Final Results: Economic Analysis of the Northeast/Mid-Atlantic (NE/MA) Clean Fuels Standard

NESCAUM

September 2011

Boston, MA and Baltimore, MD

Today's Presentation

I. Overview of Economic Analysis

II. Business-As-Usual (BAU) Results

III. Results for Clean Fuels Standard (CFS) Scenarios
- 10% Scenarios
- 5% and 15% Scenarios
- Macroeconomic impacts

IV. Summary of Key Findings

NESCAUM

I. Overview of Analysis

NESCAUM

Key Steps in the Analysis

The 5 main steps to the economic analysis of the NE/MA CFS included:

1) Characterizing two reference or "Business-As-Usual" cases to depict the world without the CFS;

2) Estimating quantities of low carbon fuels needed to meet a given carbon intensity (CI) reduction target;

3) Calculating aggregate costs and benefits of meeting program requirements.

4) Modeling the regional economic impacts of 2 and 3 (i.e., changes in gross regional product, investment, jobs, etc.)

5) Soliciting input from stakeholders on key assumptions, data sources, and proposed methodologies.

NESCAUM

Approach to Uncertainty

- A CFS is designed to spur innovation in fuel and vehicle technologies, some of which are not yet commercially available or new to market.
- A key part of this analysis was the use of a wide range of assumptions to reflect the high level of uncertainty around future fuel and technology costs and innovation rates.
- Low-end and high-end "boundary" values were used for the variables with the greatest influence on results:
  - Fossil fuel prices
  - Carbon intensities of low C fuels
  - Availability of regional biomass for fuel production
  - Costs of fuels w. low carbon intensity, infrastructure, and vehicles

NESCAUM

10% CFS Scenarios

- We compared 3 CFS policy scenarios each of which accomplishes a 10% reduction in carbon intensity (CI) over 10 years (2013 to 2022);
- Each 10% CFS scenario reflects different combinations of 3 types of fuels with low CI: electricity, biofuels, and natural gas
- Each 10% CFS scenario features:
  - Optimistic view of one fuel type's future costs and rate of innovation
  - Less optimistic representation of other two fuel type's costs and rates of innovation

NESCAUM

10% CFS Scenarios

"Biofuels Future"

- 6% of 10% target met by low-cost biofuels
- Estimate of other biofuel values are optimistic as well (e.g., carbon intensity and production costs are low, technology deployment is high)
- Other 4% met by higher-cost electricity and natural gas (2% each)

"Natural Gas Future"

- 6% of 10% target met by low-cost NG (and NG vehicles)
- Gasification technology is commercially viable
- NG vehicle costs are comparable to existing vehicles
- Other 4% met by higher cost biofuels and electricity (2% each)

"Electricity Future"

- 6% of 10% target met by electricity (and electric vehicles)
- Most vehicle charging takes place when grid capacity available
- Electric vehicle costs are comparable to existing vehicles
- Other 4% met by higher cost biofuels and natural gas (2% each)

NESCAUM

Other CFS Policy Scenarios

- 15% CI Reduction over 15 Years:
  - Assumes more optimistic range of assumptions for all key variables (i.e., CI values and costs)
  - Faster "learning" for technologies used to produce low carbon fuels (e.g., gasification)
  - Equal contributions from all 3 fuel types (i.e., each provides one-third of total CI reductions)
- 5% CI Reduction over 10 Years:
  - Assumes more pessimistic range of assumptions for all key variables (i.e., CI values and costs)
  - Little production of low C fuels in-region from local biomass
  - Equal contributions from all 3 fuel types (i.e., each provides one-third of total CI reductions)
- No In-Region Biofuels Production:
  - Same as 10% Biofuels Future, but assumes all fuels produced outside NE/MA states
  - Included to see how influential local biofuel production is on macroeconomic impacts

