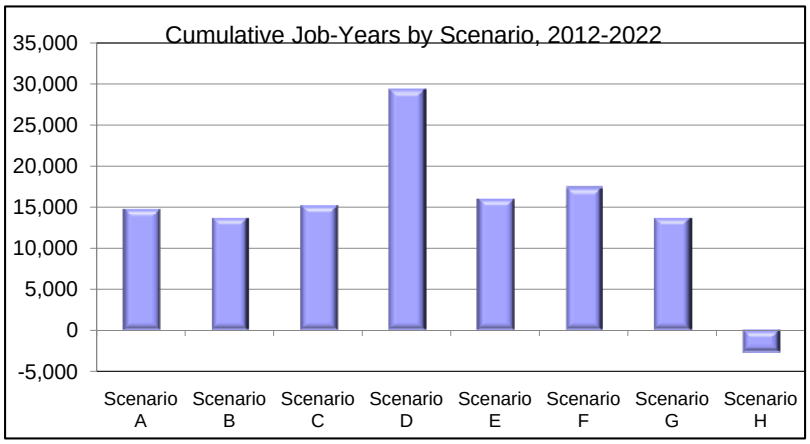
27

Macro Outputs - Employment



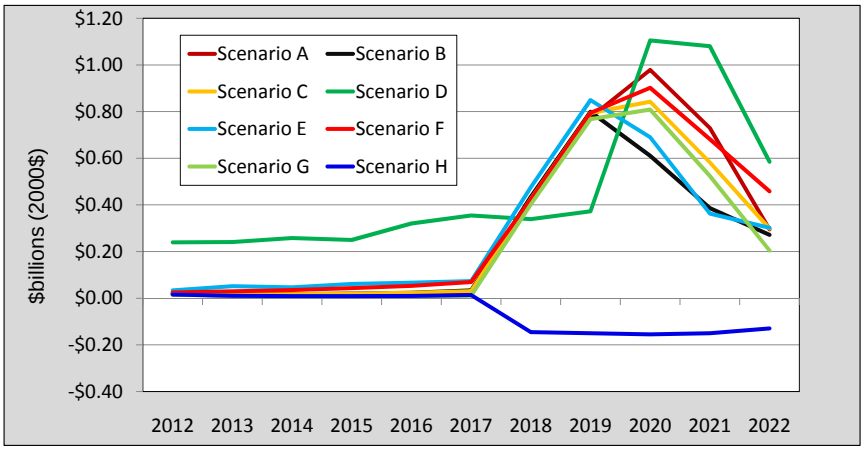
28

Macro Outputs - Employment



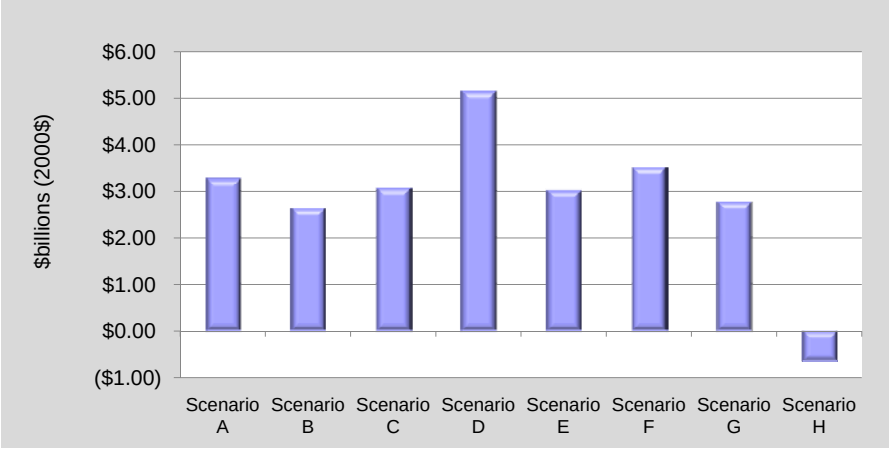
29

Macro Outputs – Aggregate Demand



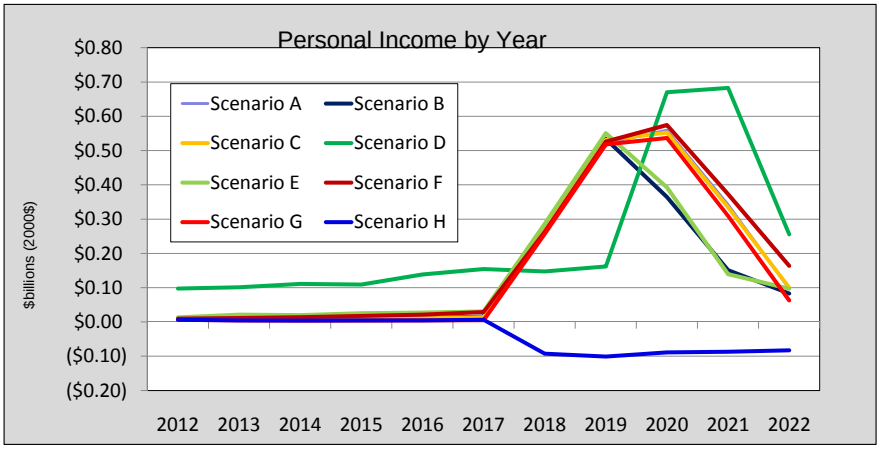
30

Macro Outputs – Aggregate Demand



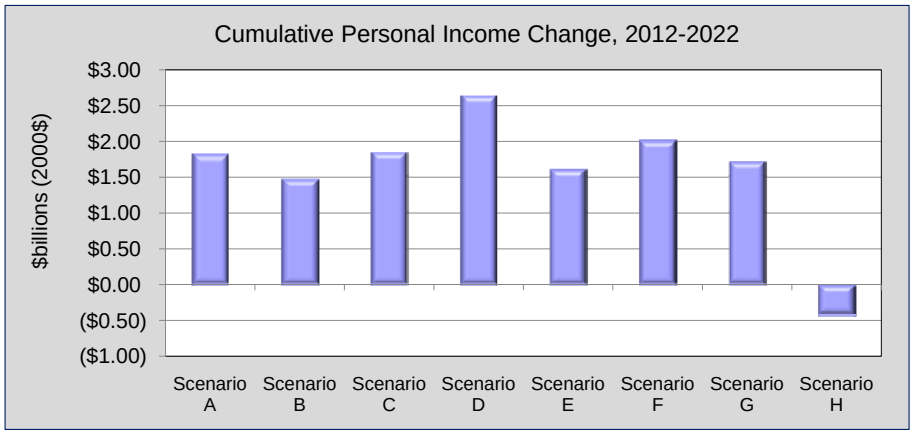
