Assessment of the NESCAUM Economic Analysis of a Clean Transportation Fuels Program for the Northeast/Mid-Atlantic Region

Final Report of Key Conclusions

Prepared by IHS for
the Consumer Energy Alliance

October 11, 2011

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KEY OBSERVATIONS AND CONCLUSIONS FROM THE NESCAUM ECONOMIC ANALYSIS OF A NE/MA CLEAN FUELS STANDARD

The Consumer Energy Alliance (CEA) asked IHS CERA and IHS Global Insight to prepare an independent assessment of the August 2011 NESCAUM report titled "Economic Analysis of a Program to Promote Clean Transportation Fuels in the Northeast/Mid-Atlantic Region".

In summary, the IHS CERA and IHS Global Insight research has found that the conclusions presented in the NESCAUM economic analysis demonstrating broad economic benefits from the Clean Fuel Standard (CFS) proposed for the New England/Middle Atlantic (NE/MA) states are critically flawed. Our critique of the NESCAUM study demonstrates that the assumptions employed for prices, availability, infrastructure and technological performance of low carbon fuels and alternative vehicles are unreasonable, unsupportable and unattainable in the 2013-2022 timeframe of the analysis. This report identifies incorrect and overly optimistic assumptions concerning costs, potential supply availability, and often uses inconsistent bases for comparisons. As a result, our report identifies incorrect and unrealizable economic benefits accruing to NE/MA consumers and the regional economy that the flawed NESCAUM scenarios attribute to the proposed Clean Fuels Standard.

We agree with the NESCAUM statement (on page ES-1 of their report) that states:

> *"This analysis of the costs and benefits of a regional clean fuels standard is not designed as a forecast of future economic conditions, fuel prices, CI [carbon intensity] values, or rates of innovation and market penetration for low carbon fuels."*

In fact, IHS concludes that the assumptions underlying the scenario analyses presented in the NESCAUM study cannot be realistically achieved in the 2013-2022 timeframe for *any* of the scenarios in the study. Moreover, the analysis for each of the scenarios presented in the NESCAUM report claim economic benefits and lower costs associated with low carbon fuels that are unattainable under any reasonable set of expectations for the period to 2022.

There are several principal assumptions and assertions in the NESCAUM study that are particularly notable for their role in leading to the unreasonable and unattainable results claimed in the Study:

- Assumptions about the availability of next generation biofuels, particularly cellulosic ethanol, are unrealistic. NESCAUM's assumptions about cellulosic ethanol availability in the Northest region exceed EIA's forecast of cellulosic ethanol use for the entire country. It also contradicts the recent report of the National Academy of Sciences, which asserts that the capacity for producing cellulosic biofuels to meet the RFS2 to 2022 will not be available. Moreover NESCAUM's optimistc assumptions about supply are in conflict with EPA's latest "on the ground" assessments, which reveal that there is hardly any cellulosic biofuel productive capacity available despite two years of aggressive RFS2 Federal mandate.
- Price assumptions for low carbon fuels are unrealistic. The National Academy of Sciences report states that without subsidies, biofuels are only economic at a crude oil price of $191/barrel or, alternatively, at a carbon price of ~ $120/tonne CO2 equivalent . NESCAUM assumes that cellulosic ethanol and biodiesel will be cheaper than gasoline and diesel, respectively. This is unlikely since no cellulosic ethanol is produced commercially today and conventional biodiesel has been consistently more expensive than petroluem diesel for many years.
- Ignoring cellulosic biofuel availability for a moment, NESCAUM assumes that only cellulosic ethanol is blended into the ~25 billion gallon NE/MA gasoline market but ignores that this will back out as much as 2.5 billion gallons of corn-based ethanol, with significant negative impacts on the corn-based ethanol industry and make the Renewable Fuels Standard more difficult to

comply with for fuel suppliers because the rest of the country will be faced with an E10 blendwall.

- Price assumptions for alternative vehicles are unrealistic. NESCAUM assumes that electric vehicles are only marginally more expensive than similar vehicles with internal combustion engines and that plug-in hybrid electric vehicles achieve price parity with internal combustion engine vehicles. Both of these assumptions are strongly at odds with industry, government, and scientific consensus.
- Assumptions about the availability and market penetration of alternative vehicles are unrealistic. Given the greater up-front cost and lack of refueling infrastructure for electric and natural gas vehicles, the rapid sales growth of these vehicles that NESCAUM assumes is extremely unlikely.
- Though NESCAUM used a suitable economic impact analysis methodology, flawed input assumptions render the results of their analysis meaningless.
- The NESCAUM economic impact analysis appears to be more focused on the transitory benefits of the "Infrastructure Phase" rather than the long-term contributions of the "Steady State Phase."
- Overstatement of biofuels supply availability leads to a corresponding overstatement of job creation and economic contribution under the NESCAUM scenarios.

CRITIQUE OF NESCAUM ENERGY ASSUMPTIONS

The IHS CERA critique of the NESCAUM study's energy-related assumptions includes those concerning biofuels, and the viability and cost of a Northeast US-based biofuels industry; the relevance and impact of the E10 ethanol blendwall; the technology, cost, sales potential, and fleet size of a large-scale electric vehicle fleet; and the cost and feasibility of large-scale natural gas vehicle fleet and associated fueling infrastructure.

Biofuels Challenges—Supply Availability

In their report, NESCAUM has used assumptions for low-carbon biofuel availability that are clearly unrealistic. In general, cellulosic-based biofuels production is still only in the laboratory and plant demonstration stage, despite an aggressive Federal Renewable Fuels Standard (RFS2) that mandates their use. NESCAUM's assumption of a quick ramp up in availability of such fuels in the Northeast is not supported by current or expected technology pathways over the next decade.

The NESCAUM "Biofuel Future" analysis assumes 70 million gallons of cellulosic ethanol use in the region in 2013, growing rapidly to 2.6 billion gallons (2600 million) in 2022 under low oil price conditions. Under high oil price conditions the assumption is that cellulosic ethanol use is even greater, growing from 160 million gallons in 2013 to 3.1 billion gallons in 2022.

The US Environmental Protection Agency's (EPA) own fact-finding efforts show that NESCAUM's assumptions are extremely optimistic. The EPA is required to lower the national cellulosic biofuel mandate if actual or expected production is less than the volume required in the RFS. The RFS cellulosic biofuel standard for 2011 was originally 250 million gallons nationally; however, in November 2010 the EPA lowered this significantly to just 6.6 million gallons, based on its analysis of actual or expected capacity. The 2012 national requirement for cellulosic biofuels is 500 million gallons. However, as of July 2011, the EPA was only able to identify 3.6 to 15.7 million gallons of cellulosic biofuel capacity nationally that could potentially be produced in 2012. The lower portion of EPA's range is based on biofuel capacity that EPA has identified as actual demonstration-scale facilities. The higher range is based on a volume of capacity that EPA has less certainty about, since this value is based on planned production and not functioning capacity. EPA is expected to finalize the adjusted 2012 cellulosic biofuel target in November 2011.

Although EPA has identified this small volume of cellulosic biofuel capacity, any volumes produced do not appear to be commercialized. According to EPA's Moderated Transaction System (EMTS), which tracks compliance with the RFS, zero cellulosic biofuels were produced in 2010 for compliance with the RFS, and none have been produced thus far in 2011.[1]

Based on EPA's assessment that only a negligible volume of cellulosic biofuel capacity is currently available nationally and that zero volumes have been blended into the nation's fuel market, NESCAUM's assumption of 70 million gallons in 2013 in the Northeast alone is unrealistic (see Figure 1). There is no credible evidence that this trend will reverse, resulting in large volumes of cellulosic biofuels availability in the next few years. IHS CERA's own internal analysis indicates there is a strong possibility that cellulosic ethanol supply will not be material by 2020 because of high costs of production, technical challenges, and the logistical and economic hurdles of harvesting, shipping and storing large volumes of biomass needed to support a commercial-scale cellulosic biofuel industry.