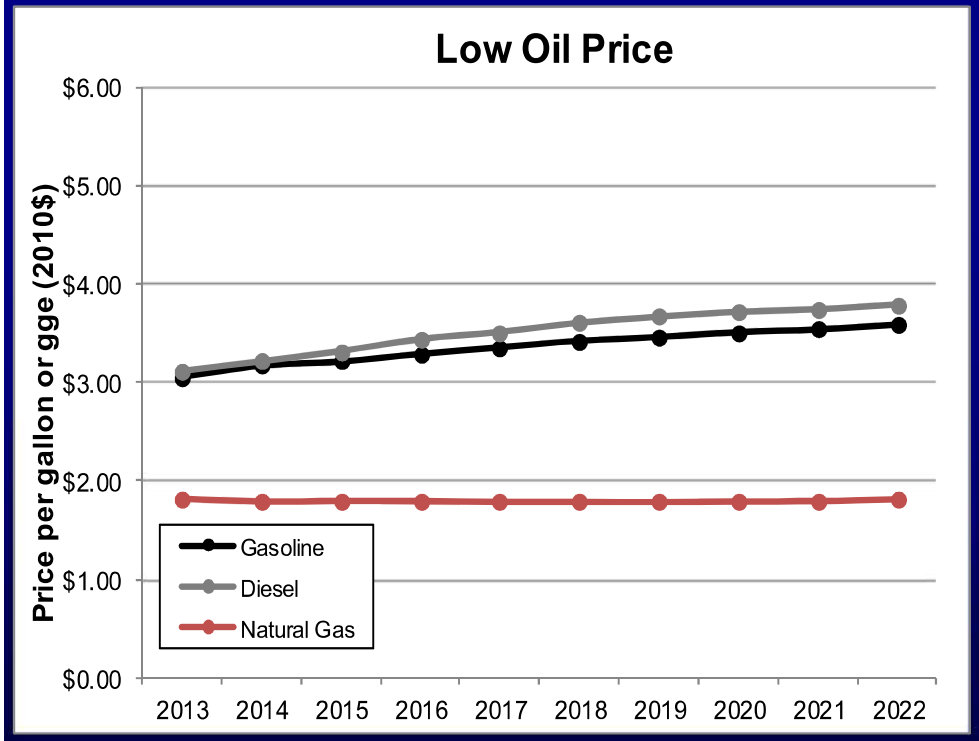
NESCAUM

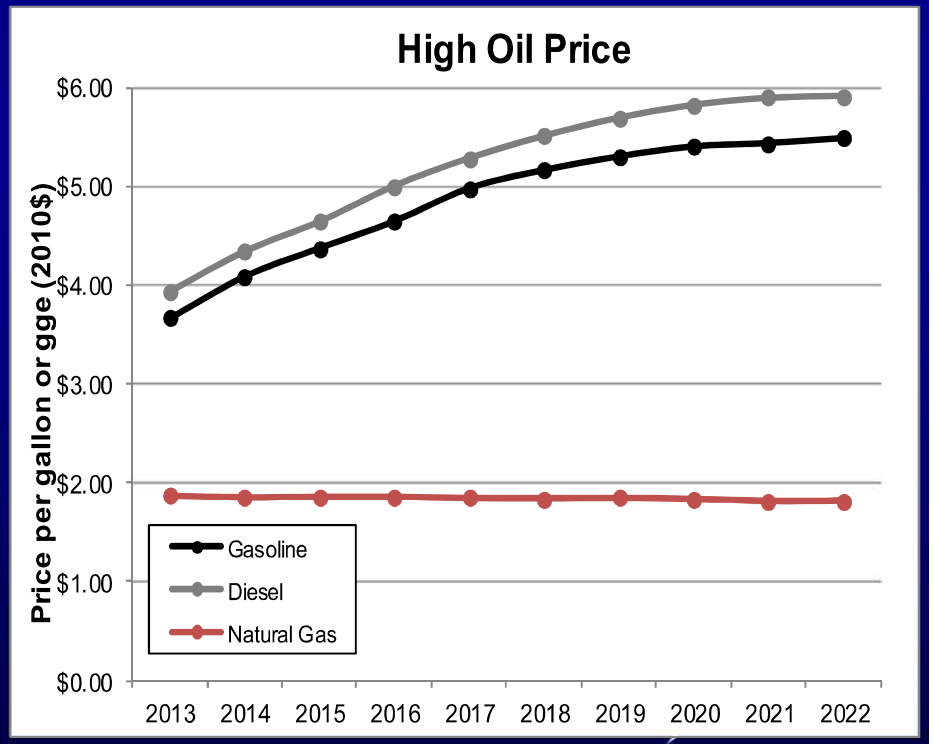
II. Business-As-Usual Assumptions and Results

NESCAUM

Gasoline, Diesel, and Natural Gas Prices

- Fossil fuel prices have a significant influence on whether substitute fuels and alternative technologies are plausible;
- EIA's *Annual Energy Outlook 2010* reference and high-end forecasts were used to develop two BAU scenarios that capture a range of possible BAU gasoline, diesel and natural gas prices.