31

Macro Outputs – Personal Income



32

Macro Outputs – Personal Income



33

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

34

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 two ethanol plants

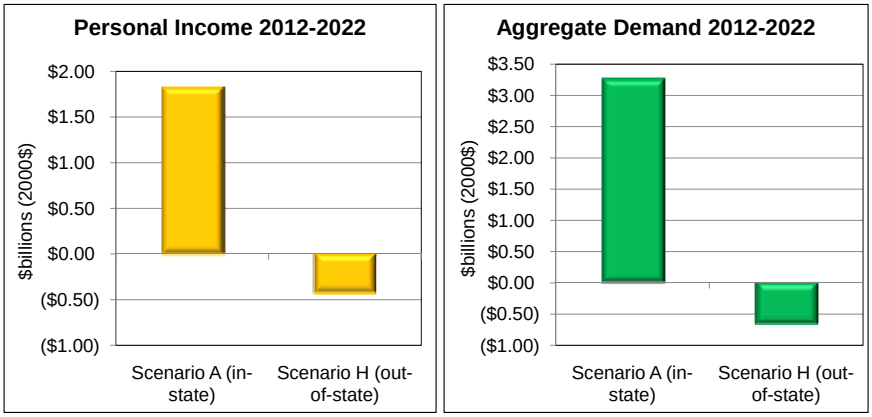
35

Specific Values Estimated

- 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