NESCAUM's assumed biofuel volumes are also substantially higher than the US government's own projections. The US Energy Information Administration (EIA) 2011 Annual Energy Outlook (AEO)

1.See http://www.epa.gov/otaq/fuels/rfsdata/2011emts.htm projects in its reference case that 1.8 billion gallons of cellulosic ethanol as well as renewable diesel and gasoline will be available nationally by 2020, significantly less than the nearly 2.2 billion gallons that NESCAUM projects for just the NE/MA region alone.

The EIA and IHS views of future cellulosic biofuel availability are also in agreement with the recently released report by the National Academy of Sciences titled "Renewable Fuel Standard: Potential Economic and Environmental Effects of US Biofuel Policy".[2] The report raises significant concerns about the economic viability and environmental benefits of cellulosic biofuels. It concludes that the capacity for producing cellulosic biofuels to meet the RFS2 to 2022 will not be available. Furthermore, it states that RFS2 may be an ineffective policy for reducing GHGs because of land use or land-cover changes that occur in the process. Crop residue and municipal waste will not produce enough biomass to meet RFS2 and as a result conversion of uncultivated cropland or displacement of commodity crops and pastures will be required. These conclusions make NESCAUM's low-oil price cellulosic biofuels scenario an even more remote possibility.

Biofuels Challenges—Cost

Along with unrealistic assumptions on biofuel supply, the NESCAUM report also uses cellulosic biofuel price assumptions that are highly improbable.

The low end estimate for the price of cellulosic ethanol is assumed to be much cheaper than gasoline in all cases in 2013 and 2022. However, the fact that there is no commercially produced cellulosic biofuels today suggests that the costs of production are far from competitive with petroleum-based fuels. A dramatic cellulosic biofuel cost reduction in the next decade is unlikely given the slow path to commercialization thus far, and suggest that NESCAUM's cost assumptions are overly optimistic. IHS knows of no major recent techno-economic breakthroughs that would alter the current cellulosic biofuel cost trajectory this decade. Even conventional biofuels, where the production processes are mature and well-understood, are generally not cost competitive with petroleum (see Figure 2). It is unlikely that advanced biofuels will suddenly leap-frog conventional biofuels, since advanced biofuel process technologies are not yet well understood and the infant industry has not yet benefitted from years of commercial scale-up.

These conclusions about the high cost of producing cellulosic biofuels are supported by the key findings of the recently released National Academy of Sciences report. It concludes that, without subsidies, cellulosic biofuels could be economic, but only at a crude oil price of $191/barrel or, alternatively, at a carbon price of approximately $120 per metric ton of CO2 equivalent. These figures are far removed from the NESCAUM assumptions for their low oil price case.

Secondly, in its comparison against an assumed retail price of petroleum-based fuels, the NESCAUM analysis is deceptive since it uses optimistically low estimated cellulosic biofuel production costs to represent assumed retail biofuel prices. There does not appear to be an allowance for a retail mark-up or consideration of other supply and transportation costs that will be required to market cellulosic fuels. The NESCAUM analysis therefore underestimates the future retail price of cellulosic biofuels.

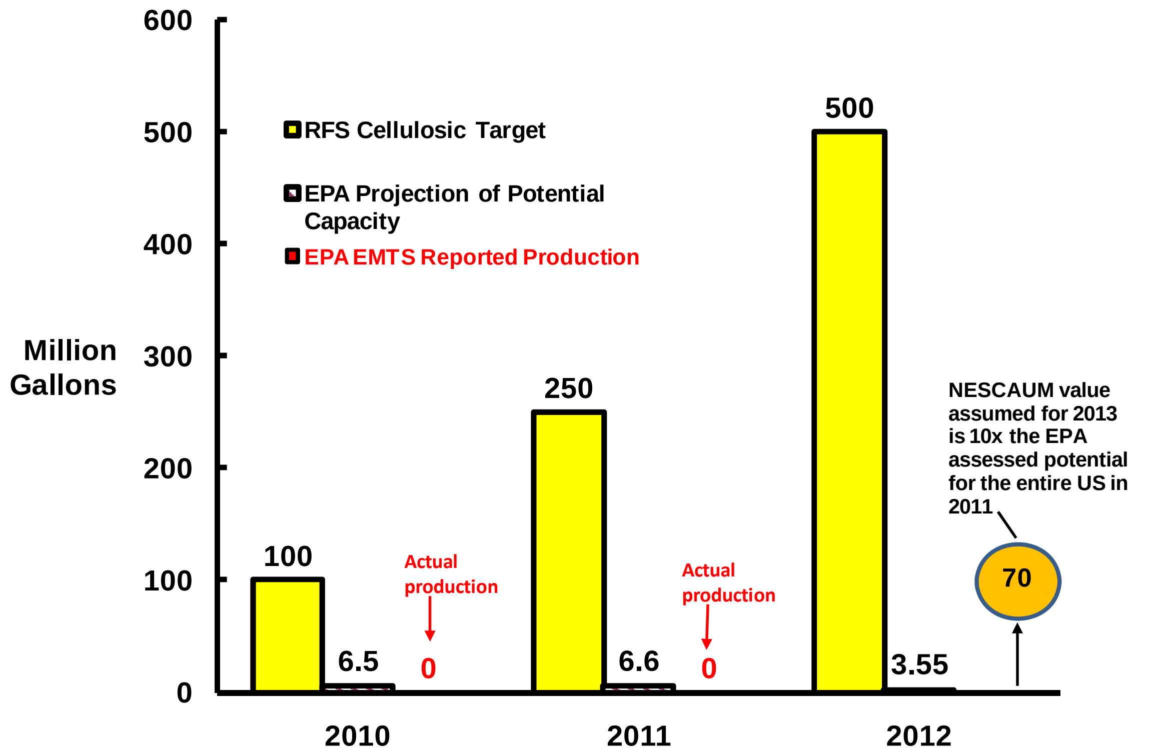
Soy-oil based biodiesel (a conventional biofuel that is produced in moderate volumes in the US) is also assumed to be less expensive than conventional diesel. A quick look at the cost of soy-oil (the principal feedstock) however, shows that estimated cash production costs (allowing for no retail mark-up) for soy-oil based biodiesel over the past 8 years have averaged over $3 per gallon, almost double the wholesale cost of petroleum-based diesel (see Figure 3). This is principally due to the high price of vegetable oil relative to petroleum crude oil. Vegetable oil is not expected to fall below the cost of

2.See National Academy of Sciences, http://www.nap.edu/catalog.php?record_id=13105 petroleum crude oil owing to growing demand for cooking oil from the emerging markets such as China and India and increased demand for vegetable oils from the biodiesel industries in various markets around the world sector.

