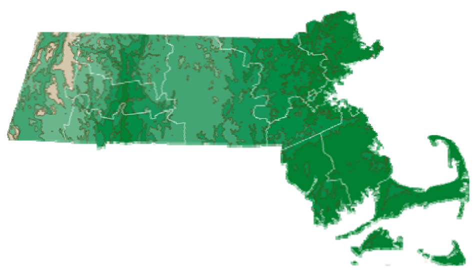
A Proposed Strategy To Promote Biofuels Production and Use in Massachusetts

An Overview of the Petroleum Fuels Market, And Policies To Reduce Foreign Oil Dependence and Spur Economic Growth in the Clean Energy Sector



Prepared For U.S. Congressman Bill Delahunt (MA, 10th District)

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Prepared by:

Northeast Biofuels Collaborative

An Affiliate of the New Fuels Alliance

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About the Northeast Biofuels Collaborative

The Northeast Biofuels Collaborative and its parent group, the New Fuels Alliance, are dedicated to advancing a renewable fuels agenda at the state and federal level. NEBC is one of two regional affiliates of the New Fuels Alliance – the other being the California Renewable Fuels Partnership (www.calrenewablefuels.org) – formed for purpose of educating policymakers about the economic and environmental benefits of producing and using biofuels and advancing policies to achieve results. The initiative was formed in collaboration with the Renewable Energy Action Project (REAP), a national coalition of organizations promoting renewable energy use, and will draw from its expertise and programmatic achievements (see www.ReapCoalition.org).

As the leading economic engine in New England, Massachusetts has a unique opportunity to advance the emerging northeast clean energy sector. To do so, the Commonwealth must make a public policy commitment to diversifying power and fuel markets with non-petroleum energy sources.

Biofuels (renewable fuel sources derived from agricultural and organic materials) are an increasingly important piece of the puzzle with regard to addressing national and state-level dependence on petroleum. Several Massachusetts-based companies are national leaders in the field of producing next generation biofuels, and there is no alternative fuel more ready to have an immediate impact on fuel diversification with minimal infrastructural change.

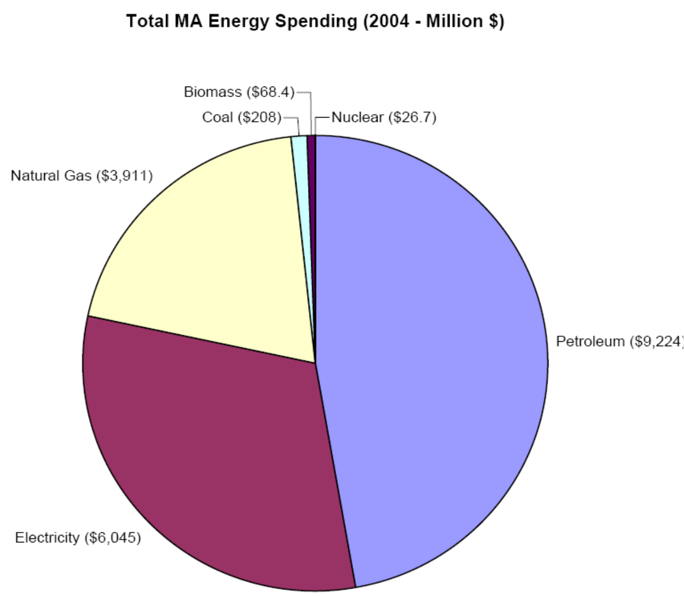
This report examines the petroleum fuels industry in Massachusetts, and makes specific recommendations for establishing a healthy biofuels industry and market in the Commonwealth.

Massachusetts Energy Profile

Massachusetts' residents pay the third highest energy prices in the country, behind only Hawaii and Washington, DC.[1] Petroleum fuels (including heating oil) are the largest single source of energy expenditures in the state, accounting for roughly half of total annual residential and commercial energy spending.

Figure 1 shows total energy expenditures for the Commonwealth in 2004. As shown, Massachusetts' residents and industries spent more than $9.2 billion on petroleum fuels in 2004, almost as much as natural gas and electricity combined.

Figure 1



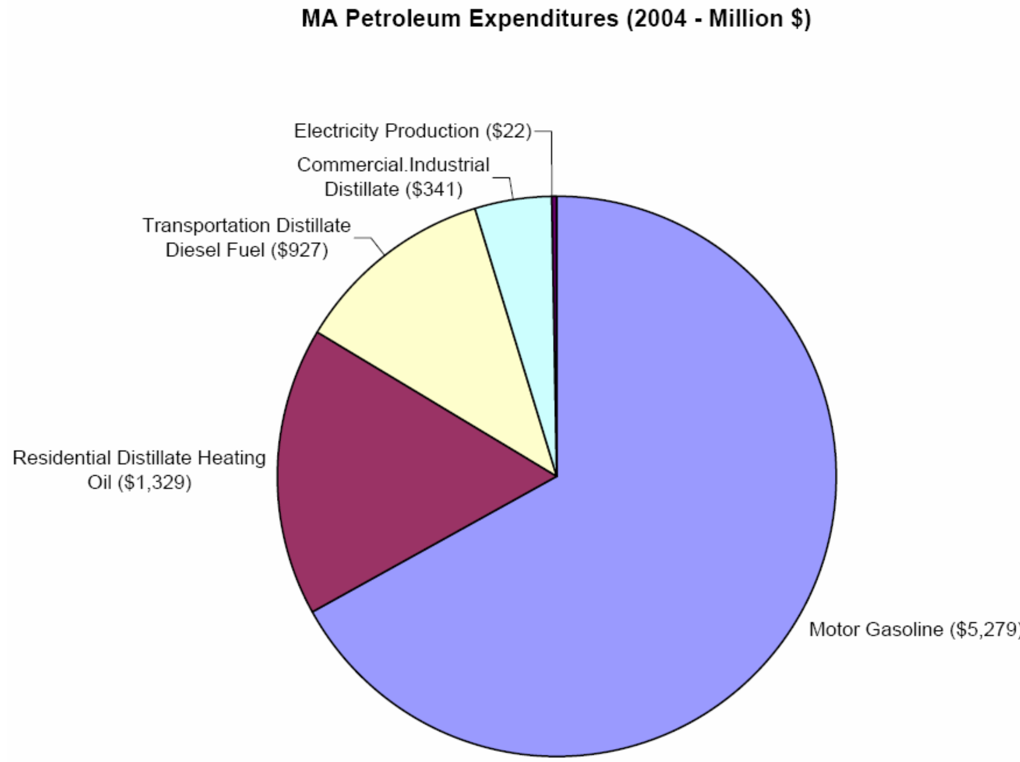
Source: DOE

Massachusetts Petroleum Dependence

Massachusetts is overwhelmingly dependent on petroleum (gasoline, diesel fuel, heating oil, etc.) to meet its demand for liquid fuels. Figure 2 breaks down the Massachusetts petroleum fuels market by sector-based expenditures.