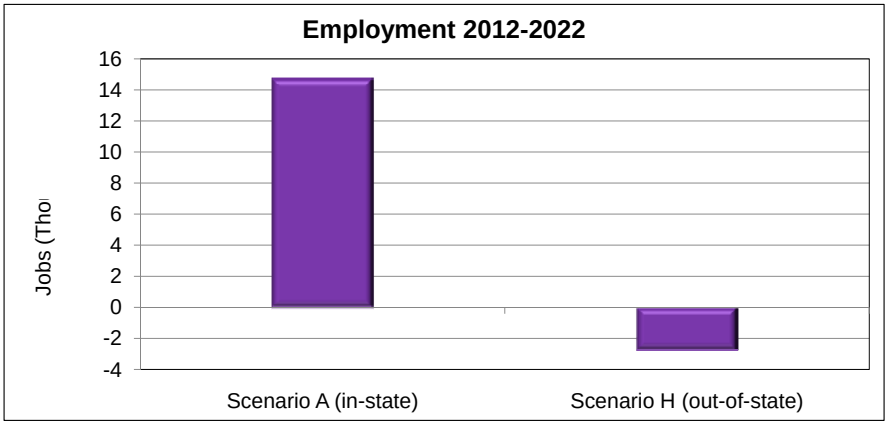
36

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



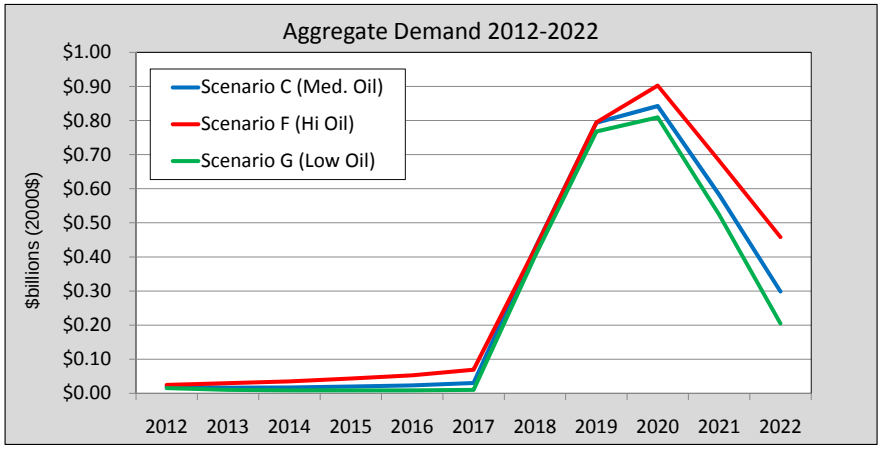
37

In-State vs. Out-of-State Biofuels



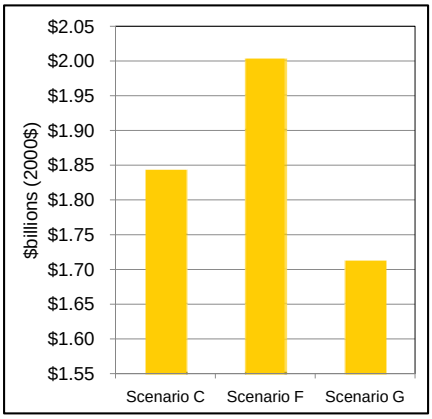
38

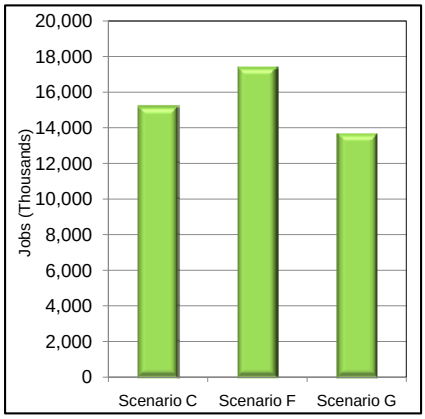
Effect of Different Fuel Price Projections – Scenarios C, F and G