Figure 1

Cellulosic Biofuel Production Minimal to Date

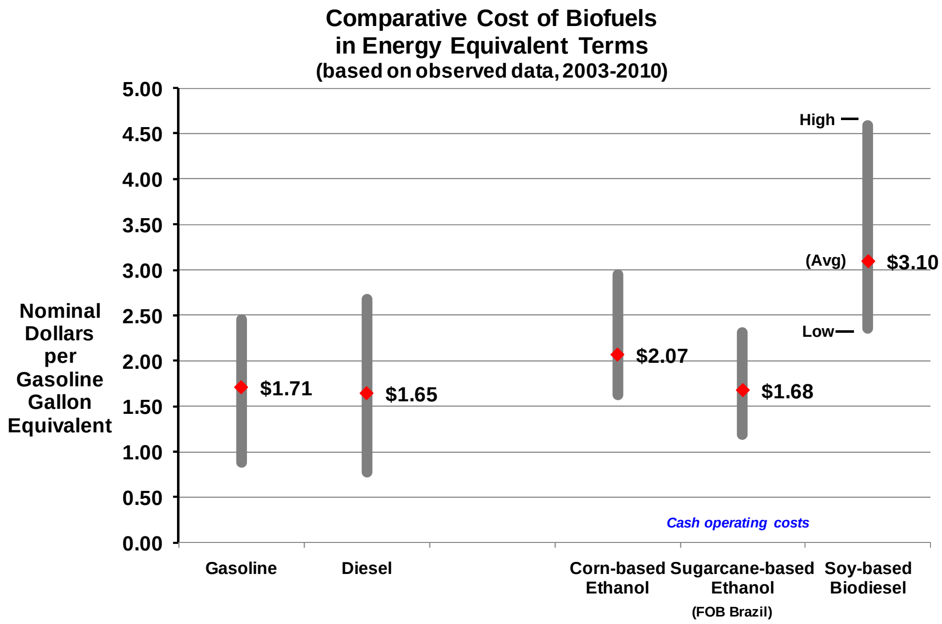
National RFS Cellulosic Biofuel Target vs. EPA Estimates of Potential Availability and Actual Production



Source: IHS CERA, EPA.
Note: EPA's estimate for 2012 is a range of 3.55 million gallons to 15.7 million gallons. The lower part of the range represents the value that EPA has the most confidence in, based on known demonstration facilities. The higher range is based on what could be achieved based on production plans, but not existing capacity.

Figure 2

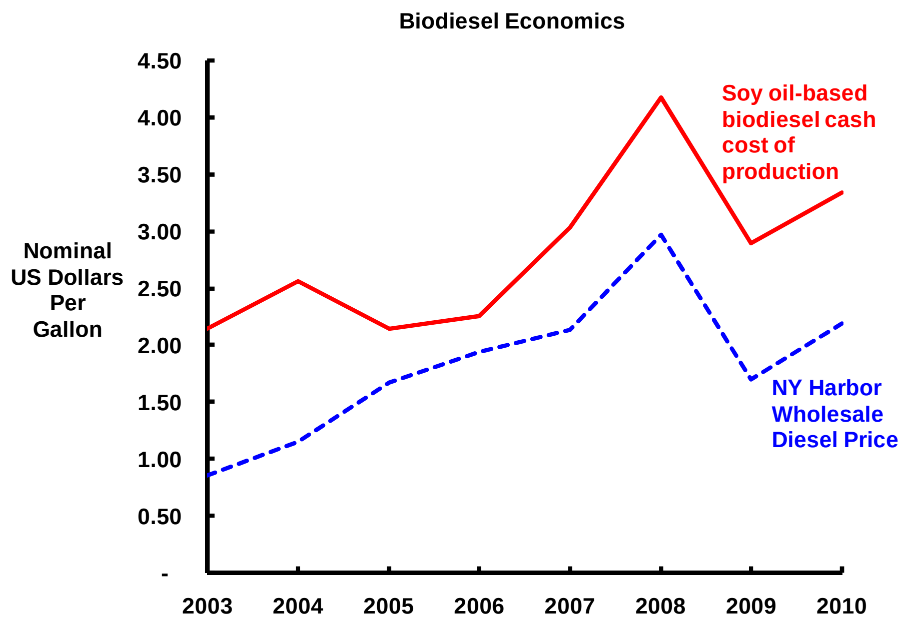
Most Conventional Biofuels Are More Costly Than Petroleum Fuels



Source: IHS CERA; Platt's; US Department of Agriculture.
Note: Brazilian ethanol cost in the US would be increased by existing tariff (currently 54 cents per gallon) and transportation cost. Ethanol and biodiesel cost of production highly dependent on underlying agricultural commodity price.

Figure 3

Biodiesel Cost of Production Still Well Above Petroleum despite Rising Crude Oil Prices



Source: IHS CERA; Platt's; US Department of Agriculture.
Note: Subsidies/tax credits not included in the biodiesel cost of production estimates

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Biofuels Challenges—National E10 Blendwall

The NESCAUM report assumes that only cellulosic biofuels will be used in the Northeast to comply with a Clean Fuels Standard and that conventional corn-based ethanol, currently used at about 10 percent by volume in the Northeast, will be eliminated from the Northeast gasoline pool. Even after ignoring the issue of cellulosic biofuel availability as well as the price difference between cellulosic and corn ethanol, eliminating corn-based ethanol from the large Northeast gasoline market would have ripple effects at the national level. In the Midwest, it could result in the shutdown of many ethanol biorefineries with associated job losses. Another scenario is that it could lead to higher gasoline prices than would otherwise be the case, since refiners and other "obligated parties" under the RFS would have to incur additional costs in order to sell discounted ethanol in the form of E85 (an alternative fuel containing a blend of up to 85 percent ethanol and 15 percent petroleum-based gasoline), requiring as well the development of an extensive E85 retail infrastructure, which does not exist today.

The Federal RFS allows refiners and fuel importers ("obligated parties") to earn credits for compliance by blending up to 15 billion gallons (by 2015) of conventional corn-based ethanol in the national market. Indeed, based on this mandate, approximately 15 billion gallons of corn-based ethanol production capacity now exists in the US.

Deprived of the Northeast market, obligated parties might try to "shift" conventional corn-based ethanol currently blended in the Northeast to other gasoline markets outside the Northeast. However, this would be infeasible—at least in the next several years—because these markets, like the Northeast, are near or already at the E10 "blendwall"—the point at which all gasoline contains 10 percent ethanol by volume (see Figure 4). Although the EPA has recently issued partial waivers for E15 gasoline (15 percent ethanol by volume), the 10 percent limit is unlikely to be surpassed for several reasons. First, EPA approved E15 only for model year 2001 vehicles and newer. Fuel suppliers are unlikely to incur the commercial risk of supplying a new fuel (E15) when most of the market is E10 (see Figure 5). Secondly, fuel suppliers are unlikely to risk liability exposure by marketing E15, since the owner's manual for most vehicles on the road today contain instructions to use gasoline with no more than 10 percent ethanol. The NESCAUM analysis appears to ignore the commercial and legal issues that need to be surpassed for E15 to be marketed.

Another possibility to surpass the E10 blendwall would be for obligated parties under the RFS to market more E85. However, this is an unlikely pathway. E85 sales are currently very small (less than 0.1% of the national gasoline market) and are further limited by a lack of E85 refueling infrastructure (very few E85 stations/pumps exist nationally). E85 is also limited by a lack of flexible-fuel vehicles (FFVs) in the US vehicle fleet (less than 10 million in a passenger vehicle fleet of 250 million), the only vehicle type warrantied by manufacturers to use this type of fuel. Further compounding the E85 challenge is the remaining hurdle that consumers must be persuaded to purchase E85. Since E85 has lower energy content (25% less energy compared to E10), it must be heavily discounted to encourage sales and consumption. Typically E85 has not met this hurdle in the US (see Figure 6). These findings are in agreement with a June 2011 Government Accountability Office (GAO) report.[3]

The displacement of corn based ethanol from the large Northeast gasoline market could have two knock-on effects. First, many corn-based ethanol biorefineries— principally located in the Midwest— would likely shut down, since the rest of the country is at the E10 blendwall and the removal of corn-based ethanol from the Northeast would deprive these biorefineries of a key market. The NESCAUM states cumulatively consume about 25 billion gallons of gasoline (including blended ethanol), according to the EIA. Assuming 10 percent ethanol by volume in these markets, the Northeast states consume about

