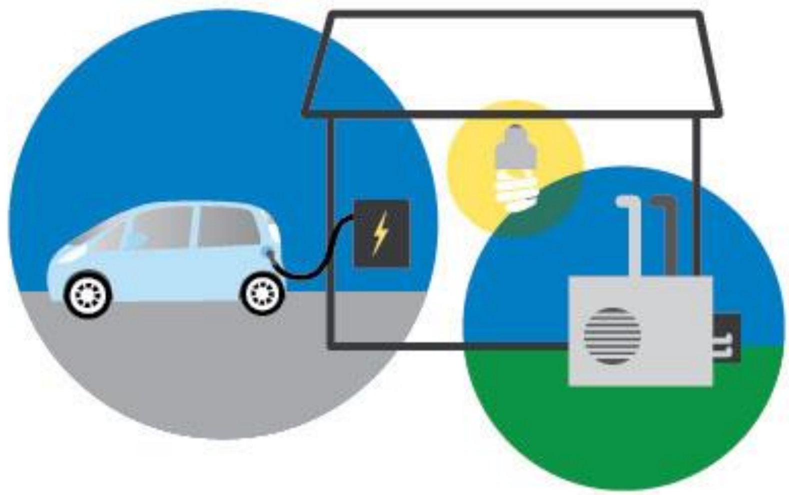
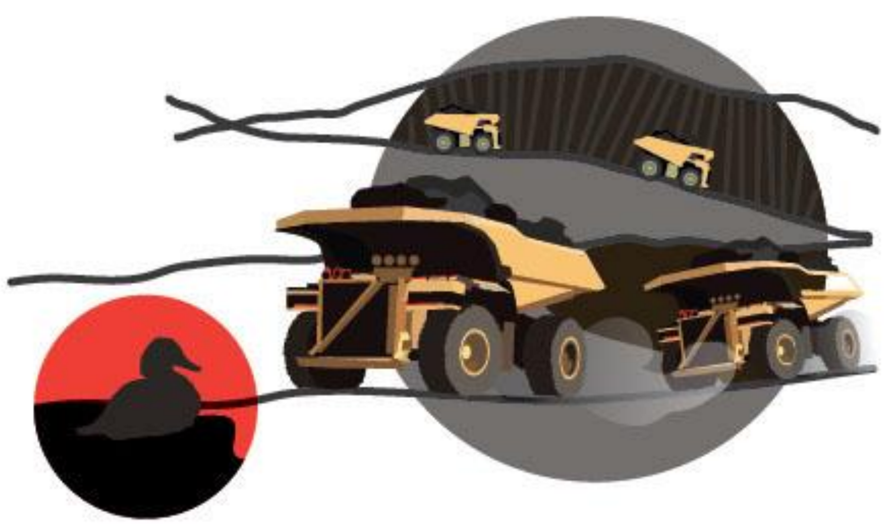


Cleaner Energy Alternatives to Tar Sands Imports: An Economic and Environmental Assessment



ENE

Table of Contents

ENE is a non-profit organization that researches and advocates innovative policies that tackle environmental challenges while promoting sustainable economies. ENE crafts cutting edge policies based on in-depth economics research and complex data analyses, and our skilled advocates put policy solutions into action. ENE promotes close collaboration with stakeholders, government, businesses, and consumer and environmental organizations to ensure that policies are effective and sound.

Principal Author: Beth Nagusky, ENE Senior Attorney and Maine Director, (207) 592-1961, bnagusky@env-ne.org

Contributing Authors: Jamie Howland, ENE-CLEAN Director; Varun Kumar, Policy Data Analyst; Leslie Malone, Canada Program Director

ENE President: Daniel L. Sosland

This document can be found online at: **http://www.env-ne.org/resources/detail/cleaner-energy-alternatives-to-tar-sands-imports**

Acknowledgements

Thanks to New Venture Fund support through the Tar Sands Free Northeast campaign. We are grateful for peer review by Kenny Bruno, New Venture Fund; Shelley Kath; Elizabeth Shope, Natural Resources Defense Council; and Dylan Voorhees, Natural Resources Council of Maine.

Executive Summary

Energy systems around the world are at a critical juncture. Choices made today will dictate future climate change impacts as well as how successfully the Northeast competes and prospers in the emerging clean energy economy. Increasing amounts of oil from unconventional sources are projected to flow through and into the Northeast and mid-Atlantic states.[1] In 2012, less than 1% of the region's total product market was supplied from tar-sands-derived fuels; however, through existing and proposed pipelines and other modes of transportation (e.g. rail and ship) refineries on the U.S. East and Gulf coasts and in Eastern Canada could have access to additional tar sands crude oil. As a result, it has been estimated that 14-18% of the Northeast and mid-Atlantic energy supply mix could be tar-sands-derived fuels by 2020.[2]

Projects to import tar sands and/or tar-sands-derived oil products have generated controversy for a number of reasons. From a full lifecycle perspective tar sands crude oil is more energy intensive and generates approximately 18% more greenhouse gas (GHG) emissions than the average barrel of conventional oil refined in the U.S.[3] Moving oil and refined petroleum products through the region by pipeline, rail, and ship also increases the risks of other environmental damages (e.g. oil spills and contaminated waterways). However, fundamental economic and consumer questions have been missing from the public debate surrounding tar sands.