39

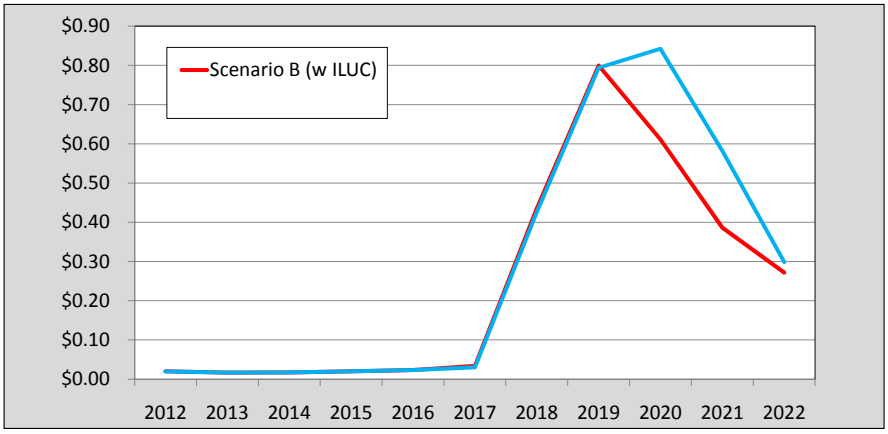
Effect of Different Fuel Price Projections – 2012 to 2022





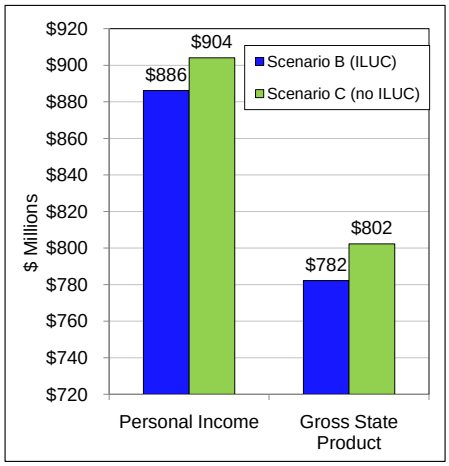
40

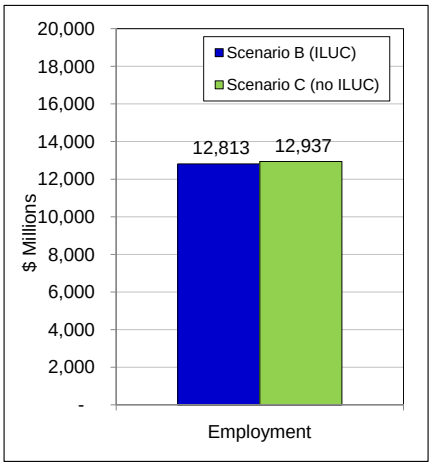
Effect of ILUC on In-State Biofuels Scenario



41

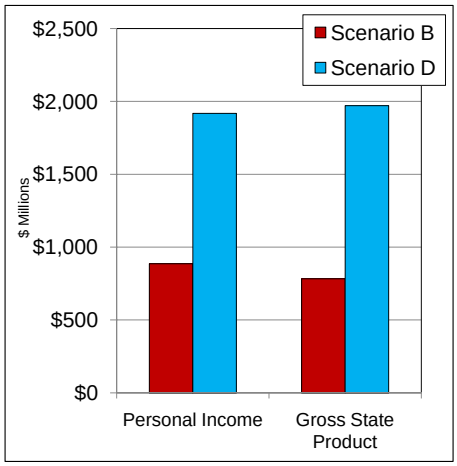
Effect of ILUC on In-State Biofuels Scenario