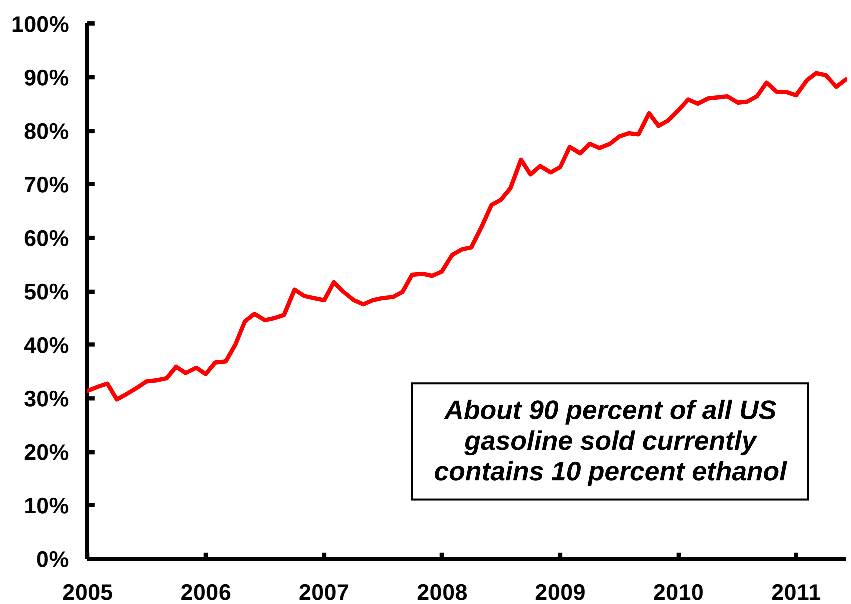
3. Government Accountability Office (GAO), "Biofuels: Challenges to the Transportation, Sale and Use of Intermediate Ethanol Blends", June 2011. http://www.gao.gov/new.items/d11513.pdf

2.5 billion gallons of corn-based ethanol. This is the output of approximately 50 moderate sized corn-based ethanol biorefineries. These biorefineries would presumably face severe economic strain as a result of the loss of the large Northeast corn-based ethanol market, most likely leading to the shut-down of this capacity with associated job losses.

A second impact could be higher gasoline prices. As part of the larger RFS mandate, obligated parties are currently allowed to earn credits of up to 15 billion gallons of corn-based ethanol by 2015. With corn-based ethanol backed out of the Northeast market, fuel suppliers would not be able to earn as many credits for corn-based ethanol through conventional gasoline blending (the E10 market) as they had previously, but would still need to comply with the overall RFS target. Since markets outside of the Northeast will be at the E10 blendwall, obligated parties could try to earn RFS credits by selling E85 in these markets. However, as explained above, in order for consumers to be induced to buy E85, the fuel would need to be sold at a price low enough relative to gasoline to reflect its significantly lower energy content. This would result in higher costs for obligated parties, since they would still need to pay ethanol producers a high enough price to maintain production, while then having to sell ethanol at a much lower discounted price in the form of E85. In addition, obligated parties would have to incur additional distribution, storage and infrastructure costs that will be necessary to build out an E85 infrastructure. As the cost of complying with the RFS increases for obligated parties, this added cost will likely be passed on to the consumer in the form of higher gasoline prices.

Figure 4

Share of Ethanol-based Gasoline Blends

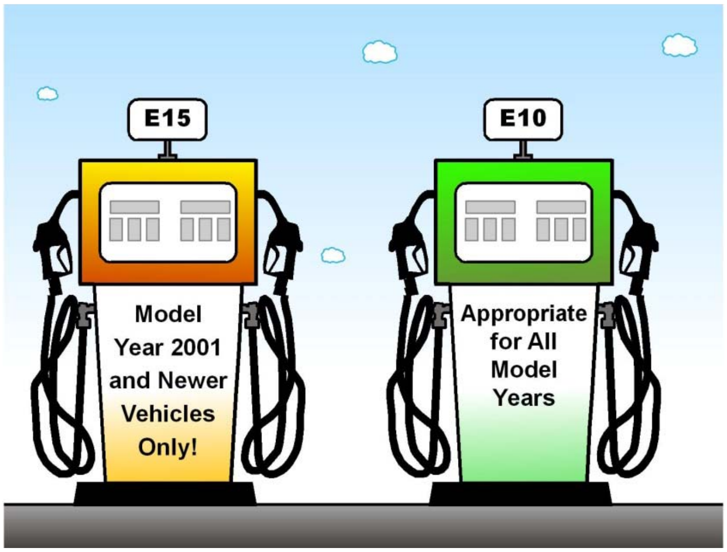


Source: IHS CERA, US Energy Information Administration.

Figure 5

Is E15 the New Blend Wall? Maybe Not.

Limited use of E15 creates storage and distribution challenges, plus risks of misfueling



Source: IHS CERA.
01004-1

Figure 6

E85 More Costly Than Gasoline/E10

AAA Daily Fuel Gauge Report, September 22, 2011

	Regular	Mid	Premium	Diesel	E85	E85 MPG/BTU adjusted price
Current Avg.	**$3.556**	**$3.698**	**$3.827**	**$3.882**	**$3.195**	**$4.205**
Yesterday Avg.	**$3.570**	**$3.711**	**$3.841**	**$3.886**	**$3.193**	**$4.202**
Week Ago Avg.	**$3.623**	**$3.762**	**$3.889**	**$3.902**	**$3.238**	**$4.261**
Month Ago Avg.	**$3.572**	**$3.700**	**$3.829**	**$3.878**	**$3.206**	**$4.219**
Year Ago Avg.	**$2.720**	**$2.888**	**$2.993**	**$2.972**	**$2.291**	**$3.015**

Source: AAA, OPIS (fuelgaugereport.opisnet.com).

Flawed Fuel Assumptions

In the high oil price scenarios, the NESCAUM analysis assumes that the carbon intensity of petroleum fuels increases over time, by about 5 percent over the 10-year study period. No data are presented to back up this assertion. NESCAUM states only that ”high oil prices result in an increase in the economic viability and market share of products derived from higher carbon intensity feedstocks.”

Although more sources of crude oil would become economic under high oil price conditions, the assumption that these sources have greater carbon intensity is erroneous. Additionally, the proportion of light liquids, including natural gas liquids and condensate, is increasing on a global basis.

Alternative Vehicle Challenges

Electric vehicles will be much more expensive than NESCAUM estimates

There are two vehicle technologies that allow the use of grid electricity in transport. The first is a battery electric vehicle (BEV). BEVs have an all-electric drivetrain and run only on electricity. The range of the vehicle depends on the size of the battery. For example, the Nissan Leaf has a 24 kilowatt-hour (kWh) battery and approximately 100 miles of range. The battery is the most important determinant of the cost of a BEV.

The second technology is a plug-in hybrid electric vehicle (PHEV). These vehicles have a dual drivetrain—electric and internal combustion engine (ICE). PHEVs have a shorter all-electric range than BEVs because they have an ICE to extend their range and allow on-the-go refueling, resulting in lower battery cost than BEVs. However, all of the costs of the electric drivetrain are in addition to the cost of the ICE.

NESCAUM assumptions for the cost of BEVs and PHEVs are much lower than industry, government and academia estimates and these are lower than the costs asserted in internal analyses performed by IHS CERA, IHS Global Insight and the IHS Automotive Group. Figure 7 illustrates the significant discrepancies between NESCAUM BEV cost assumptions and public literature references.

NESCAUM’s low-end estimate for BEVs assumes that BEVs have no incremental cost over comparable ICE vehicles when averaged over the complete timeframe of the analysis (2013–2022). For this price path to be true, BEVs would have to be cheaper than ICE vehicles before 2022 to average out their greater cost today. This assumption is unrealistic, even if a higher proportion of BEVs are sold in the out-years of the scenario interval.