Gasoline sales are by far the leading categorical expense, accounting for more than half of the petroleum fuels market (58%), with heating oil (14%) and transportation sector diesel fuel (10%) rounding out the state fuel energy market.[2] In addition to robust gasoline demand, the northeast region is the largest heating oil market in the United States, consuming roughly 4 billion gallons per year (bgy) of the product. Massachusetts consumes more heating oil (~ 1.1 bgy) than any other New England state, and is home to the third largest heating oil market in the country.[3]

Figure 2



Source: DOE

Massachusetts also consumes the bulk of the gasoline delivered to New England markets. The Commonwealth is home to roughly 5.4 million registered motor vehicles refueling at 2,700 fueling stations, which sell about 2.8 billion gallons of gasoline per year. [4] In 2004, Massachusetts consumed roughly 47 percent of all transportation fuels delivered to the six New England states.

Fuel-grade ethanol is the only non-petroleum fuel source with a significant market share in the northeast region. All grades of gasoline currently sold in Massachusetts are known as “E10” because they contain 10 percent corn-ethanol and 90 percent petroleum. Ethanol use in Massachusetts is a dynamic of federal law and regulatory forces. Since the Greater Boston airshed is out of compliance with federal Clean Air Act (CAA) air quality standards, gasoline sold in the area must be reformulated gasoline (RFG). Until 2006, the RFG program required minimum oxygen content to improve combustion efficiency. Ethanol became the “oxygenate” of choice after MTBE emerged as a drinking water contaminant. Now, refiners are free to blend RFG without ethanol, as long as national ethanol blending targets are met.

Because Boston is the largest fuel market in the state, oil suppliers distribute RFG statewide rather than segregating rural fuel markets that are in compliance with the CAA (and are therefore permitted to use conventional gasoline). Connecticut and Rhode Island use RFG gasoline statewide for the same reasons. Vermont, New Hampshire and Maine use conventional gasoline blends.[5] While there are economic and regulatory reasons to keep blending ethanol in Massachusetts today, blenders are no longer required to use ethanol.

Figure 3

2004 New England Gasoline Sales (Billion gallons per year; DOE)				
PADD 1 State	**CG**	**RFG**	**Total Gasoline**	**Estimated Ethanol Use**
Connecticut	0.00	1.58	1.58	.158
Maine	0.74	0.00	0.74	0.00
Massachusetts	**0.00**	**2.82**	**2.82**	**.282**
New Hampshire	0.18	0.5	0.69	.050
Rhode Island	0.00	.48	0.48	.048
Vermont	.32	0.00	0.32	0.00
TOTAL	**1.25**	**5.38**	**6.63**	**0.538**
Percent Sales	**19%**	**81%**	**100%**	**10% of RFG Market**

Figure 3 provides a regional perspective on gasoline sales, by volume and type of gasoline used. Because ethanol is part of the RFG blend, and is not counted individually, ethanol use is estimated based on its volumetric share of the RFG market.

Distillate (diesel fuel) is the second largest petroleum market in Massachusetts. Distillate markets are sometimes confusing, as highway/off-highway diesel and heating oil are both distillate fuels, and are often lumped together statistically. But from a consumer perspective, they are completely different fuel products.

Heating oil competes with natural gas for residential and commercial heating markets. The northeast region's 4-bgy heating oil market represents roughly 69 percent of the U.S. heating oil sales. Massachusetts consumes roughly one-quarter of this market. In 2004, Commonwealth residents burned approximately 812 million gallons of heating oil in their homes and apartments, while the commercial and industrial sectors used roughly 263 million gallons of heating oil.[6] As shown in Figure 2, residential and commercial sectors spent roughly $1.7 billion on heating oil in 2004.

The on- and off-highway diesel fuel market has a different profile. The national on-road diesel fuel market is completing a transition from low sulfur diesel (LSD) to ultra low sulfur diesel (ULSD) for the October 15, 2006 retail ULSD compliance deadline. ULSD must have sulfur ratings of 15 ppm or less. The 2006 ULSD rules apply to on-highway diesel fuel retailers only.

The off-highway diesel market will be required to reduce sulfur levels over the next two years. Off-highway diesel suppliers must shift from traditional off-highway diesel (> 500 ppm sulfur) to low sulfur diesel (< 500 ppm sulfur) by 2007, and to ULSD (< 15 ppm sulfur) by 2010. Locomotives and marine engine suppliers are allowed an additional 2 years (2012) to comply with the ULSD requirement.

In general, the northeast region consumes roughly four to five times less transportation sector diesel fuel than gasoline. This is also true in Massachusetts.

Figure 4 provides volumetric transportation diesel fuel sales for New England states. Massachusetts (476 million gallons per year) is by far the largest transportation sector diesel fuel market in New England, accounting for 39 percent of total regional on- and off-highway diesel use.

Figure 4

New England Transportation Sector Diesel Fuel Sales Profile*
(2004 Figures; Thousands of gallons)

State	Highway	Off-Highway	Total Diesel
CT	284, 212	14,206	298,418
ME	174,373	22,050	196,423
MA	**424,503**	**51,898**	**476,401**
NH	111,503	13,870	125,373
RI	57,962	2,369	60,331
VT	61,874	6,746	68,620
TOTAL	1,114,427	111,139	1,225,566

Massachusetts Petroleum Sources, Distribution & Storage

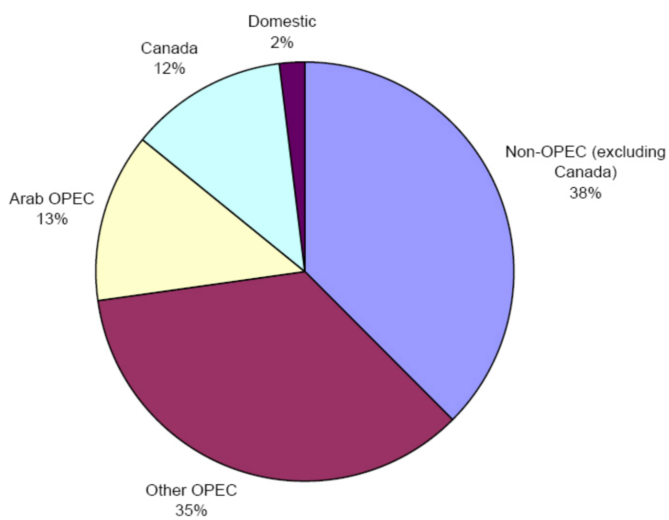
Massachusetts does not have crude oil resources, and is geographically isolated from oil refineries and the national petroleum pipeline system. As a result, petroleum consumed in Massachusetts must be secured and refined elsewhere, and transported to the state as "finished product" (i.e. as refined gasoline or diesel).