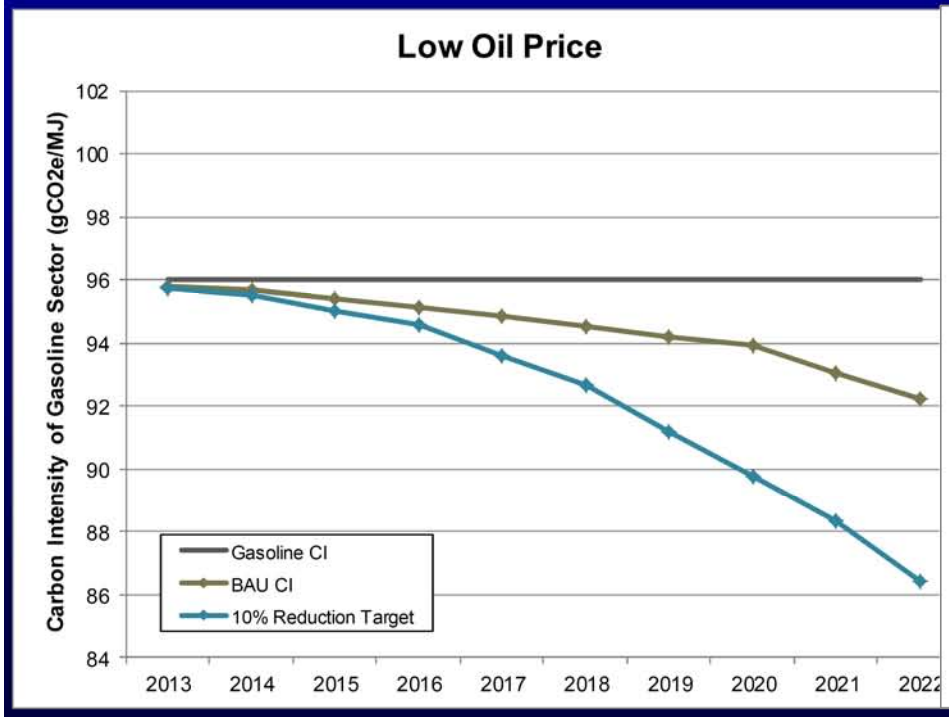


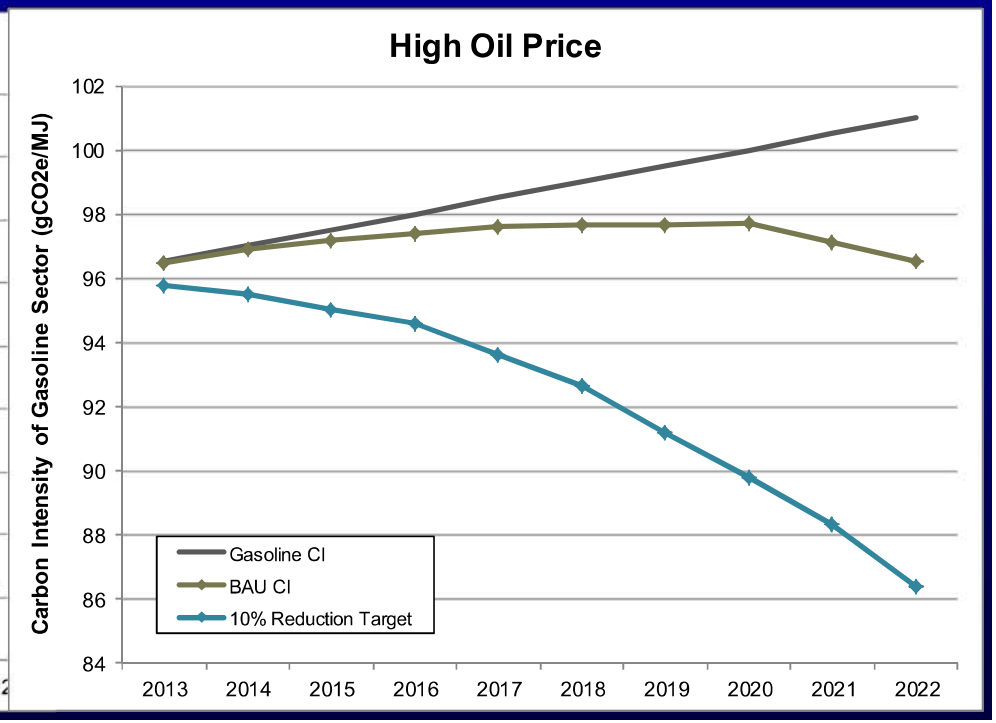
Source: EIA Annual Energy Outlook (AEO), 2010.