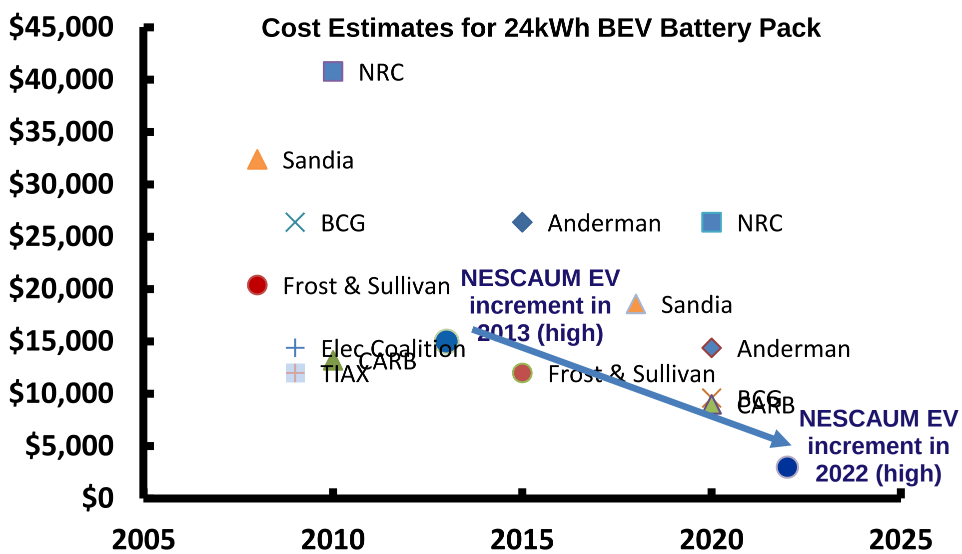
The NESCAUM high end estimate assumes that the incremental cost of a BEV over an ICE vehicle decreases from $15,000 in 2013 to $3,000 by 2020, for an effective weighted average of $5,000 over the full timeframe. Battery cost is the primary contributor to today’s price differential between BEVs and ICE vehicles. Figure 7 shows cost estimates for a 24kWh BEV battery pack (the size of battery found in the Nissan Leaf) from multiple sources. Although the NESCAUM values on the graph represent incremental vehicle cost rather than battery cost, NESCAUM’s value for today’s incremental cost is well in line with other sources. However, even the high end estimate for incremental BEV cost is lower than the estimate from any other source.

The NESCAUM analysis assumes no cost difference between PHEVs and conventional ICE vehicles in all cases. Given that PHEVs are *more* expensive today than BEVs, this assumption is also unsupportable based on our proprietary and other 3rd party analysis. PHEVs have smaller batteries than EVs, but the addition of the gasoline engine to extend range more than makes up for the reduction in battery cost from a BEV. Figure 8 shows cost estimates for PHEVs from various sources. None of these studies forecasts that PHEVs will achieve price parity with ICE vehicles. In fact, the lowest forecast price differentials are more than $4,000, achieved in 2030 and 2035, beyond the timeframe of the NESCAUM analysis. Figure 8 illustrates the significant discrepancies between NESCAUM PHEV cost assumptions and public literature references.

Figure 7

NESCAUM Assumes Rapid Drop in BEV Costs

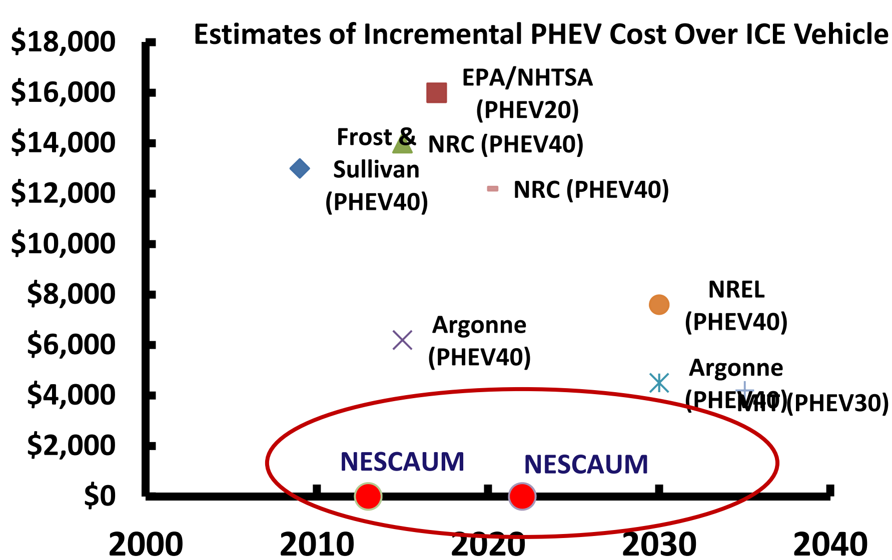
Assumption far exceeds consensus view of feasible cost reductions



Source: *Electrification of the Transportation System*, MIT Energy Initiative Symposium, April 10, 2011.

Figure 8

NESCAUM Assumes Zero Incremental Cost for PHEVs



Source: *Electrification of the Transportation System*, MIT Energy Initiative Symposium, April 10, 2011.
Note: The number in parentheses after each data point represents the all-electric capability of each vehicle. For instance, PHEV40 is a vehicle with 40 miles of all-electric range.

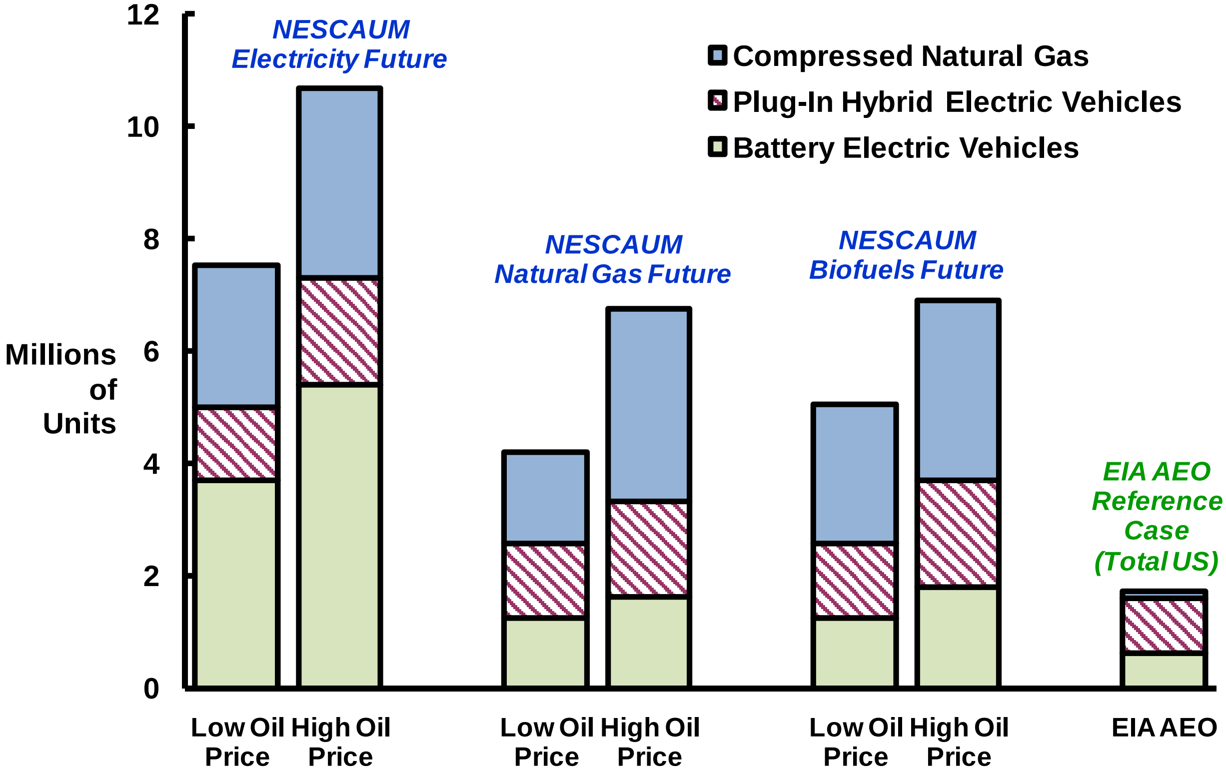
Alternative vehicle challenges:
Sales of alternative vehicles in the NESCAUM analysis far exceed consensus estimates