MASSACHUSETTS FUEL SOURCES & DISTRIBUTION IN GENERAL TERMS

Given the small size of northeast states and the regional (rather than state-based) petroleum distribution network, it is difficult to track refinery receipts to ascertain exact Massachusetts foreign crude oil dependence figures. However, foreign oil dependence can be estimated with some level of certainty on a regional basis. Figure 5 provides a summary of northeast crude oil sources, based on 2004 refinery receipts.

Figure 5

Northeast Crude Oil Sources (2004)



Source: Downstream Alternatives & EIA

As shown, a very small percentage (~ 2 percent) of the crude oil destined for northeast fuel markets is sourced domestically. On the other hand, almost 50 percent of the crude oil used to produce northeast petroleum fuel comes from OPEC nations (e.g. Persian Gulf countries, Venezuela, Nigeria). Non-OPEC countries (e.g. Mexico, Canada, Russia) account for most of the remaining crude oil imports to refineries serving the northeast region.

Crude oil imports destined for northeast fuel markets are refined into ”finished product” in four primary regions: eastern Canada, the U.S. Virgin Islands, the Mid-Atlantic region (DE, NJ, PA) and the Gulf Coast. As a general rule, states in Northern New England receive a greater percentage of their petroleum fuels from Canada (even if much of the crude feedstock is foreign) than Southern New England states, due to the higher transportation costs from southern sources and navigational hazards.

A vast majority of the petroleum refined in these four regions and destined for Massachusetts markets arrives into the Port of Boston by ocean vessel.[7] Vessels arriving in Boston Harbor are of either domestic or foreign receipt. The domestic vessels usually come from one of two places: (1) New York Harbor, which serves as a primary deep-water petroleum hub for the northeast region; or, (2) “Mid-Atlantic refineries” in New Jersey, Delaware and Pennsylvania. New York Harbor receives petroleum product from the Gulf Coast via the Colonial Pipeline, which originates in Texas and terminates in New Jersey, as well as oil tankers from foreign sources, such as the Virgin Islands and Venezuela. New York Harbor relays ocean and pipeline fuel deliveries to the Port of Boston on smaller vessels more suitable for local navigation. Mid-Atlantic refineries often ship directly to the Port of Boston. As such, a “domestic receipt” does not necessarily mean domestic source, as most of the petroleum passing through New York Harbor or refined in PADD1 refineries is of foreign origin.

However, not all Massachusetts fuel arrives via the Port of Boston. A small percentage is delivered by regional pipeline, rail or tanker truck from neighboring states. Two regional pipelines – the 12-inch diameter Buckeye and the 6-inch diameter Exxon Mobil pipeline – serve Commonwealth petroleum markets.[8] However, neither the Buckeye nor the Exxon pipeline is connected to larger regional or national pipeline system. Rather, they originate in the port communities of New Haven (CT) and Providence (RI), respectively. As such, products delivered to Massachusetts via pipeline have traveled by water as well. Both the Exxon and Buckeye pipelines are considered small capacity, and terminate in Springfield, MA.

Tanker trucks and rail play a limited role in the Massachusetts fuel import market. For example, tanker trucks from the Port of Albany (NY) deliver fuel to smaller fuel markets in Western Massachusetts.[9] Some truck and rail deliveries are made from neighboring states. However, tanker trucks play a primary role for intra state delivery from bulk fuel terminals to retail stations. Ports in Fall River, New Bedford and Salem Harbor also receive petroleum imports.

A Closer Look at the Massachusetts Fuel Market

The fuel distribution market in Massachusetts changes from year to year, and is not always easy to track. For example, because the Buckeye and Exxon pipelines also service markets outside of Massachusetts (i.e. pipelines are open systems capable of supplying various terminals along the length of the line), it is difficult to obtain figures for exactly how much petroleum ultimately reaches the end of the line in Springfield, MA. Similarly, the Port of Boston does not just serve Massachusetts fuel markets, so it cannot be assumed that all Port of Boston fuel receipts end up in state markets. However, the following estimates provide guidance.

Roughly 7.3 billion gallons of petroleum products moved through the Port of Boston in 2006.[10] With Massachusetts consuming in the vicinity of 4.5 billion gallons of petroleum per year, the Port of Boston serves as an oil distribution hub for other markets.

In 2005, Boston received distillate (heating oil and diesel fuel) and RFG gasoline from three primary sources: Canada ~ 63 percent; U.S. Virgin Islands ~ 19 percent; and Venezuela ~ 9 percent.[11] However, this does not mean that the petroleum product was shipped directly to Boston from these regions. Up to 46 percent of recent imports entering Boston Harbor were initially delivered to the northeast region via the Colonial Pipeline.[12] In addition, the refineries in the countries/territories of origin receive and process crude oil from a variety of foreign sources, including the Middle East and Africa. So gasoline from the U.S. Virgin Islands is largely foreign oil.