In the spirit of advancing an informed dialogue, ENE has prepared this assessment to address the following questions: 1) To what extent are increasingly viable cleaner alternatives – such as energy efficiency, advanced electric technologies, and cleaner fuels – available to cost-effectively meet our energy needs? and 2) What are the consumer costs and greenhouse gas emissions impacts of these alternatives compared to continued reliance on fossil fuels, in particular tar-sands-derived fuels?

ENE's analysis examines how the Northeast and mid-Atlantic states could displace refined petroleum products, specifically tar-sands-derived fuels used for heating and transportation, over a ten-year period (2013-2022), and the associated economic and GHG emissions impacts of doing so. The analysis concludes that:

- **Increasing the region's reliance on tar-sands-derived fuels is unnecessary**. Alternative energy options exist in sufficient quantities to displace, over a ten-year period, at least 15% of the fossil fuels currently used for heating and transportation, an amount equivalent to all of the tar-sands-derived oil products projected to flow through or to the Northeast and mid-Atlantic states.

- **Investments in cleaner energy alternatives that could displace reliance on tar-sands-derived fuels in the region would be less costly to consumers, industry, and the environment.** In most cases an increased investment in alternative energy options would cost less and result in lower GHG emissions than consuming conventional or tar-sands-derived refined petroleum products.

Figure 1 shows the economic and emission reduction benefits that could be achieved if the region were to reduce heating and transportation fuel demand by 15% through energy efficiency, advanced electric technologies, and cleaner fuels. [4], [5]

---

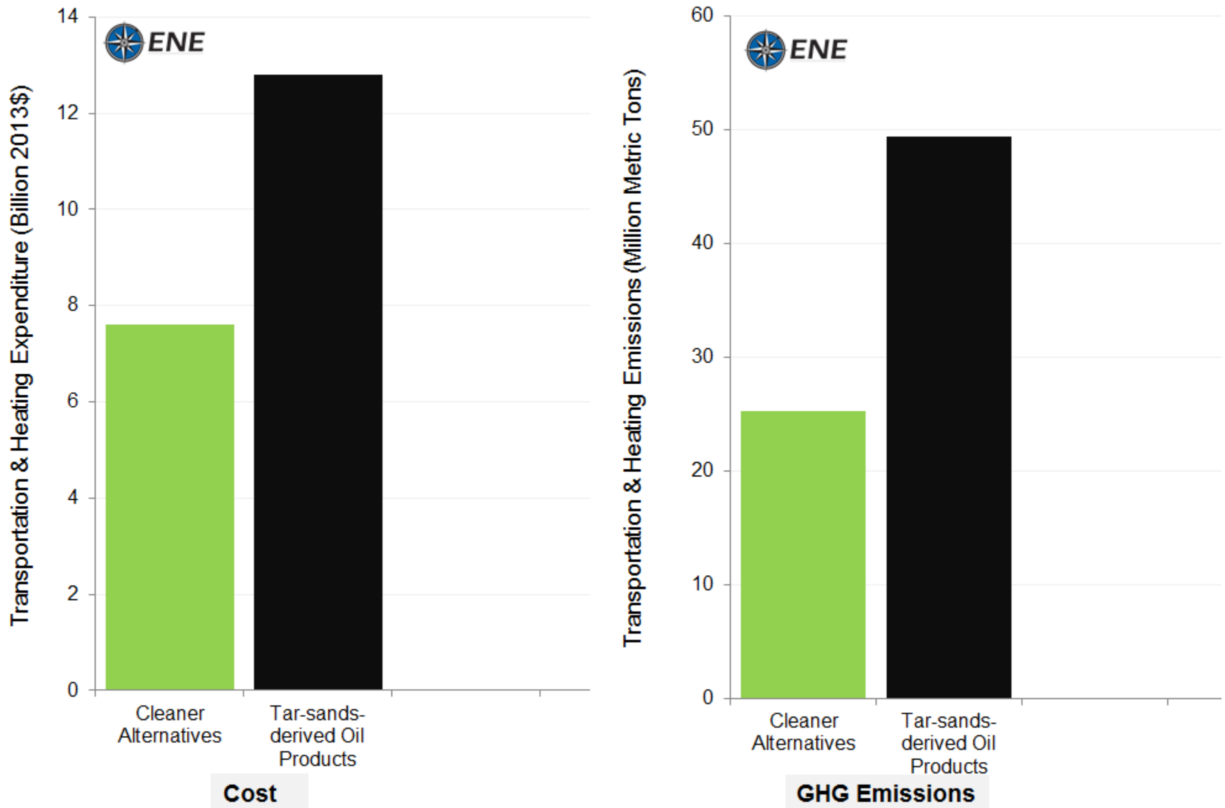
[1] The Northeast and mid-Atlantic states included in this study are: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.

[2] Hart Energy. (2013, June). *Evaluation of Potential Pathways for Tar Sands to the U.S. Northeast*. Prepared for NRDC. Available from: http://docs.nrdc.org/energy/files/ene_14011601a.pdf

[3] ENE estimate based on direct emissions factors from the EPA and production and transportation emissions factors from a Congressional Research Services report – *Canadian Oil Sands: Life-Cycle Assessments of Greenhouse Gas Emissions*

[4] Figure 1 assumes reductions in the heating sector come from efficiency (50%) and air source heat pumps (50%), and in the transportation sector from switching light duty vehicles to electric vehicles and heavy duty vehicles to natural gas.