In every scenario the NESCAUM analysis includes sales forecasts for alternative vehicles that are well beyond consensus estimates. For example, Figure 9 depicts the forecasted fleet of alternative vehicles in each NESCAUM scenario in 2022, along with EIA's forecast for the same year. NESCAUM's assumptions for BEV, PHEV, and natural gas vehicle (NGV) penetration for the NE/MA region alone exceed EIA's forecast for the entire United States in each case. As the NE/MA study area comprises just 1/5th of total US vehicle stock, NESCAUM's estimates for alternative vehicle penetration are clearly very high.

Figure 9

Comparison of NESCAUM Alternative Vehicle Fleet Size for NE/MA vs. EIA Reference Case for the Entire US in 2022

NESCAUM assumption for NE/MA far exceeds EIA assumption for US



Sources: NESCAUM *Clean Transportation Fuels Final Report*, July 2011; US DOE EIA *2011 Annual Energy Outlook*, Reference Case.

Figures 10 through 12 depict annual sales of alternative vehicles in the NE/MA region in each NESCAUM scenario compared to EIA's forecast of alternative vehicle sales in the region. Particularly in the case of NGVs, NESCAUM's estimates of annual vehicle sales are orders of magnitude higher than EIA expects.

Figure 10

NESCAUM Alternative Vehicle Sales Vastly Exceed EIA Estimates—BEV Vehicles

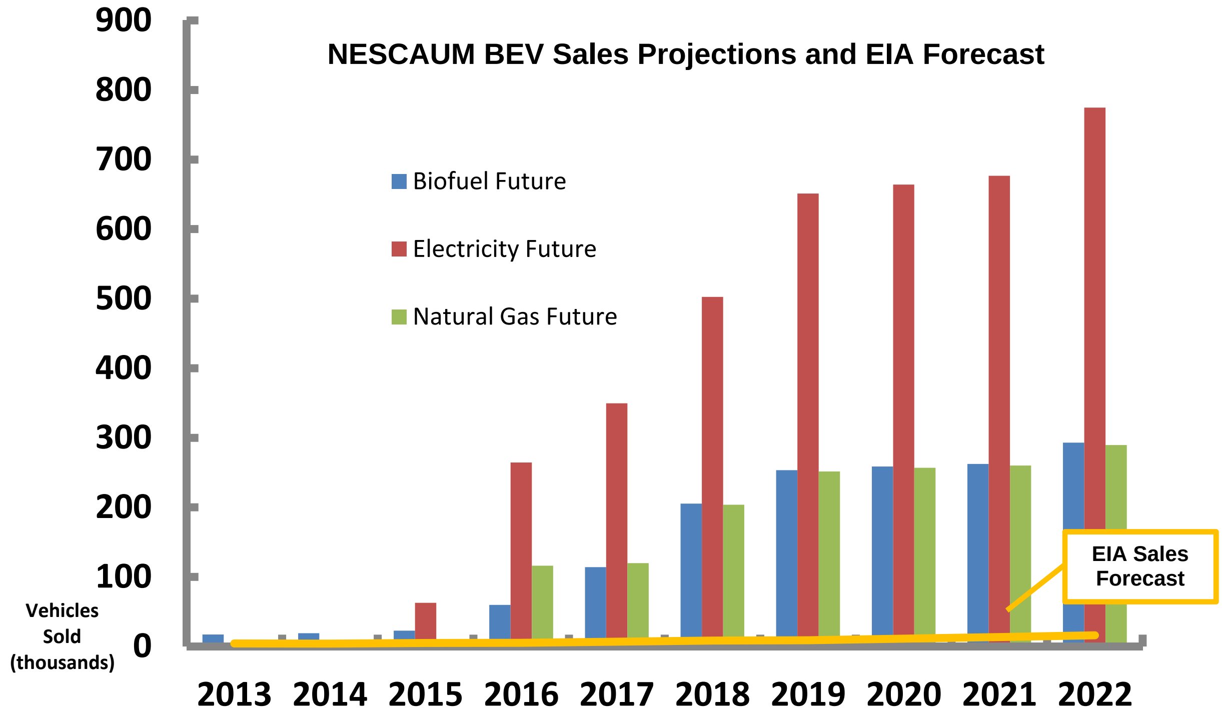
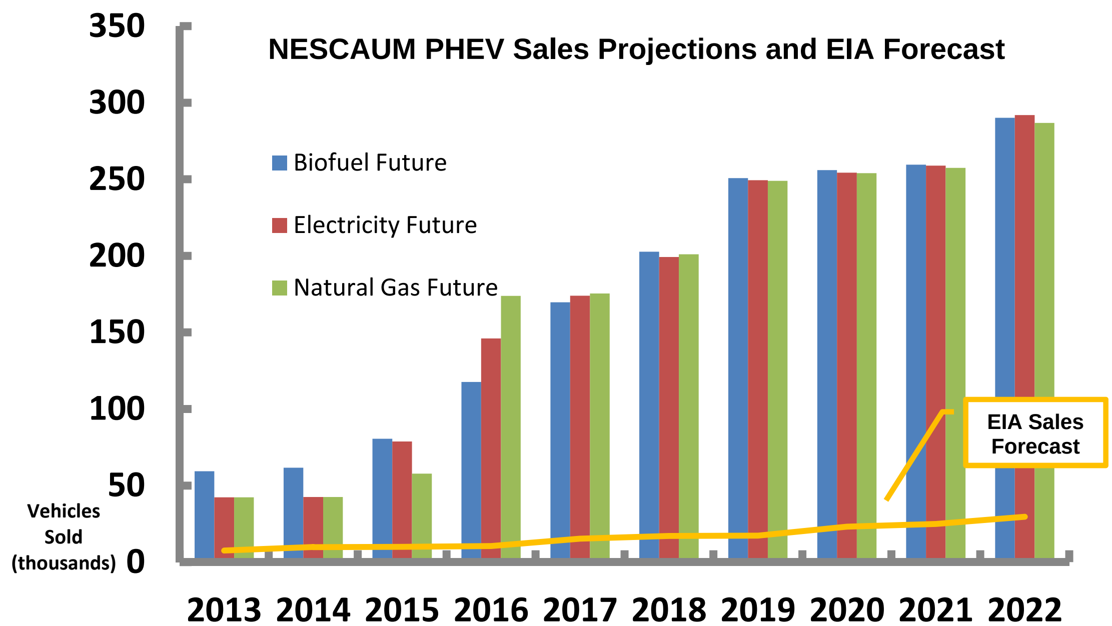


Figure 11

NESCAUM Alternative Vehicle Sales Vastly Exceed EIA Estimates—PHEV Vehicles



Barriers to Widespread NGV Adoption

Similar to the electric vehicles, NESCAUM makes extraordinary projections for natural gas vehicles sales compared with EIA–see Figure 12.

NESCAUM's cost estimates for NGVs, however, are much more realistic than those for BEVs and PHEVs. Nonetheless, the higher upfront vehicle cost of NGVs poses a significant barrier to their adoption. For example, the Honda Civic NGV costs approximately $7,000 more than the comparable ICE Civic – which matches the high-end cost used in the NESCAUM study. Currently, conversion kits are commercially priced from $4,000 to $6,000.