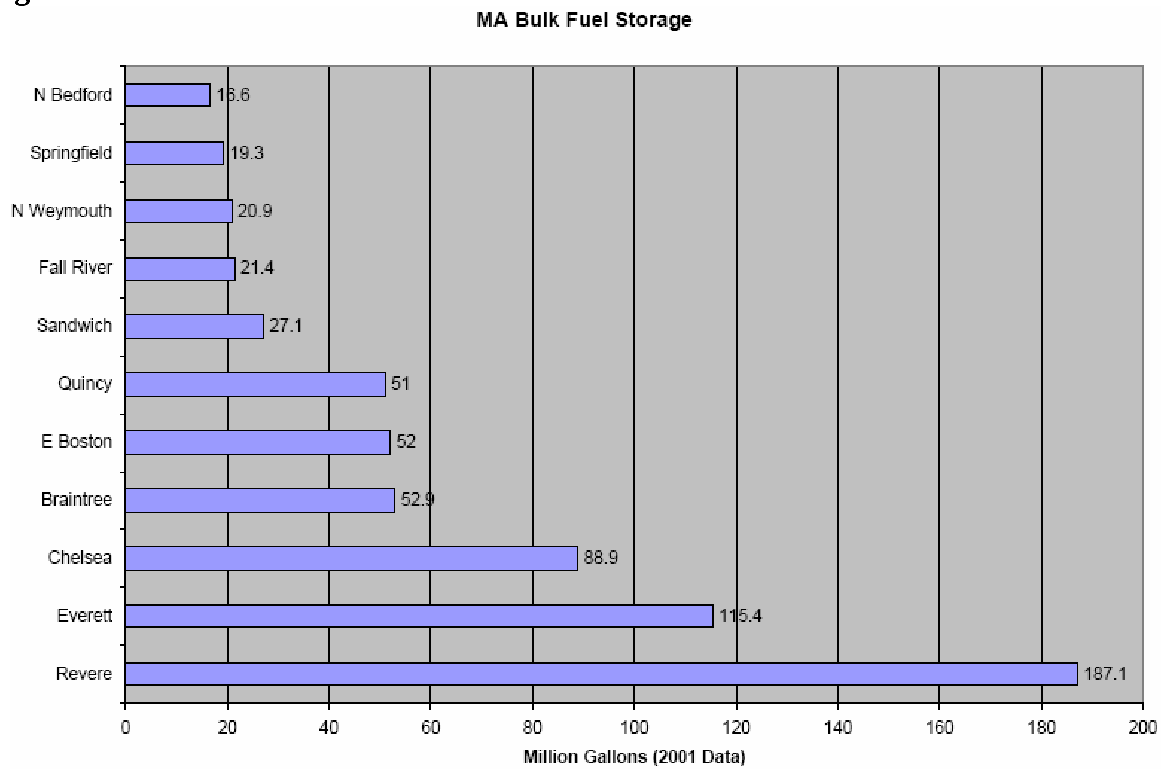
The Port of Boston is not the only water-based New England distribution point for petroleum fuels, but it is by far the most prominent. In 2005, the Port of Boston received 96 percent of the state's waterborne petroleum deliveries.[13] Ports accounting for the balance include Fall River, New Bedford and Salem Harbor.

Once the fuel product arrives in Massachusetts, it must be offloaded and stored for distribution to retail markets. Currently, there are 24 petroleum product terminals in Massachusetts that are registered with the Internal Revenue Service.[14] Some terminals handle only a particular fuel (e.g. heating oil or RFG gasoline). The largest Massachusetts facilities are located in and around the Port of Boston. For example, Irving Oil Terminals, Inc. maintains a 25-acre facility in Revere consisting of eleven aboveground bulk product storage tanks. These tanks have a total gross storage capacity of approximately 32 million gallons. Ten of the tanks are used to store petroleum products and the remaining tank contains ethanol.[15] Revere is home to roughly 30 percent of the fuel storage volume in the Commonwealth.

In all, Massachusetts has about 300 above ground bulk storage tanks with a holding capacity of roughly 650 million gallons of petroleum[16]. This is the equivalent of roughly 54 days of petroleum supply, assuming that Massachusetts consumes approximately 12 million gallons of gasoline, diesel fuel and heating oil per day. However, because the Port of Boston stores fuel for out-of-state markets as well, the number of "fuel days" in storage is much less than 54 days.

On a volumetric basis, the vast majority of the Commonwealth's bulk fuel storage capacity (96%) is located near waterborne terminals. Figure 6 shows Massachusetts's storage capacity by region, as of 2001. While the fuels market has changed since 2001, especially with regard to increased ethanol use in gasoline, Figure 6 nonetheless provides a general framework for understanding where bulk fuel terminals are located. As shown, Springfield is the only non-waterborne terminal area with significant bulk fuel inventory.

Figure 6



Source: ICF Consulting, RFR-2002-ENE-002

The Consumer Costs of a Business-As-Usual Approach

PUMP PRICE SPIKES

Product inventory (or bulk storage capacity) is critical to maintaining price stability in the petroleum fuels market, especially in the event of refinery outages, large storms, or other distribution problems.[17] Put another way, the only way to curb pump price spikes in the immediate aftermath of a supply disruption is by drawing down product inventories at terminals or refineries.[18]

Yet, the oil industry has systematically scaled down bulk storage of finished gasoline products over the last two decades. For example, the oil industry maintained roughly 60 million barrels of petroleum bulk storage on the east coast in the early 1980s. As of 2005, east coast bulk storage was down to ~ 40 million barrels; a 33 percent reduction in gasoline stocks despite sharply increasing pump prices and the growing market for petroleum fuels.[19]

While some of this trend can be explained by changes in crude oil distribution and supply, the consolidation of the oil industry and its preference for tight supplies is well documented.[20] A 2004 GAO report found that in addition to rapid consolidation among branded oil companies, these companies have also acquired large numbers of independent refineries, "ensuring that [branded companies] produce only enough gasoline to meet their current branded needs."[21] In essence, the branded oil companies have taken significant volumes of unbranded, excess supply off the market, both in the form of bulk storage of branded fuel and unbranded supply. This inventory strategy saves the oil industry money because there is less idle product in the market, but increases the likelyhood of market instability and pump price spikes because there is less room for error in the system.

Such an event occurred in August 2005 as a result of Hurricane Katrina. In the days that followed the August 29 hurricane, pump prices increased in all regions of the country between an average of 10 to 24 percent, with much higher spikes in certain sub-regions. The east coast region experienced the highest pump price spikes of any region in the country (see Figure 7).