Figure 1: Cost and Emissions Associated with Cleaner Alternatives to reduce oil demand by 15% in 2022



Clean energy alternatives not only save consumers money, they also improve the competitiveness of business, and increase economic output.[6] Instead of billions of dollars flowing out of the region to import polluting fossil fuels, advancing clean energy alternatives will continue to unlock the economic potential of local industries.

Study Overview

The study examines how the Northeast and mid-Atlantic states could displace refined petroleum products, specifically tar-sands-derived fuels used for heating and transportation, over a ten year period (2013-2022), and the associated economic and GHG emissions impacts. The study assesses two possible levels of market penetration of tar-sands-derived refined petroleum products:

- **Scenario 1: Low Market Penetration (5%)** – This scenario assumes an amount of tar-sands-derived fuel that is equivalent to what could be produced from crude oil that might flow through the Portland-Montreal Pipe Line (PMPL) through the Northeast (152,000 barrels per day or 55.5

[5] The emissions from natural gas will vary considerably based on the production emissions associated with the natural gas. For electric vehicles the emissions factor used for electricity is that of a natural gas combined cycle power plant. Only average emissions are presented for hydrogen vehicles. E85 production emissions are from the California Air Resource Board carbon intensity factors. They include fuel processing and transportation emissions, indirect emissions due to land-use change and emissions reductions due to sequestration.

[6] ENE's study – *Energy Efficiency: Engine of Economic Growth* (2009) – found that fifteen years of investment in cost-effective energy efficiency programs for heating oil would result in a net increase in Gross State Product and employment in New England of $53.1 billion and 417,000 job-years, respectively.

million barrels per year).[7, 8] On average, this is equal to approximately 5% of the refined petroleum products consumed in the region in 2011.

- **Scenario 2: High Market Penetration (15%)** – This scenario assumes an amount of tar-sands-derived fuel that is equivalent to 15% of the refined petroleum products consumed in the region in 2011.[9]

For the purposes of this analysis ENE uses historic consumption patterns to determine the portion of the tar-sands-derived fuels that would be allocated to the heating or transportation sectors.[10] The breakdown is roughly 20% to heating and 80% to transportation. Alternative energy options were identified that could offset the need for heating fuels (distillate, residual fuel, kerosene, and propane) and transportation fuels (gasoline and diesel). (See Table 1, below). For heating, ENE calculated the number of oil-heated homes and commercial/institutional buildings that would need to be either retrofit to be more energy efficient (weatherized) or switched to advanced technologies and alternative sources of energy (fuel switched) to displace either 5% (Scenario 1) or 15% (Scenario 2) of the refined petroleum products consumed in the region.[11]

For the transportation sector, ENE calculated the number of Light Duty Vehicles (LDVs) and Heavy Duty Vehicles (HDVs) that would need to be switched to advanced technologies or alternative fuels using alternative sources of energy under each Scenario.[12] It is assumed that fuel switching in the transportation sector is phased in over a period of ten years to reflect the typical replacement of the existing fleet.[13]

---

[7] The capacity of PMPL is used as a proxy. ENE recognizes that the crude oil that could flow east through PMPL will enter the world oil market and the resulting refined petroleum products will not necessarily be sold and consumed in the Northeast and mid-Atlantic region.

[8] ENE's analysis was completed prior to the National Energy Board of Canada's approval of Line 9B, which effectively increases the potential flow of tar sands crude through the PMPL to 192,000 barrels per day.

[9] The Hart Energy report estimates that 14-18% of the Northeast's refined petroleum products could be derived from tar sands in 2020. ENE's high market penetration scenario is 15% of 2011 consumption levels; however, based on 2020 consumption levels the quantity of fuel analyzed in this scenario is closer to the projected upper range in the Hart report.

[10] Refined petroleum products used for industrial processes, aviation, power production and other purposes are allocated to the heating and transportation sectors proportionately.

[11] For the alternative heating options, ENE used a level of efficiency that would reduce oil consumption by 30% per treated home or building. It is assumed that air source heat pumps and wood would be a supplemental heat source that reduces heating oil consumption by 50% in the residential sector and a replacement heat source that reduces heating oil consumption by 100% in the commercial and institutional sector (supplemental heat source analysis is based on one home installing one air source heat pump or pellet or wood stove as opposed to a complete system conversion). Geothermal and natural gas systems would completely replace heating oil in both sectors.

[12] ENE utilized the Energy Information Administration's forecast for gasoline consumption for light duty vehicles (EIA Annual Energy Outlook 2013), which forecasts a decline in consumption due largely to the recently adopted corporate average fuel economy (CAFE) standards and a nationwide reduction in vehicle miles traveled. For new heavy duty vehicles ENE analyzed the impacts of the New Fuel Efficiency and GHG Emissions Program, which will take effect for model years 2016-2018 (the standards for model years 2014 and 2015 are voluntary and not included in this analysis). It is assumed that these standards will remain static after 2018.