NESCAUM

10% Carbon Intensity Reduction

- Carbon intensity of petroleum-based fuels assumed constant under low oil prices (gasoline at 96g/MJ in 2013), increasing under high prices (i.e., to 101 g/MJ by 2022)
- Under BAU, Renewable Fuel Standard (RFS) and Zero Emission Vehicle (ZEV) programs contribute CI reductions in the absence of the Clean Fuels Standard

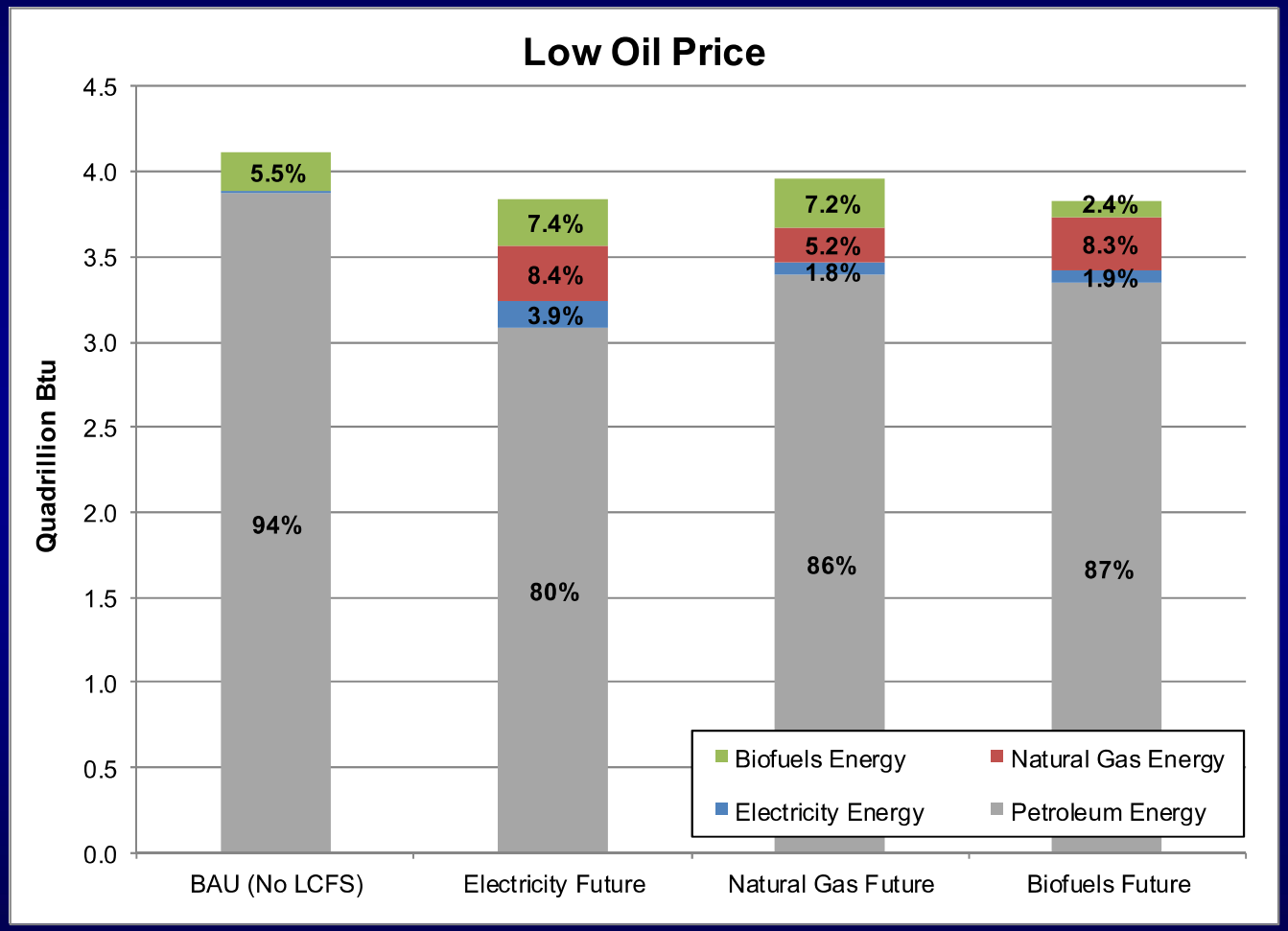




III. CFS Scenario Results

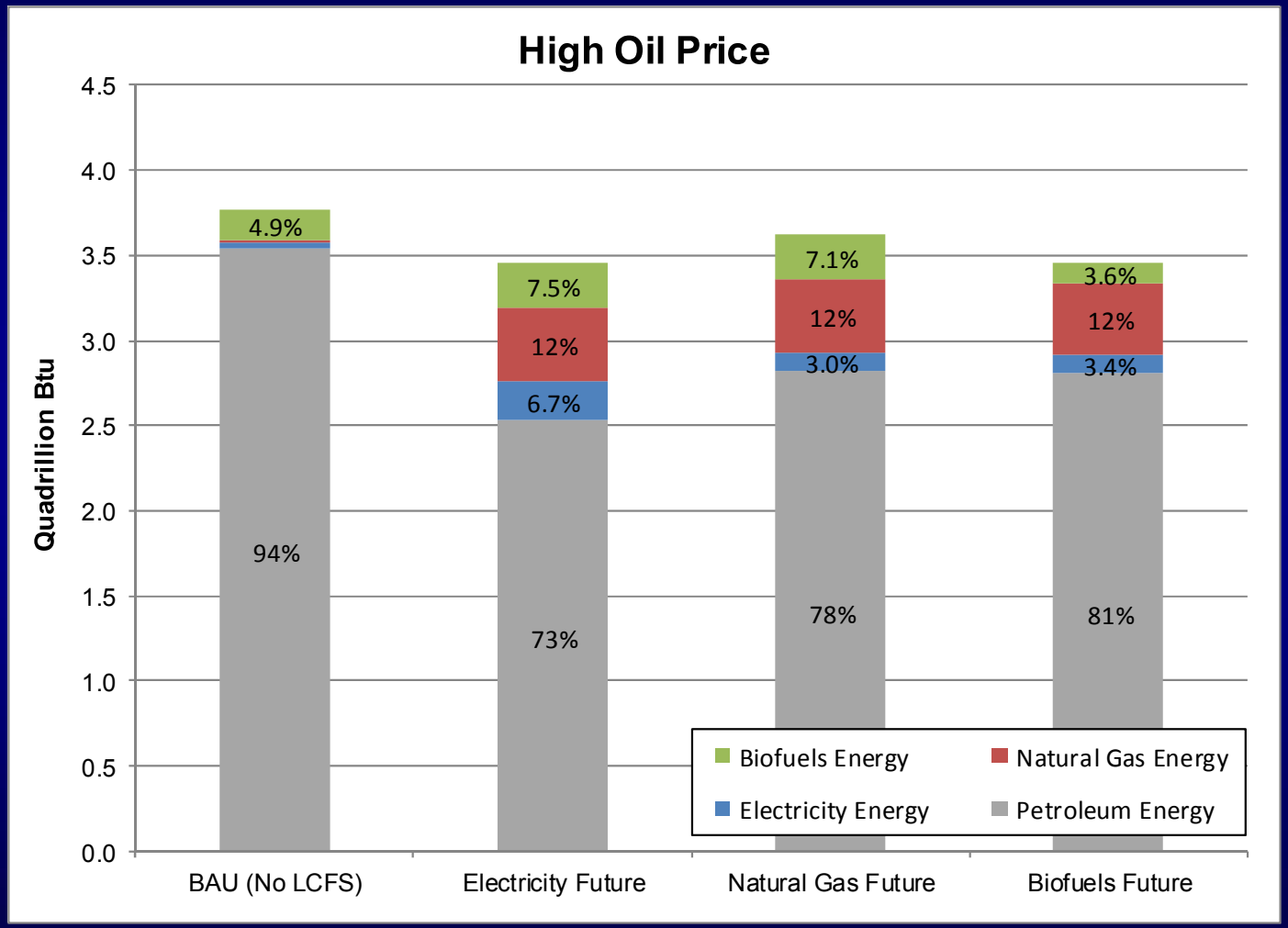
NESCAUM

Fuel Diversity (Low Oil Price)—10% CFS Scenarios (Yr. 10)



NESCAUM

Fuel Diversity (High Oil Price)— 10% CFS Scenarios (Yr. 10)