Figure 7

Hurricane Katrina Impact Percentage Increase in Retail Prices by Region (Regular Grade Gasoline)

Region	Aug 29 to Sept 5
East Coast	**22.9**
Midwest	16.5
Gulf Coast	14.8
Mountain	15.0
West Coast	10.2
United States	18.0

Source: Federal Trade Commission (2006)

The northeast region's dependence on Gulf Coast gasoline clearly contributed to the relative increase in gasoline prices. However, a 2006 FTC report also acknowledged that Katrina touched off a series of fuel distribution problems, including increased tanker rates in response to higher U.S. demand for foreign gasoline, and insufficient trucks and drivers to replace pipeline volumes.[22] As a result, regions without local refining capacity (i.e. those regions like the northeast that rely heavily on fuel deliveries because they have no refinery inventory) paid for both higher fuel costs and higher transportation costs.

The issue of shrinking fuel inventories has begun to attract the attention of northeast state officials. On May 16, 2007, Connecticut Attorney General Richard Blumenthal called for an investigation into oil company manipulations of petroleum markets. Attorney General Blumenthal specifically called for an increase in minimum oil product inventory levels, stating, "Big Oil has created a market on the brink, manipulating inventories and refinery capacity to the point that the slightest supply disruption sends prices -- and company profits - skyrocketing."[23]

THE MASSACHUSETTS "PETROLEUM DEFICIT"

Even without major fuel supply disruptions, petroleum dependence comes at a steep price to consumers and state economies. This is the case because a very large percentage of each consumer dollar spent on energy flows out of most U.S. states, especially those with limited in-state energy production capacity such as Massachusetts.

While there is limited information available on energy consumer dollar flow, it is estimated that only 15 cents of every dollar spent on petroleum is reinvested in local, or state, economies (excluding state and federal taxes).[24] Stated differently, about 80-85 cents of every dollar spent on petroleum ends up out of state, and often in the hands of unstable foreign regimes.

Massachusetts has not conducted a petroleum-consumer dollar flow analysis in

National Security

"On the eve of 9/11, the need to reduce radically our reliance on oil was not clear to many and, in any case, the path of doing so seemed a long and difficult one. Today, both assumptions are being undermined by the risks of the post-9/11 world, by oil prices, and by technological progress in fuel efficiency and alternative fuels."

- R. James Woolsey (former CIA Director) to the U.S. Senate, Nov. 16, 2005.

The primary objective of this report is to illustrate the potential for a more sustainable fuel-energy sector in Massachusetts. However, the national security risks of petroleum dependence are real. A crisis simulation developed by Securing America's Future Energy (SAFE) showed that a roughly 4 percent global shortfall in daily oil supply resulted in a 177 percent increase in the price of oil (from $58 to $161 per barrel).

Then there is the "real cost" of a gallon of petroleum fuel, after taking into account the full spectrum of government expenditures on oil security, as well as the public health and environmental degradation that occurs as a result of petroleum dependence. Even before recent spikes in the price of gasoline and conflicts in the Middle East, it was estimated that the real cost of a gallon of gasoline is between $6-15 per gallon (International Center for Technology Assessment).

The consumer costs of reducing our dependence on petroleum fuels – i.e., of enacting policies that promote non-petroleum fuels – are often raised as a basis for opposition to change. In the face of this challenge, proponents of alternative fuels (including policymakers) must be more willing to stand up and share with the public the risks and costs of doing nothing.

recent years. But without oil resources or petroleum refining capacity, it is reasonable to conclude that Massachusetts also exports most of every dollar spent on petroleum. A recent study in Arizona provides general support for this position. Arizona, which also has little petroleum production or refining capacity, found that only 21 cents of every dollar spent on petroleum fuel recirculates through the local economy.[25] Since the date of the 2000 Arizona study, pump prices and industry profits have soared, creating (likely) higher rates of petroleum dollar exportation to foreign stockholders.

The 15-20 cent (or 80-85 percent loss) per dollar reinvestment rate for petroleum contrasts sharply with other forms of consumer spending. This rate was the worst in the Arizona energy analysis, which reported 50 percent reinvestment rates for both electricity and natural gas. While 50 percent reinvestment for electricity and natural gas seems like an overestimate, and likely does not occur in the northeast region, the general conclusion of the report is that Arizona's dependence on petroleum fuels represents an "enormous"[26] lost economic opportunity.

From these and other factors, it is possible to provide a rough estimate of the Massachusetts "petroleum deficit." Figure 8 provides annual petroleum expenditures in New England and the "adjusted annual petroleum dollar loss," assuming a 20 percent consumer dollar recirculation. The table also provides an estimate of the "state job deficit pool" created by petroleum dollar loss, based on DOE estimates that every $1 billion in trade deficit results in about 27,000 job losses.

The calculations shown are crude in nature. Pinpointing actual job exportation figures

Figure 8

Northeast Motor Fuel Receipts & Associated State Job Deficit Pool (Receipts in Million Nominal Dollars; Job Figures are Nominal)							
PADD 1 State	Gasoline	Trans Sector Diesel Fuel	Residential Distillate (Heating Oil)	Comm. & Industrial Distillate Use	Total Fuel Receipts	Adjusted Petroleum Dollar Loss*	*State Job Deficit Pool*
Connecticut	3,367	568	1,150	265	5,350	4,280	*115,600*
Maine	1,306	372	658	274	2,610	2,088	*56,400*
MA	**5,199**	**927**	**1,329**	**342**	**7,797**	**6,238**	***168,400***
New Hampshire	1,269	222	336	144	1,971	1,577	*42,700*
Rhode Island	717	124	264	66	1,171	937	*25,300*
Vermont	625	124	181	96	1,026	821	*22,200*
TOTAL	$12,483	$2,337	$1,187	$1,187	$19,925	$15,941	*430,600*

Please note that the job deficit figures are intended to be illustrative only, as actual annual job loss depends on a wider set of inputs than utilized here.
** Adjusted petroleum dollar loss assumes 20 percent consumer dollar recirculation rate.*

related to petroleum dependence requires more inputs than shown. However, the table does illustrate the magnitude of consumer spending on petroleum fuels, as well as a theoretical number of "fuel jobs" that could be at least partially retained via the regional production and use of alternative fuels.

Biofuels: An Overview

Massachusetts cannot become a petroleum fuel producer. But it can reduce its dependence on petroleum with increased production and use of biofuels.