[13] It is assumed that all of the energy efficiency improvements or fuel switching in the heating sector occurs in year 1 (i.e. 2013).

Table 1: Alternative Energy Options Assessed to Displace Refined Petroleum Products in the Heating and Transportation Sectors

Heating Sector	Transportation Sector	
Residential and Commercial/Institutional Buildings	**Light Duty Vehicles**	**Heavy Duty Vehicles**
Energy Efficiency (*weatherization & more efficient equipment*)	Electric Vehicles	Biodiesel
Electric Air Source Heat Pumps	Hydrogen	Natural Gas[14]
Electric Ground Source Heat Pumps	Natural gas	
Wood Pellets/Chips	E85 (*85% ethanol and 15% gasoline blend*)	
Natural Gas		

To assess the economic impacts the analysis compares the total cost of the alternative energy options across all homes and businesses or vehicles to cases where the region continues to rely on fossil fuels from 2013-2022. For the heating sector, costs include purchasing energy and amortized equipment and infrastructure (natural gas service lines and mains) expenditures. For the transportation sector, costs include purchasing fuel and incremental vehicle and infrastructure costs.

ENE also assessed the GHG emissions impact of the alternative energy options compared to increased reliance on tar-sands-derived products.[15] The emissions analysis includes GHG emissions associated with production, distribution, and consumption for all fuel and power sources.

Finally, ENE analyzed the impact that adoption of a Clean Fuel Standard (CFS) in the Northeast would have on demand for cleaner vehicles and fuels, both with and without increased import of tar-sands-derived gasoline and diesel.[16] The CFS adopts a life cycle approach to quantifying the carbon intensity of particular fuels, which includes emissions associated with both fuel production and consumption. The ENE analysis shows that the alternative technologies and fuels that can cost-effectively displace the tar-sands-derived transportation fuels in the Northeast would also allow the region to achieve the CFS targets. Additional information with respect to the study methodology is provided in a supplemental document.[17]

Key Results

The following highlights the key results of ENE's detailed analysis, which found that:

- **Increasing the region's reliance on tar-sands-derived fuels is unnecessary**. Alternative energy options exist in sufficient quantities to displace, over a ten-year period, at least 15% of the fossil fuels currently used for heating and transportation, an amount equivalent to all of the tar-sands-derived oil products projected to flow through or to the Northeast and mid-Atlantic states.

[14] It is assumed that natural gas is split 50/50 with compressed natural gas used for short haul vehicles and liquid natural gas for long haul vehicles.

[15] For wood pellets and chips a range of emissions estimates were used since biomass lifecycle emissions are highly dependent on the particular fuel source. The biomass emissions rates used are based on the Massachusetts Department of Energy Resources' *Renewable Energy Portfolio Standard – 225 CMR 14.00 – Guideline for the Calculation of Overall Efficiency and Lifecycle GHG Analysis*.

[16] The CFS analyzed by ENE is modeled after the standard that has been discussed and explored by the region's environmental regulators and analyzed by NESCAUM. It requires a 1% annual/10% over 10 years reduction in the carbon intensity of transport fuels.

[17] Potential Impacts of Tar-Sands-Derived Fuels or Alternatives on a Clean Fuel Standard, http://www.env-ne.org/resources/detail/tar-sands-and-cfs

- **Investments in cleaner energy alternatives that could displace reliance on tar-sands-derived fuels in the region would be less costly to consumers, industry, and the environment.** In most cases an increased investment in alternative energy options would cost less and result in lower GHG emissions than consuming conventional or tar-sands-derived refined petroleum products.

ENE's assessment spans a ten-year period in which buildings and equipment in the heating sector are weatherized or fuel switched in year 1, and vehicle fleets are incrementally transitioned away from fossil fuels to the alternative energy options over the study period.

In the following sections the cleaner alternatives are presented as standalone options. However, it should be noted that within both the heating and transportation sectors a combination of cleaner alternatives could be used to achieve the same result.

Heating Sector Results

Table 2 shows the number of homes and businesses that would need to be weatherized or fuel switched to an alternative technology or fuel to replace the amount of tar sands derived heating fuels considered under the two market penetration scenarios.[18]

Table 2: Number of Homes and Businesses Treated to Offset Tar-Sands-Derived Heating Fuel under Scenarios 1 and 2

		No. of Homes	No. of Businesses
Scenario 1 (5%)	Improved Energy Efficiency	1,388,259	112,917
	Electric Air Source Heat Pumps	832,955	33,875
	Electric Ground Source Heat Pumps	416,478	33,875
	Natural Gas	416,478	33,875
	Wood Pellets/Chips	832,955	33,875
Scenario 2 (15%)	Improved Energy Efficiency	3,483,372	285,653
	Electric Air Source Heat Pumps	2,090,023	85,696
	Electric Ground Source Heat Pumps	1,045,012	85,696
	Natural Gas	1,045,012	85,696
	Wood Pellets/Chips	2,090,023	85,696

Figure 2 shows the total Net Present Value (NPV) of the costs of each alternative analyzed. Costs include the upfront equipment and natural gas main expansion costs amortized over the measures' life, and fuel or electricity. For both Scenarios 1 and 2, the alternative heating options are lower cost than continued reliance on refined petroleum products. Under Scenario 1, switching to alternative heating options would save the region between $6 billion (ground source heat pump case) to $13 billion (improved energy efficiency case) compared to continued reliance on oil over the 10 year period. Under Scenario 2, the savings range from $16 to $32 billion.