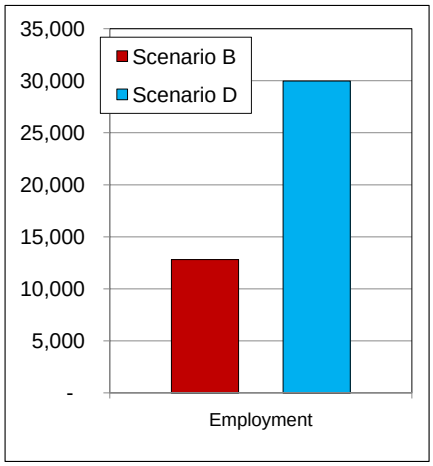




42

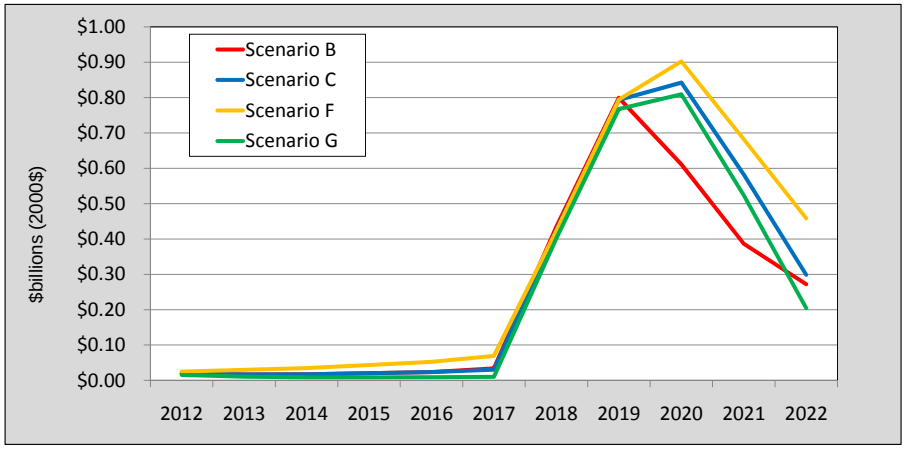
Biofuels vs. CNG and EVs
2012 – 2022 Macro Impacts





43

Maximum Biofuels:
Four Scenarios – the Same Pathway



44

Maximum Biofuels: Four Scenarios – the Same Pathway

- Scenarios B, C, F and G:
  - Maximize in-state biofuels production
  - Multiple feedstocks – cellulosics, 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)

45

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

46

Selected Industry Impact

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

47

Discussion Session

Michael F. Lawrence, President

Economics
Public Policy
Planning
Jack Faucett Associates
Since 1963

Phone: (301) 961-8835
Email: Lawrence@jfaucett.com

48

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

49

Macro Impacts Example: A New Ethanol Plant

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

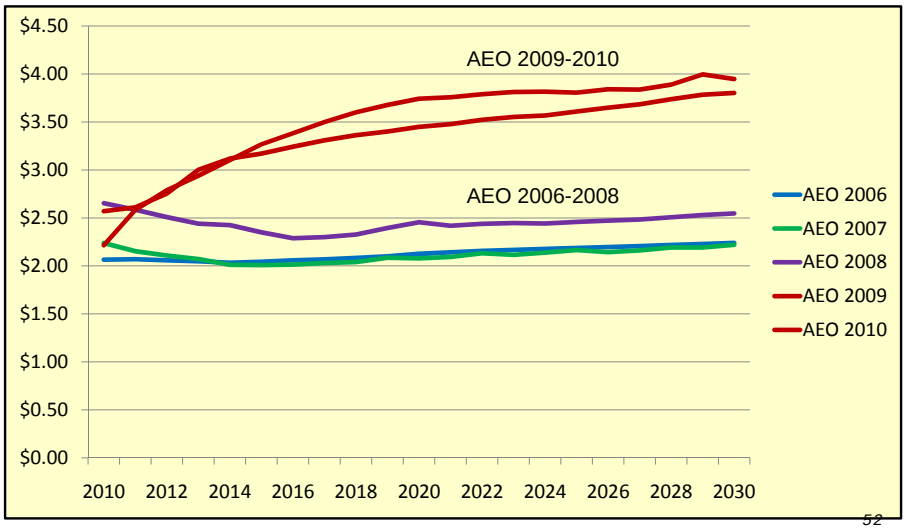
50

Macro Impacts Example: A New Ethanol Plant

- Operations
  - Water Consumption
  - Feedstock Consumption ➔ Agriculture Sector Income
  - Labor Spending ➔ Consumer Income ➔ Consumer Spending