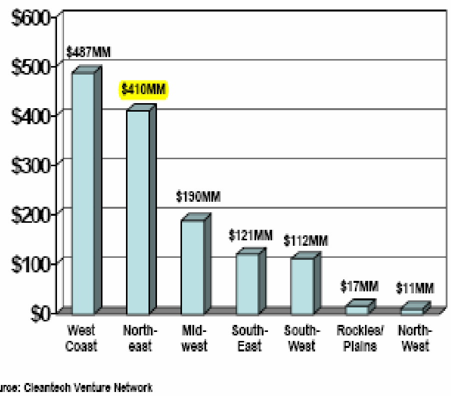
Biofuels have several key attributes as an alternative energy source: (1) biofuels have high market penetration potential due to their relative compatibility with existing fuel infrastructure and vehicles; (2) biofuels bring immediate economic return, primarily in the form of increased jobs and local tax revenue; (3) biofuels reduce smog-forming and cancer-causing emissions, and (4) biofuels are available now, proving to be highly responsive to state and federal policy commitments over the last several years.

On this last point, the northeast fuels market offers a prime example. Ethanol rose to the challenge of completely replacing the gasoline additive and drinking water contaminant MTBE, which accounted for 11 percent of every gallon of gasoline in Massachusetts as recently as 2003. The northeast region now utilizes 1.3 billion gallons per year of ethanol, with Massachusetts accounting for roughly 20 percent of this ethanol market. No other non-petroleum energy source has achieved such rapid market penetration.

The Economics

The northeast region, and especially Massachusetts, is a national and international leader in intellectual and venture capital. The region is second only to the west coast in attracting clean-tech investment capital (see Figure 9 for 2005 dollar comparison).

Figure 9



The biofuels sector has emerged as an important new clean-tech industry. Private equity and venture capital investments in biofuels increased more than fourfold in the United States in just the last two years, from an estimated $650 million in 2005 to $2.8 billion in 2006.[27] However, biofuel is also a highly competitive capital investment market, with several regions vying for market leadership, including California.

Clearly, there are two ways to participate in the emerging biofuels energy-tech industry: at a purely technological (R&D) level, or by producing biofuels as well. Several Massachusetts-based companies are among the leaders in the R&D effort to bring cellulosic (or "next generation") biofuel to market, including BioEnergy International, Verenium, Mascoma, Agrivida and SunEthanol. But the potential for local production, especially from an economic perspective, should not be overlooked.

Figure 10 illustrates that even a modest biofuel production industry (< 100 mgy) can result in very positive economic returns. Local biofuel feedstock utilization creates the greatest local economic return.

There are two common questions associated with biofuels production in the northeast: (1) what is the northeast region's biofuel production capacity from traditional agricultural feedstocks (both locally grown and imported); and, (2) when will the emergence of "next generation" biofuels (cellulosic ethanol, algae biodiesel, biobutanol, etc.) occur?

The answer to these two questions depends on a variety of factors, including: (a) the availability of traditional biofuel feedstock (corn, soybeans) from other regions; (b) the availability of local biofuel feedstock; and, (c) progress on the technological side with regard to bringing "next generation" biofuels to market.

It is difficult to make predictions about any of these three factors with any level of certainty. For example, the price of gasoline, corn prices, and shifting federal energy policies are just three of the factors that could fundamentally change the biofuels landscape. However, there are market indicators worth mentioning:

(1) The region is home to more than 60,000 farms, with tens of thousands of additional acres of fallow land.

(2) A 2001 analysis prepared by the Northeast Regional Biomass Program concluded that there is enough corn in the northeast to support several smaller scale (~ 10-30 mgy) ethanol production facilities, with an overall regional capacity (not necessarily *feasible* capacity) of several hundred million gallons per year.[28]

(3) Several east coast and northeast biofuel projects are planning on using traditional feedstocks (corn, soybeans) grown outside of the region, at least as a part of their feedstock strategy (see: Berkshire Biodiesel).

Figure 10

Local Economic Impacts of Ethanol and Biodiesel Production

According to two reports prepared by economist John M. Urbanchuk for the renewable fuels industry, a single 50 MGY ethanol plant has the *potential* to create the following state and local economic impacts:

- $140 million "one time" boost for plant construction
- Approximately 40 full-time jobs; 800 indirect jobs in all sectors of the economy
- $46 million in annual expenditures for goods/services
- $30 million increase in local household income
- $115 million annual increase in Gross State Output

* The economic impacts shown above assume local feedstock procurement. A reasonable benefits deduction for 100% imported feedstock might be 50%, given that roughly half of the economic gains created by biorefineries are on the refining and handling side.

Sources: John M. Urbanchuk, *Ethanol and the Local Community* (2002) & *Contribution of the Ethanol Industry to the Economy of the United States* (2006).

In 2006, the Minnesota Department of Agriculture published an economic analysis of the state's biodiesel industry. The report, based on 60 MGY in-state production capacity, projects the following local benefits:

- 4 plants = ~ 60 MGY cumulative capacity
- $928 million/yr increase in Gross State Output
- 122 direct jobs; 4,034 indirect jobs
- 5,668 new jobs economy-wide
- Increases local feedstock crop demand (13%)
- Increases feedstock processing capacity (31%)

* The economic impacts shown above assume local feedstock procurement. A reasonable benefits deduction for 100% imported feedstock might be 50%, given that roughly half of the economic gains created by biorefineries are on the refining and handling side.

Source: Su Ye, *Economic Impact of Soy Diesel in Minnesota*, Minnesota Department of Agriculture (September 2006)

(4) In February 2007, the U.S. Department of Energy awarded grants to six companies to assist with the construction of six cellulosic ethanol plants. The grants will lead to a total public/private investment of $1.2 billion in cellulosic ethanol.

(5) In May 2006, Goldman Sachs & Co. invested $30 million in Iogen Corp's cellulosic ethanol technology R&D.

(6) In October 2006, Chevron Technology Ventures and the National Renewable Energy Laboratory (NREL) reached a five-year agreement to research and develop technologies to convert biomass into fuels.

(7) In October 2006, Broin Companies and DuPont reached an agreement to research cellulosic ethanol development.

How the northeast fits into this picture remains to be seen, and will depend on commitment made by northeast states. It is oft stated and well recognized that the northeast region has relatively low

2nd Generation Biofuels

The term second generation refers to biofuels produced from feedstocks other than corn, sugar or soybean oil. The term includes ethanol produced from woody biomass or biodiesel produced from algae. Ethanol produced from food waste and biodiesel produced from waste oil is not considered second generation because traditional refining processes are used.