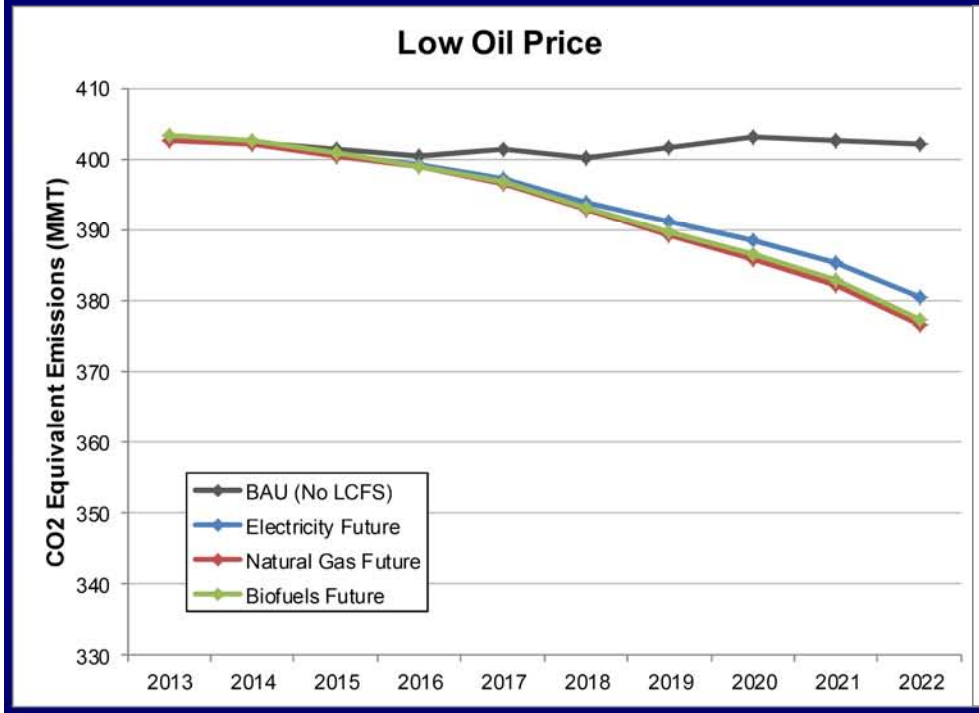
NESCAUM

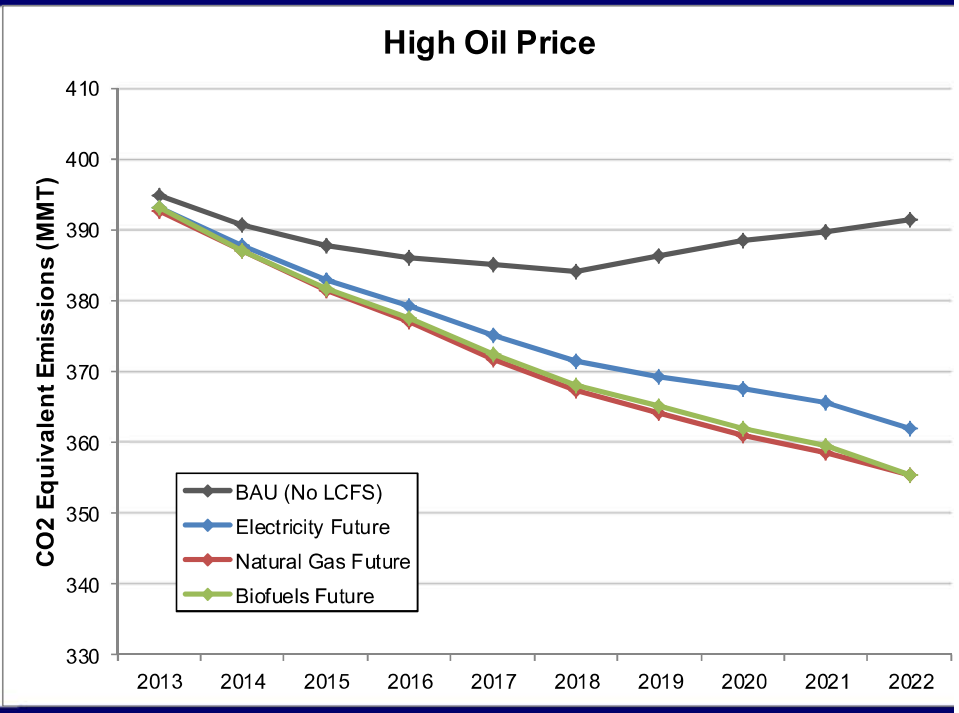
Change in Gas and Diesel Demand— 10% CFS Scenarios (10 Yr. Totals)

Combined Gas and Diesel Demand	10% LCFS Scenario					
	Electricity Future		Natural Gas Future		Biofuels Future	
	Low Oil Price	High Oil Price	Low Oil Price	High Oil Price	Low Oil Price	High Oil Price
BAU Gasoline and Diesel Demand (Bgal)	337	315	337	315	337	315
Scenario Gasoline and Diesel Demand (Bgal)	314	275	323	290	323	286
Change in Gasoline and Diesel Demand (Bgal)	-23	-40	-14	-25	-14	-29
Percentage Change from BAU	*-7%*	*-13%*	*-4%*	*-8%*	*-4%*	*-9%*

NESCAUM

Change in GHG Emissions— 10% CFS Scenarios 2013-2022





Value of Cumulative GHG Reductions:

$2.1B - $9.6B under Low Oil Price

$3.6B to $18B under High Oil Price

NESCAUM

Cumulative CFS Costs and Benefits, Low Oil Price (10-Yr. Totals)

Estimated Costs and Benefits (Billion 2010$s)	Electricity Future (10%)	Natural Gas Future	Biofuels Future	5%, 10 Yr.	15%, 15 Yr.