From an individual household perspective, reduced reliance on heating oil also reduces home heating bills. The average annual heating oil bill in the Northeast is approximately $2,500. A home with

[18] As noted in Footnote 11, it is assumed that air source heat pumps and wood would be a supplemental heat source that reduces heating oil consumption by 50% in the residential sector and a replacement heat source that reduces heating oil by 100% in the commercial and institutional sector. This is why, in Scenario 1 and 2, the same number of businesses are fuel switching despite the alternative energy option, whereas there are twice as many homes required to switch to air source heat pumps and wood pellets/chips than those required to switch to ground source heat pumps and natural gas.

improved efficiency and/or a conversion to an alternative heat source would realize an annual bill that is approximately 20-50% lower, saving the average homeowner approximately $600 to $1,370 per year.

Figure 3 shows that the GHG emissions associated with the alternative heating options are, in almost every case, lower than those from the tar-sands-derived heating fuel case. The actual level of emissions from natural gas and biomass may vary substantially depending on the emissions associated with the production and consumption of those fuel types.

Figure 2: Fuel/Power, Equipment and Infrastructure Cost for Alternative Heating Options versus Heating Oil from 2013-2022 (2013$)

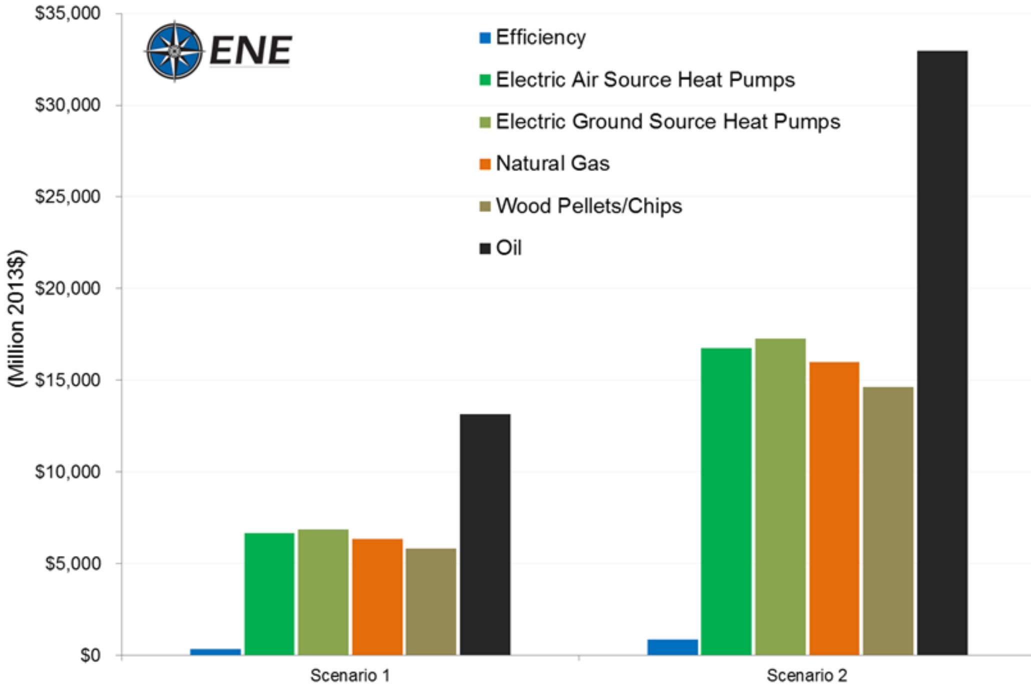
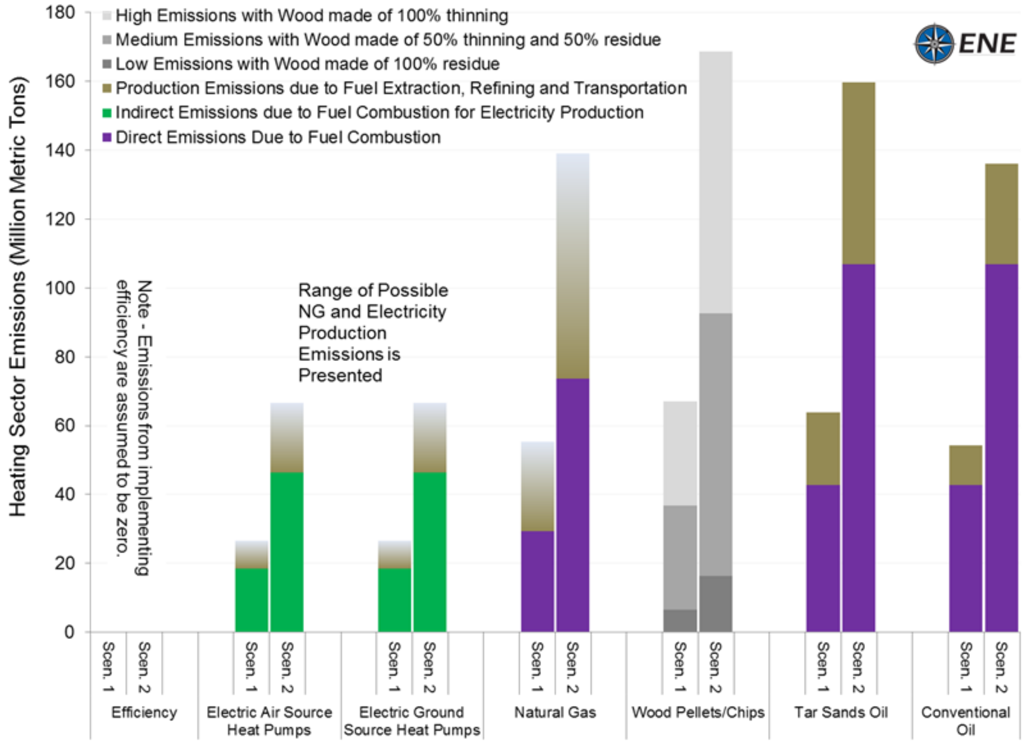