The timetable for the emergence of cellulosic biofuels remains uncertain. However, there are two significant trends worth noting: (1) an industry-wide recognition that traditional biofuel feedstocks (corn, soybeans) have a limited growth horizon; and, (2) significant progress in the biotech space toward efficiently breaking down plant matter for biofuel production.

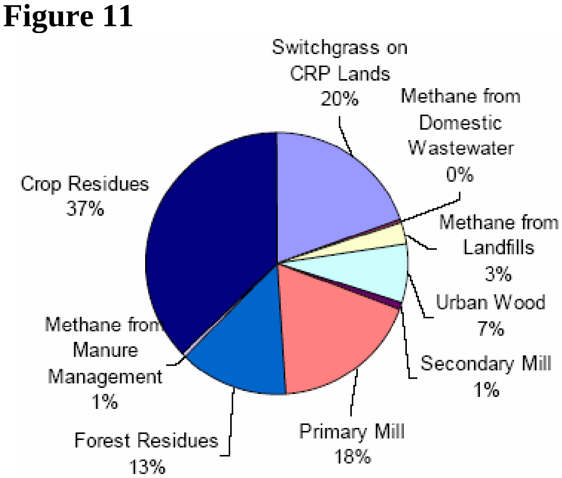
While there is debate about the prospective roles of wood residue, wheat straw, corn stover (corn cob) and dedicated energy crops in the future ethanol market, many forecasts agree that corn grain ethanol production will plateau at 15 bgy, absent considerable advancement in extracting fuels from corn kernels. This reality has encouraged existing ethanol producers and the private sector to invest in producing ethanol from alternative feedstocks. The ongoing challenge to producing cellulosic ethanol is improving the efficiency (and reducing the cost) of breaking down cellulose into fermentable sugar.

Detractors say that for years the cellulosic ethanol boom has been predicted without demonstrated progress. While it is true that cellulosic ethanol is not market-ready, progress is in fact being made. Since 2001, the cost of cellulose-digesting enzymes has dropped from $5 per gallon to roughly 10-18 cents per gallon of ethanol, which in turn brings the total production cost of cellulosic ethanol to within about 50 cents of the production cost of corn ethanol.

concentrations of traditional biofuel feedstock (corn and oil seed).[29] It is assumed, then, that the region will not see substantial growth in the biofuel sector. As discussed, the potential to produce biofuels from imported feedstocks should not be overlooked. The northeast has relied on crude oil from regions much farther away than the Midwest for a very long time. However, a more substantial opportunity lies in “second generation” or “next generation” biofuel production.

The northeast region is rich in potential “second generation” biofuel feedstock, including existing biomass (e.g. wood waste), and potentially, grown biomass (e.g. willow and poplar) and advanced biomass (e.g. algae). Figure 11 breaks down the national biomass picture by feedstock category, and helps put into perspective where the northeast fits into this market.

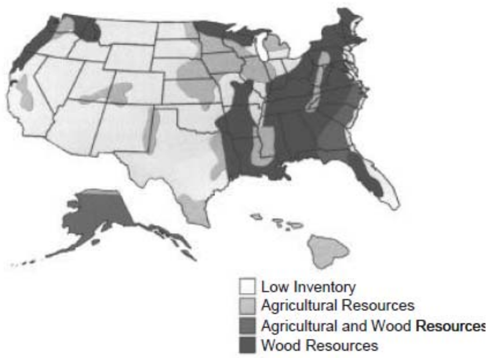
Figure 11



Source: U.S. DOE Office of Fuels Development

As shown, crop residues remain the primary source of U.S. biomass (37 percent). However, three biomass resources endemic to the northeast region (forest residues, primary and secondary mill waste, and urban wood) together account for an even greater portion of the national biomass resource (39 percent). These three biomass categories are sometimes referred to in a single category called "wood resources." Figure 12 provides a geographic profile of the nation's wood versus agricultural resources. Figure 12 does not include the potential to grow woody biomass, such as willow and hybrid poplar, in Eastern Atlantic and northeastern states.

Figure 12



Source: U.S. DOE Office of Fuels Development

Clearly, having the biomass resource and harvesting it in a sustainable way are two different things. However, the point is the same: next generation biofuels are not inherently farm-state oriented.

THE ENVIRONMENT

The cumulative environmental impact of any given energy solution is difficult to quantify. For biofuels alone there are air, water, climate and land use impacts. Because an exhaustive analysis exceeds the scope of this report, the following list provides a brief summary of the common issues.

Air Quality: Blending biofuels with petroleum fuels generally reduces emissions of most major pollutants. Figure 13 provides the general pollutant responses to common biofuel blends in the transportation sector. For those responses marked with parentheses there remains some scientific uncertainty and technical debate. The most common air quality issue associated with biofuel blending pertains to NOx. There is some engine data that suggests that low-level ethanol blends (e.g. E10) and high-level biodiesel blends (e.g. B50) increase NOx emissions. On the biodiesel side, it is probable that higher blends (~ B40 +)

Figure 13

Common Pollutant Responses to Biofuels
(compared to a 100% petroleum fuel baseline, by fuel type)

Fuel	CO	Tailpipe VOC	Evap VOC	NOx	Total Toxics	PM
Ethanol						
E10	Decrease	Decrease	Increase	(Increase)	Decrease	(Decrease)
E85	Decrease	Decrease	Decrease	(Decrease)	(Decrease)	?
Biodiesel						
B5	Decrease	Decrease		No Impact	Decrease	Decrease
B20	Decrease	Decrease		(No Impact)	Decrease	Decrease
B100	Decrease	Decrease		Increase	Decrease	Decrease

(1) Pollutant responses shown are generalizations based on the U.S. EPA Complex Model (which regulates federal RFG) and the California Predictive Model (which regulates California RFG only).
(2) Pollutant responses shown assume all other fuel parameters (e.g. sulfur, aromatics) are held constant (i.e. this table does not reflect absolute emissions impacts because refiners can, and are often required to, adjust other fuel parameters to "zero out" any pollutant increase).
(2) "( )" indicates a "likely" (limited data); "?" indicates incomplete data or scientific uncertainty.

increase NOx emissions (while very significantly reducing all other categories of emissions). However, the theory that lower blends (including B20) increase NOx is increasingly tenuous, as recent data from the National Renewable Energy Laboratory (NREL) suggests otherwise.[30]

On the ethanol side, the NOx issue is largely a regulatory one, as all RFG gasoline blends must comply with federal fuel regulations (whether they contain ethanol or not), which control for NOx. The impact of ethanol blending in conventional gasoline (CG) is different, but CG cannot be used in areas with ozone attainment issues. For a more detailed analysis, U.S. EPA recently completed its "Regulatory Impact Analysis" for increased renewable fuel use under the federal Renewable Fuel Standard.[31] The study includes airshed modeling showing that ethanol blending will have a negligible effect on atmospheric ozone (smog) levels.