Program Benefits:					
Value of Reductions in Gas & Diesel	$50.6	$30.7	$30.3	$13.2	$30.0
Program Costs:	$52.0	$28.9	$43.3	$16.1	$29.0
Net Program Benefits (Costs) w/o GHG Reductions	**($1.4)**	**$1.8**	**($13.0)**	**($2.9)**	**$1.0**
Net Program Benefits (Costs) WITH GHG Reductions	**$0.7 - $6.7**	**$3.3 to $11.4**	**-$(10.6 to -$3.9**	**--**	**--**

All values discounted at 7 percent.

NESCAUM

Cumulative CFS Costs and Benefits, High Oil Price (10-Yr. Totals)

	Electricity Future	Natural Gas Future	Biofuels Future	5%, 10 Yr.	15%, 15 Yr.
Program Benefits:					
Value of Reductions in Gas & Diesel	$137	$87.2	$100	$104	$120
Program Costs:	$96.0	$58.2	$77.9	$85.9	$68.6
Net Program Benefits (Costs) w/o GHG Reductions	**$41**	**$29**	**$22**	**$17**	**$52**
Net Program Benefits (Costs) WITH GHG Reductions	**$43 - $55**	**$34 - $49**	**$26 - $39**	**--**	**--**

All values discounted at 7 percent.