Figure 3: GHG Emissions for Alternative Heating Options versus Tar-Sands-Derived and Conventional Heating Oil (2013-2022)



Transportation Sector Results

The transportation sector analysis focuses on cleaner alternatives for LDVs and HDVs to offset the level of tar-sands-derived gasoline and diesel assumed under Scenarios 1 and 2. Table 3 shows the number of LDVs and HDVs that would need to be converted to displace the quantity of tar-sands-derived heating fuels considered under the two market penetration scenarios.[19]

Table 3: Number of LDVs and HDVs Converted to the Alternative Transportation Options to Offset the Level of tar-sands-derived Gasoline and Diesel under Scenarios 1 and 2

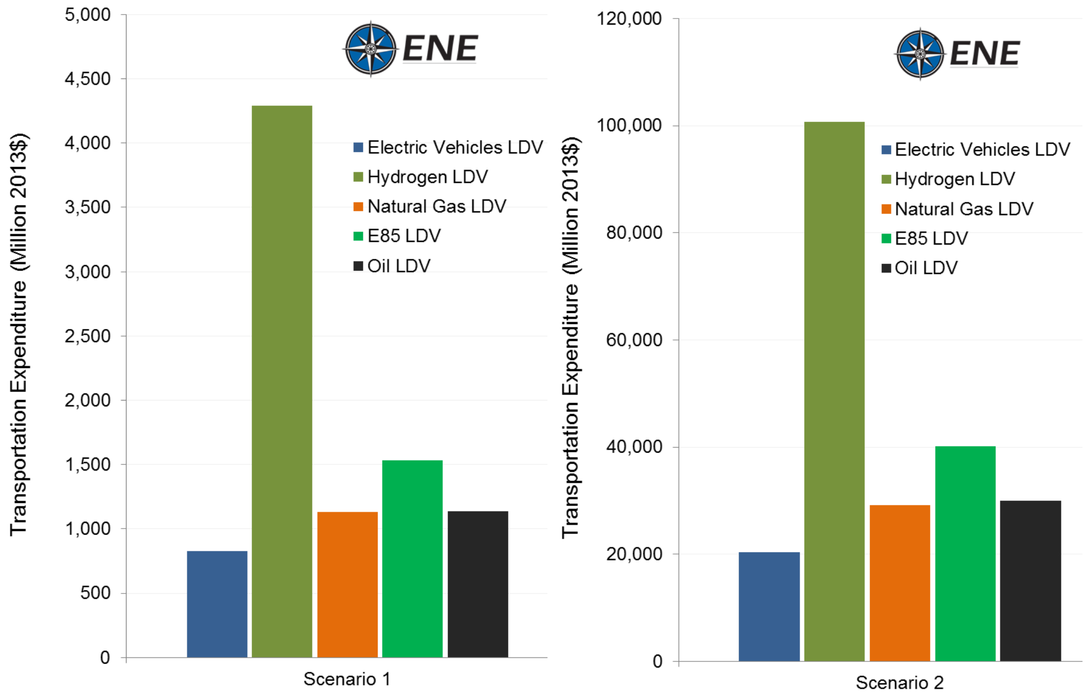
	Light Duty Vehicles	Heavy Duty Vehicles
Scenario 1 (5%)	202,556	55,300
Scenario 2 (15%)	2,495,202	136,730

As shown in Figures 4 and 5, the total cost of converting the LDVs and HDVs – including fuel and incremental vehicle and infrastructure costs – varies by technology. Converting LDVs to electric and natural gas vehicles generates savings whereas hydrogen and E85 cost more than gasoline and diesel.

[19] It is important to note again here that this analysis of alternative energy options in the transportation sector uses the Energy Information Agency's forecast of LDV gasoline consumption, which assumes a decline in consumption due to the recently adopted CAFE standards, a reduction in vehicle miles traveled, and other factors (i.e. this reduction in demand is incorporated into the analysis but not as a result of ENE's alternative transportation options for LDVs). Diesel consumption is also projected to decline due to the New Fuel Efficiency and GHG Emissions Program for HDVs, which will significantly reduce the amount of oil products needed.