The greatest challenge for NGVs lies not in vehicle cost, but in refueling infrastructure. The low energy density of CNG limits vehicle range and consequently increases trips to fueling stations. Those fueling stations are likely to be hard to find—only 885 CNG pumps are available today out of 160,000 gasoline stations nationwide. Building additional CNG retail pumps poses significant infrastructure expense—more than $350,000 for a commercial station. Since most fuel stations are independently-owned small businesses the cost of installing CNG infrastructure could be prohibitive. Home refueling equipment costs approximately $5,000 to purchase and install.

Given the infrastructure expense, NGVs face a chicken and egg dilemma. Retailers will not install expensive refueling infrastructure without a guaranteed market of NGVs. Consumers will not pay the greater upfront cost of NGVs without adequate infrastructure for refueling. Natural gas is cheaper as a transportation fuel than gasoline, but the infrastructure issues involved with its use have largely kept NGVs confined to vehicle fleets, where centralized refueling can minimize or eliminate the infrastructure challenge.

NESCAUM includes very ambitious rates of growth for natural gas vehicles and refueling stations, as shown in Figure 13. However, without a solution to the chicken and egg dilemma, NGVs will not develop at the rate NESCAUM forecasts.

Other NGV challenges that may deter consumers include longer fueling times compared to current ICE vehicles and less cargo capacity than comparable ICE vehicles due to on-board CNG storage.

Figure 12

NESCAUM Alternative Vehicle Sales Vastly Exceed EIA Estimates —NGV Vehicles

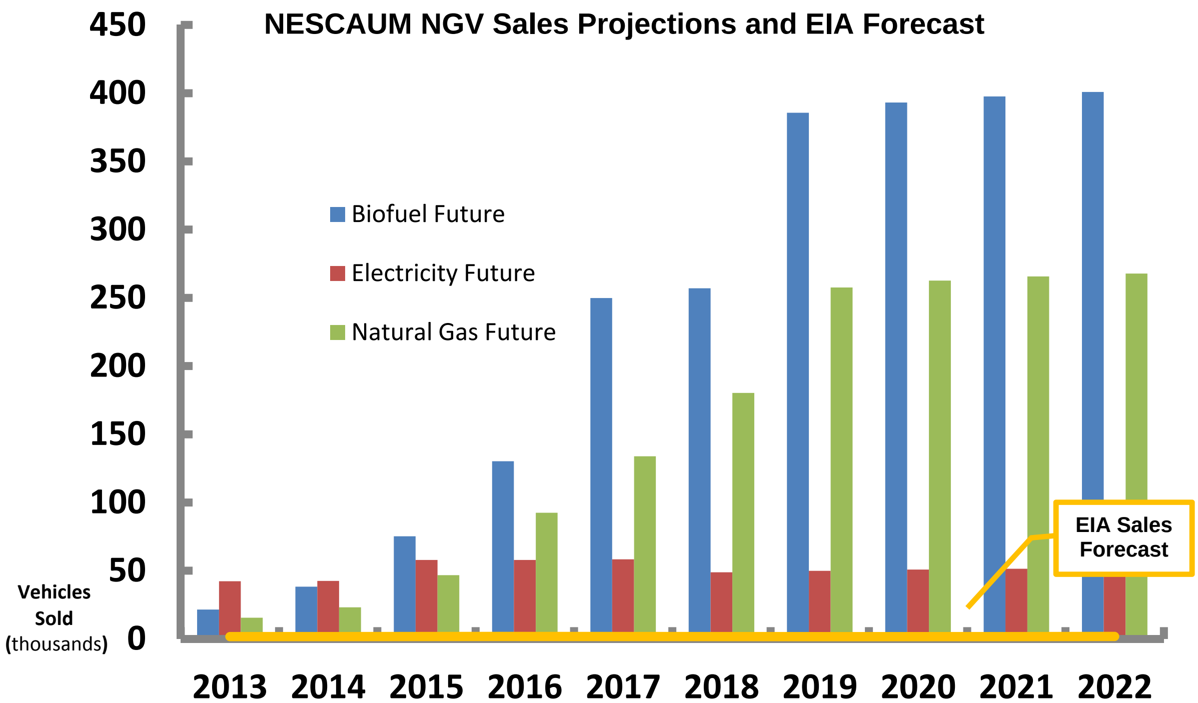
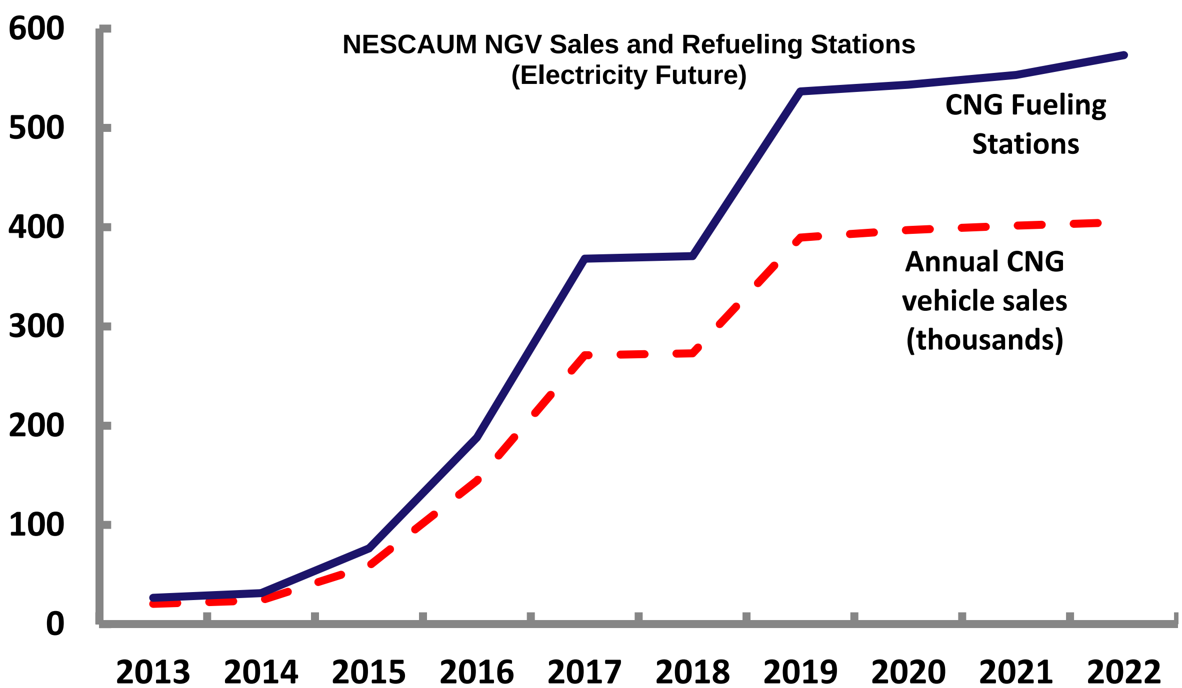


Figure 13

NESCAUM Assumes Skyrocketing NGV Sales and Infrastructure Development, but What Drives Growth?



CRITIQUE OF NESCAUM'S ECONOMIC IMPACT ANALYSIS

Implications of Flawed Assumptions, not Methodology

The IHS Global Insight critique is confined to evaluating the economic results based on the assumptions employed. Our critique assumes appropriate application of the REMI model, which is deemed suitable for the type of modeling used in the NESCAUM analysis. This critique challenges neither the methodology employed nor the data inputs utilized for the model simulations. However, with so many disparate sources of input data, IHS Global Insight is concerned that competing or conflicting assumptions could be embedded within these data.

Fundamentally, the flaws identified in the NESCAUM assumptions employed render their analysis meaningless.