NESCAUM

CFS Impacts on Employment, Yr. 10 (2022)

Type of Economic Impact	Year 10 Low Oil Price	Year 10 High Oil Price
Jobs Retained or Generated (Total)		
Electricity Future (10% CI reduction)	26,600	43,800
Natural Gas Future (10% CI reduction)	9,490	21,700
Biofuels Future (10% CI reduction)	41,300	50,700
Biofuels, No In-Region Production (10%)	1,270	3,650
5% CI Reduction Scenario (10 Yr.)	24,300	76,000
15% CI Reduction Scenario (15 Yr.)	25,400	56,600

NESCAUM

CFS Impacts on Gross Regional Product (Yr. 10 and 10 Yr. Totals)

Type of Economic Impact	Year 10		10-Year Total	
	Low Oil Price	High Oil Price	Low Oil Price	High Oil Price
Gross Regional Product (Billion 2010 $s)				
Electricity Future (10% CI reduction)	3.1	4.9	12	29,
Natural Gas Future (10% CI reduction)	2.1	3.9	7.3	17
Biofuels Future (10% CI reduction)	4.3	4.6	20	28
Biofuels, No In -Region Production (10%)	2.2	2.3	8.4	11
5% CI Reduction Scenario (10 Yrs.)	1.6	4.5	4.8	25
15% CI Reduction Scenario (15 Yrs.)	3.8	6.6	15	34

NESCAUM

CFS Impacts on Real Disposable Personal Income (Yr. 10 and 10 Yr. Totals)

Disposable Personal Income (Billion 2010 $s)	Low Oil Price	High Oil Price	Low Oil Price	High Oil Price
Electricity Future (10% CI reduction)	1.4	3.3	3.6	14.7
Natural Gas Future (10% CI reduction)	0.9	1.6	2.2	7.2
Biofuels Future (10% CI reduction)	2.4	3.3	9.6	15
Biofuels, No In-Region Production (10%)	-0.05	0.9	-2.6	1.3
5% CI Reduction Scenario (10 Yr.)	1.0	4.1	2.2	16
15% CI Reduction Scenario (15 Yr.)	2.2	5.7	12	28

NESCAUM

CFS Impacts on Industry Groups

- Industries with most positive “value-added” and job level Impacts:
  - Direct: Utilities, Construction/Mfg, Forestry/Ag
  - Indirect: Healthcare, Finance & Insurance
- Industries with negative value-added and job level impacts:
  - Retail/Wholesale Trade
  - Petroleum and Coal Mfg. (sub-sector of Chemical Mfg.)
- Net value-added, job levels, and real income are positive across all industries at regional level

NESCAUM

IV. Summary of Key Findings

NESCAUM

Summary of Key Findings (1)

- **Gasoline and Diesel Use:**
  - Decreases by 12 to 29 percent (4.0 to 8.7 billion gallons annually) once the 10% CFS is fully implemented;
- **GHGs Emissions:**
  - Reductions of 5 to 6% under low oil prices; 7 to 9% under high oil prices for 10% CFS scenarios
- **Fuel Diversity:**
  - Greater diversity of fuels and greater domestic contributions
  - Petroleum-based fuels still dominate market share (70+% minimum))
- **Net Cost-Benefit:**
  - Positive under all scenarios when oil prices are high, more so w/ value of GHG benefits
  - Near parity or negative at low oil prices, some turn positive when GHG benefits added

NESCAUM

Summary of Key Findings (2)

- **Macro-economic impacts:**
  - Small but net positive impacts projected for all macroeconomic indicators
  - Utilities, construction, healthcare, forest/ag positive; retail/wholesale trade and petroleum mfg negative

- **Most influential variables affecting results:**
  - CI of petroleum and low carbon fuels;
  - Petroleum prices; and
  - Price of low carbon alternatives (fuel, infrastructure and vehicles);

NESCAUM

Questions?

NESCAUM