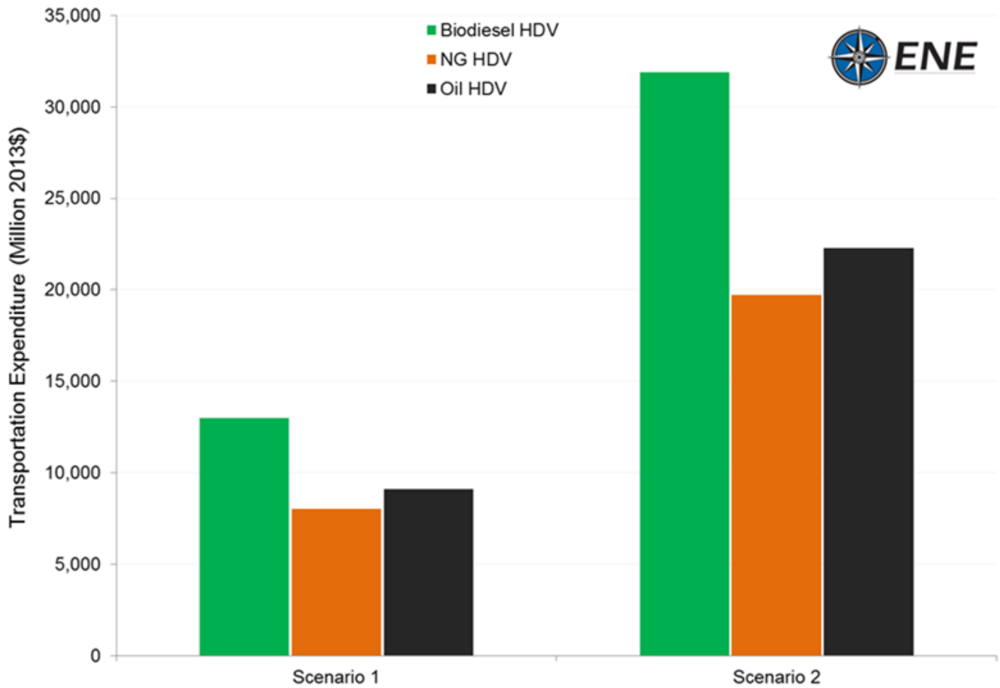
Converting HDVs from diesel to natural gas would produce savings whereas switching to biodiesel would be more costly.[20]

Figure 4: Light Duty Vehicle Fuel/Power and Incremental Vehicle and Infrastructure Costs for Alternative Transportation Options versus Oil Products from 2013-2022 (2013$)



[20] These fuels were analyzed for HDVs because they are the most widely available.

Figure 5: Heavy Duty Vehicle Fuel and Incremental Vehicle and Infrastructure Costs for Alternative Transportation Options versus Oil Products from 2013-2022 (2013$)



Electric vehicles and cleaner fuels emit fewer GHG emissions than gasoline and diesel derived from conventional and tar sands oil. As shown in Figures 6 and 7, replacing LDVs and HDVs fueled by gasoline and diesel with cleaner transportation options would in almost every case result in lower total GHGs emission from 2013-2022.[21]

[21] The emissions from natural gas will vary considerably based on the production emissions associated with the natural gas. For electric vehicles the emissions factor used for electricity is that of a natural gas combined cycle power plant. Only average emissions are presented for hydrogen vehicles. E85 production emissions are from the California Air Resource Board carbon intensity factors. They include fuel processing and transportation emissions, indirect emissions due to land-use change and emissions reductions due to sequestration.

Figure 6: GHG Emissions for Alternative Transportation Options (LDVs) versus Tar-Sands-Derived and Conventional Oil Products (2013-2022)