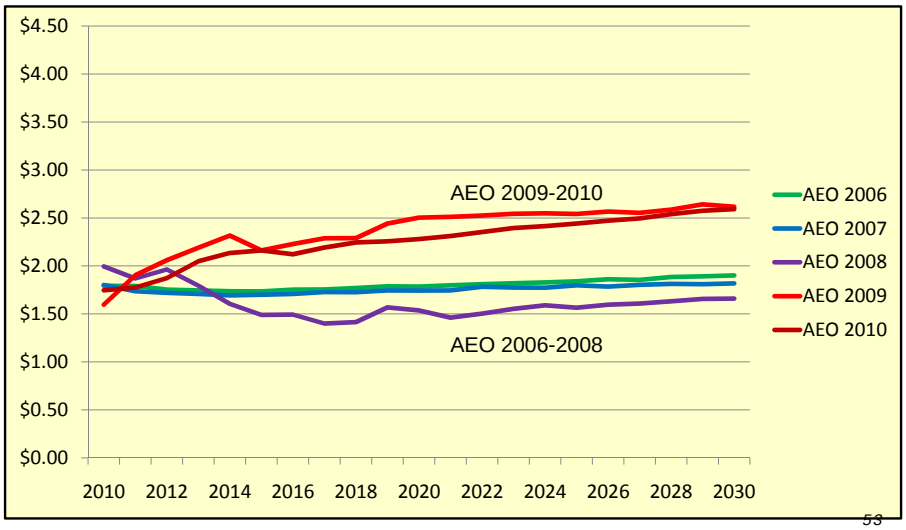
51

AEO Gas Price Forecasts Vary



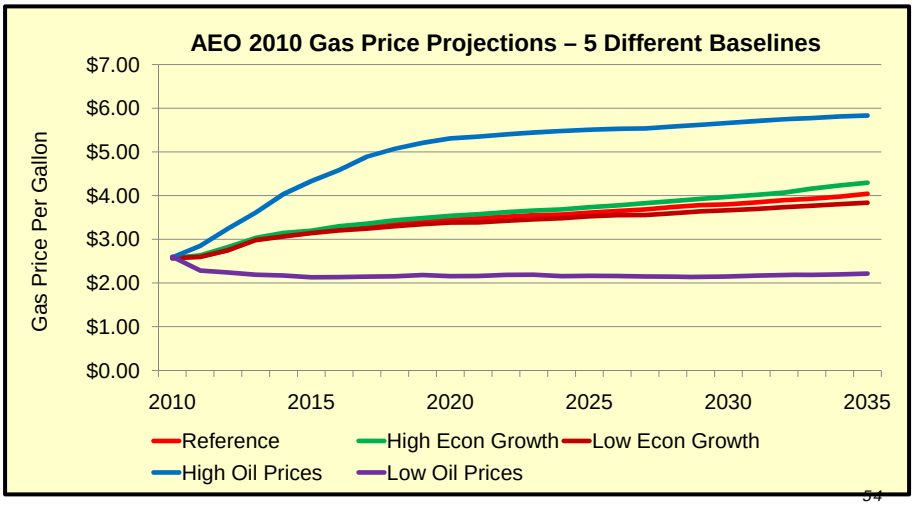
52

AEO Ethanol Price Forecasts Vary



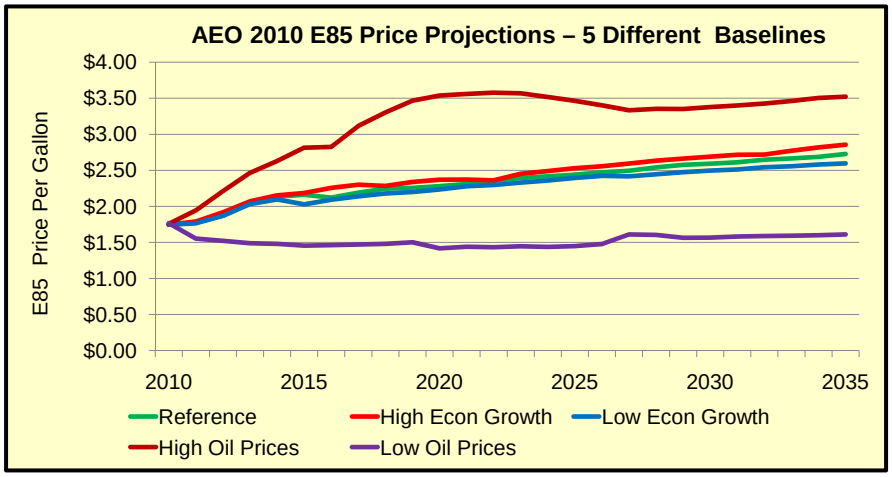
53

Growth and Oil Price Assumptions Determine Gas Price Projections



54

E85 Prices are Similarly Sensitive to Assumptions



55