Two Distinct Phases Must Be Quantified in an Economic Impact Analysis

The Infrastructure Phase centers on the transition from one industrial, commercial or regulatory environment to another. As such, the phase focuses on construction and implementation of new systems and infrastructure components. The NESCAUM scenarios assume the economic impacts in the Infrastructure Phase will be driven by new investment in low carbon fuel production and infrastructure. Though significant, the economic contributions of this phase are transitory. Once the new infrastructure is in place, the construction investments and jobs will dissipate, along with their indirect and induced economic effects.

The Steady-State Phase reflects the on-going economic contribution after the new infrastructure is in place. This phase produces the long-term, sustainable economic contribution. The Steady-State Phase of the NESCAUM scenarios assumes savings to local households and businesses from reduced fuel expenditures. Based on the NESCAUM assumptions related to advanced biofuels and alternative vehicle adoption, IHS Global Insight's review suggests that the economic benefits related to these savings and investments are seriously constrained or non-existent.

The jobs and overall economic contribution of the NESCAUM scenarios are dominated by the manufacturing and construction jobs that are typically associated with the Infrastructure Phase. This indicates the economic contribution by the Steady-State Phase of the scenarios may not be sustainable.

Additionally, the economic impact of decreased government revenues from reduced fuel taxes on gasoline and diesel could be significant yet are not adequately explained in the impact assessment. The economic benefits of lower fuel expenditures will be offset by incremental costs of new alternative fuel vehicles and conversion kits for existing vehicles.

Infrastructure Phase: New Investment on Alternative Fuels

Increased demand for low carbon fuels

- Impacts are larger under high oil price scenarios because greater demand for alternative fuel infrastructure drives more investment
- Important Assumption: Size of *regional* biofuels and biogas production

Comments:

- Assumptions about size of regional biofuels production are crucial, and should be made explicit and analyzed in detail
- Increased investment in alternative fuels production and infrastructure may actually displace other investment (in the allocation of regional capital), offsetting job gains associated with the CFS

Steady-State Phase: Savings to Households and Businesses

- Key NESCAUM Assumption: Alternative fuels are less costly
- NESCAUM assumption is that lower fuel costs generate increased disposable income for households and lower costs for businesses, both spurring demand for local goods and services
- Savings to local households and businesses drive significant increases in local spending on non-energy goods and services
- Impact is magnified because a greater proportion of this spending remains in the region with multiplier effects
- Impacts are higher under the high oil price scenarios because savings are greater

Comments:

- If alternative fuels are actually more costly than conventional fuels, the net impacts on disposable income and demand for local goods and services can turn negative
- Non-transportation electricity costs might increase under CFS, resulting in an increased cost to households

Jobs Economic Impact: NESCAUM Supply Availability

The overstatement of production and supply significantly undermines the validity of any related job creation over the NESCAUM scenario interval. In particular, flaws in the NESCAUM assumptions regarding the pace of technological advancement cast doubt on the level of regional investment necessary to support the cited job gains. More appropriate assumptions would reflect delayed investment in new facilities, which consequently limits the creation of direct plant oriented jobs such as engineers. The failure to produce an adequate supply of clean fuels obviates the need to construct the refining and fueling infrastructure that generates indirect construction jobs (albeit short-term employment). Lastly, dollars allocated to ensuring compliance could negatively affect investment choices in alternative growth industries and dampen job growth due to lost investment opportunities.

Income Economic Impact: NESCAUM Supply Availability

Correcting NESCAUM's overstatement of advanced biofuels supply availability results in correspondingly lower gains in real disposable income since many of the claimed job gains (and the associated income gains) go unrealized. In the best NESCAUM scenario in 2022, the income impact is a faintly audible $3.33B on the region's real disposable income total of nearly $3 trillion (based in IHS Global Insight's September 2011 forecast). Under more realistic scenarios of biofuels production, both within and outside the region, income effects in the NESCAUM region would at best be negligible since the value-added from additional processing capacity, upstream supply and related supply chain effects is unlikely to exist. From the perspective of growing upstream supply (e.g. agriculture feedstocks) to meet NESCAUM in-region production levels, IHS Global Insight's Agriculture Group asserts conversion from food/feed crops to fuels crops could have the unintended consequence of higher food prices that would negatively affect disposable income.

Gross Regional Product Economic Impact: NESCAUM Supply Availability

Under the NESCAUM Biofuels Future scenario, the value-added to gross regional product (GRP) through compliance equates to $4.64B on an (IHS Global Insight Sept. 2011) estimated GRP of $3.92T in 2022. More realistic assumptions reflecting consensus-based current and future technological trends would undermine any meaningful additions to GRP as the region would fail to attract the necessary capital investment, R&D or upstream resources vital to creating a viable multiplier effect from a clean fuels supply. While producing low carbon fuels in-region is preferable in this scenario, the low probability of having an in-region production capacity pushes out any gains beyond the scenario horizon.

Little commentary is provided in the NESCAUM analysis relative to the cost of compliance. The economic benefits related to CFS compliance are typically associated with the Infrastructure Phase (i.e. temporary benefit) and NESCAUM affords little consideration to the negative impacts of compliance. For example, any investment generated to ensure CFS compliance could potentially displace investment in industries with higher economic multipliers, thereby holding back potential growth in GRP.

By attracting the wrong capital investment to ensure compliance, the region may also be rendered less competitive by virtue of investment lost to other regions either: 1) Better suited for low carbon fuel production; or 2) Offering growth opportunities with a better return on capital.

BACKGROUND ON IHS CERA AND IHS GLOBAL INSIGHT

IHS CERA

IHS Cambridge Energy Research Associates®, Inc. (IHS CERA®) is a leading advisor to international energy companies, governments, financial institutions, and technology providers. IHS CERA delivers critical knowledge and independent analysis on energy markets, geopolitics, industry trends, and strategy. Our services help decision makers anticipate the energy future and formulate timely, successful plans in the face of rapid changes and uncertainty. IHS CERA is valued for our independence, fundamental research, foresight, and original thinking. Our unique integrated framework enables us to offer new insights ahead of conventional wisdom, providing a comprehensive "early warning system" that has a direct impact on investment, decision making, and performance.

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IHS Global Insight

IHS Global Insight offers economic and financial analysis, forecasting, and market intelligence for over 200 countries worldwide and coverage of over 170 industries that helps clients to monitor, analyze and interpret conditions affecting their business. IHS Global Insight operates throughout the world with 25 offices in the US, Canada, Asia, Europe, the Middle East and Africa. More than 3,800 clients around the world look to IHS Global Insight for professional research and consulting support. Our staff of 600 economists, analysts and support staff provides clients with subscription forecasts, specialized consulting support, and access to historical and forecast databases and economic software and data services. We provide expertise in international macro economies, individual industries, financial markets, trade, transportation and economic modeling.

IHS Global Insight was formed in May 2001 through the merger of DRI, founded as Data Resources, Inc. in 1968 and WEFA, founded in 1963 as Wharton Econometric Forecasting Associates – two companies that were created to provide quantitative economic research information to business and government agencies. Global Insight was acquired by IHS Inc. (NYSE: IHS) in October 2008.

PROJECT TEAM

For IHS CERA

Aaron Brady
Director
Global Oil

Samantha Gross
Director
Global Energy

Bill Veno
Senior Director
Global Downstream

For IHS Global Insight

Jim Diffley
Chief Regional Economist
US Regional Economics

Bob Flanagan
Director
Economic Impact Analysis

Shane Norton
Director
Economic Impact Analysis

Brendan O'Neil
Director
Public Sector Consulting

For further information, contact

Brendan O'Neil
IHS, Inc.
1150 Connecticut Avenue
Suite 401
Washington, DC 20036
+1 (202) 481 9239
brendan.oneil@ihs.com