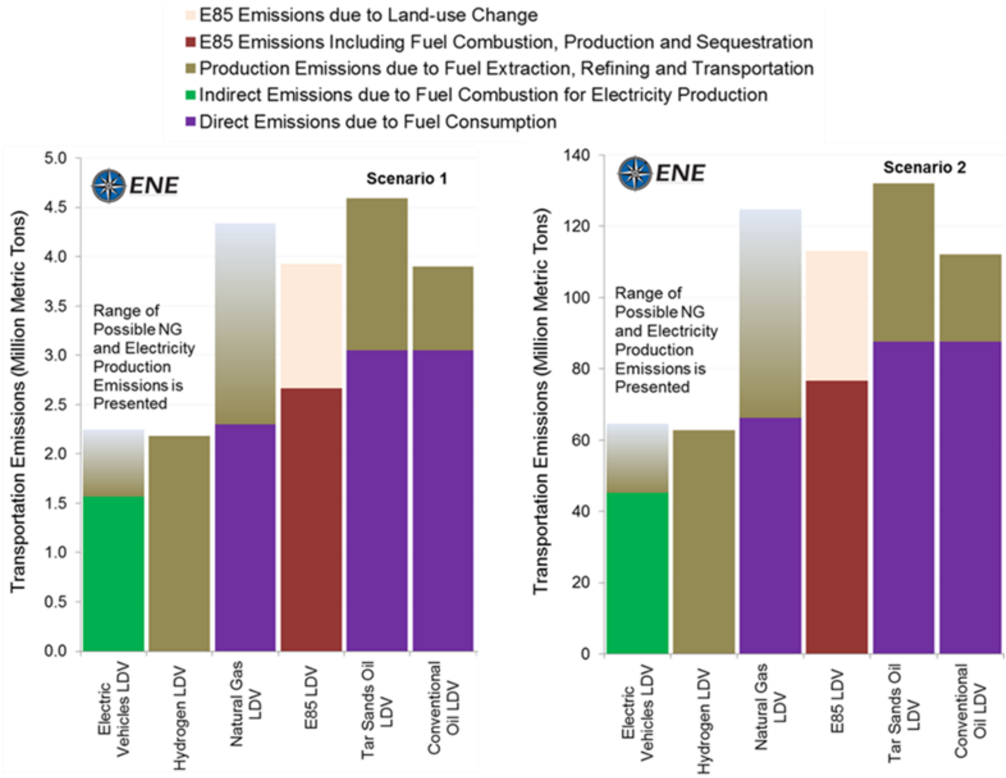
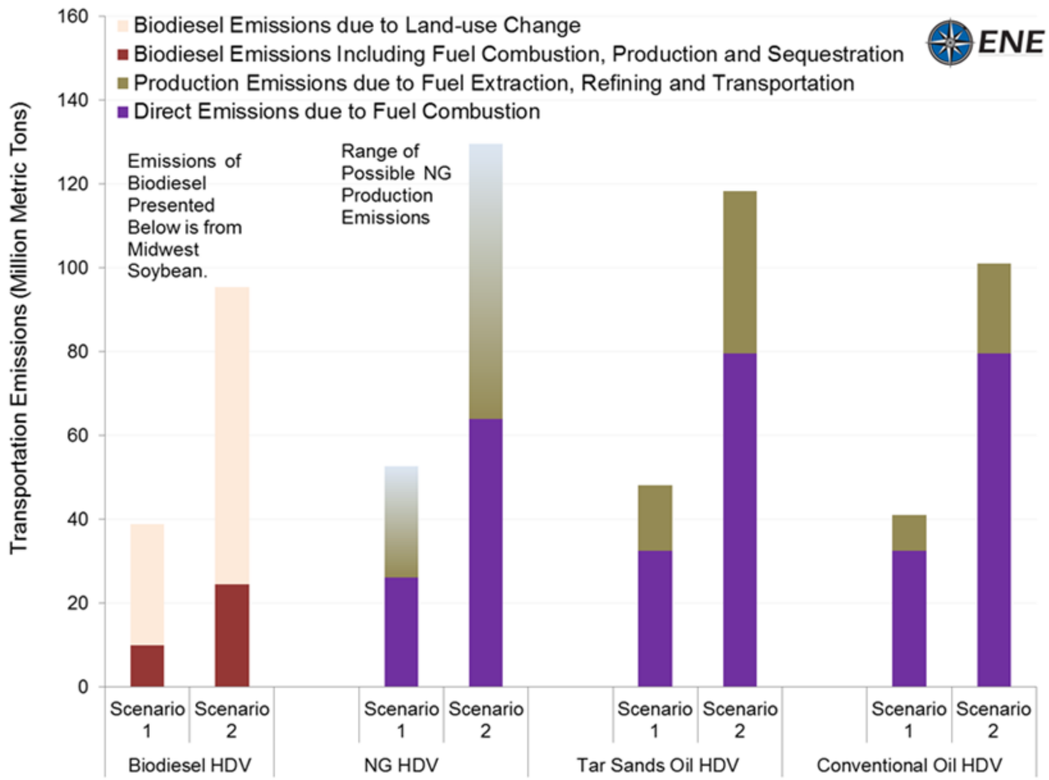


Figure 7: GHG Emissions for Alternative Transportation Options (HDVs) versus Tar-Sands-Derived and Conventional Oil Products (2013-2022)



Conclusions

ENE's detailed analysis shows that the Northeast and mid-Atlantic region could offset all of the tar-sands-derived refined petroleum products that could flow through the region via the PMPL pipeline or into the region through other routes with cleaner, lower cost alternatives.

These cleaner energy alternatives include building and equipment efficiency, advanced heating and vehicle technologies, and switching to cleaner heating and transportation fuels. Most importantly for consumers, businesses, and the environment, most of these alternative energy options are lower cost and generate fewer GHG emissions.

In the heating sector, the alternative heating options cost less than continuing to rely on imported distillate fuel oil, residual fuel oil, kerosene, and propane; saving consumers $6 to $13 billion (Scenario 1) or $16 to $32 billion (Scenario 2) from 2013-2022, and reducing heating bills by 20-50%, depending on the market penetration scenario and heating alternative deployed. The cleaner heating alternatives also generate up to 160 million metric tons less GHG emissions than heating fuels derived from tar sands over the study period (Scenario 2).

In the transportation sector, electric vehicles are the least-cost alternative transportation option for LDVs when compared to gasoline and diesel; saving drivers $310 million (Scenario 1) or $10 billion (Scenario 2) from 2013-2022. For HDVs switching to natural gas reduces costs by approximately $1 billion (Scenario 1) or $3 billion (Scenario 2) over the same period of time compared to conventional diesel while switching to biodiesel increases costs. While some of the alternative transportation options generate significantly less GHGs (e.g., electric vehicles), for others the actual net impact will depend on the lifecycle emissions of the fuels.