One area with clear air quality gains is biodiesel/heating oil blends (known as Bioheat). The Massachusetts Oilheat Council and the National Oilheat Research Alliance conducted emissions testing of a 20 percent biodiesel, 80 percent heating oil blend in 2003. The tests demonstrated the following emissions benefits: CO_2 (15% reduction), CO (12% reduction), PM (12% reduction), NO_x (20% reduction), SOx (20% reduction) and Toxics (12-20% reduction).

Land Use: The land use debate stems from concerns about unsustainable farm practices and/or the destruction of ecosystems to plant biofuel feedstock crops. The theoretical solution to the problem is to build land use consideration into fuel diversification policies, as reflected by the increased carbon emissions of land destruction or some type of lower sustainability rating for certain fuels. This type of valuation is not currently part of any state or federal biofuel policy. But it is an emerging challenge in the context of the latest generation of fuel diversification policies being considered at the state and federal level, most notably the carbon-based fuel performance standards.

The issue is complicated because land use impacts are the least studied of the major environmental issues associated with biofuels, and an accepted methodology does not exist to value one biofuel over another with the full spectrum of land use impacts incorporated into the analysis. In addition, there is a paucity of data on the effects of various land use practices (i.e. tillage, processing, pesticides) on greenhouse gas emissions and the environment, which means that current analyses that venture too far into these areas become very uncertain.

There are, however, two life-cycle fuel analysis models that consider land use impacts: the GREET model (U.S. Department of Energy's Argonne National Laboratory, Wang), and the LEM model (Delucchi). Of these, only GREET has undergone rigorous peer review. The LEM model includes a wider set of land use impact metrics than GREET, but the LEM approach also has a much higher degree of uncertainty, is unfinished, has not undergone rigorous peer review, and better represents rough magnitudes under particular sets of assumptions chosen by its author.[32]

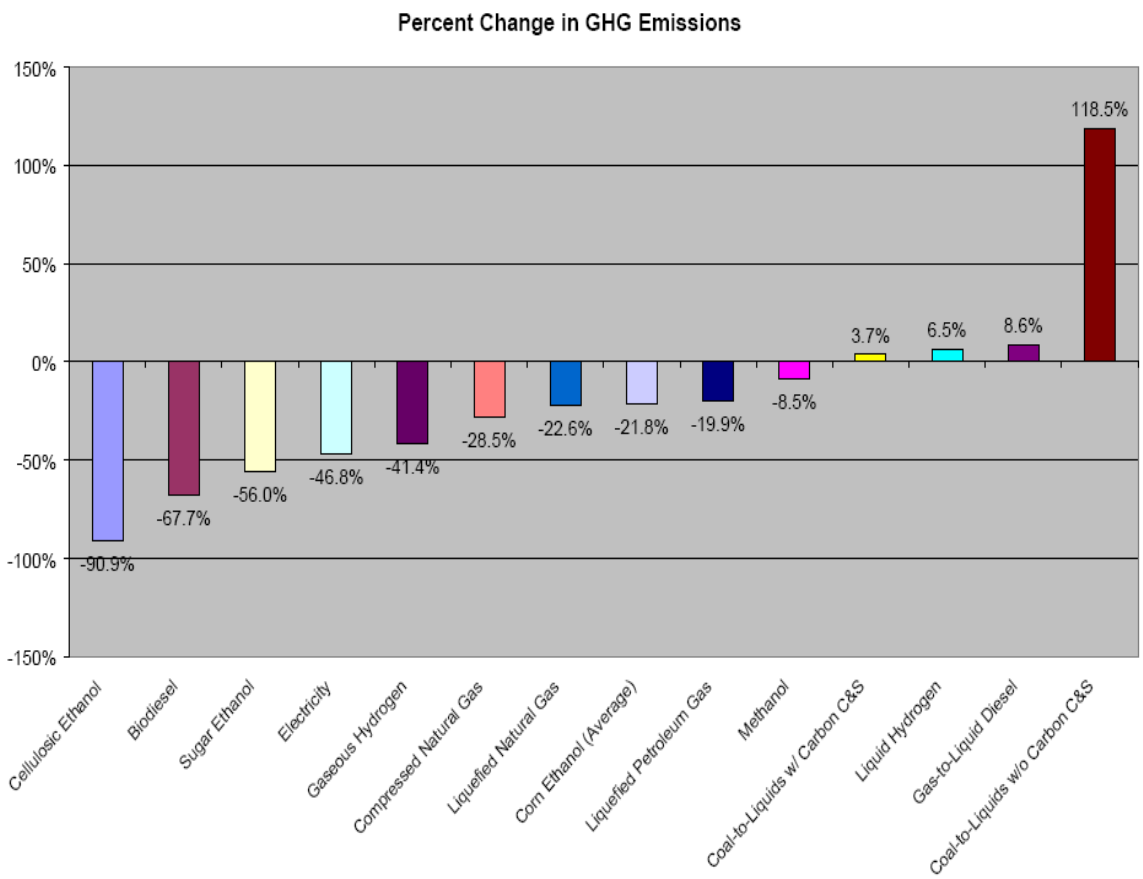
Given the limited science on land use impacts, the authors of this report agree that: (1) the GREET model is the best framework on which to base a policy that seeks to include land use impacts; and, (2) the uncertainties of land use impacts should not prevent the initial implementation of renewable or carbon-based fuel performance standards at the state or federal level. Land use should continue to be a part of the policy development process, ultimately leading to a workable solution that rewards sustainable biofuel production and use. However, the debate will be perpetual, because of the inherent uncertainties of ongoing analysis.

Climate Change: As discussed, the GREET (Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation) model is the only "life cycle emissions" model that has undergone rigorous peer review for the purpose of predicting the life-cycle GHG impacts of various fuels. GREET shows that the impact of biofuel use on climate change emissions ranges from marginally positive (with today's ethanol) to substantially positive (with second generation ethanol and biodiesel).

Over the last two years, U.S. EPA has been evaluating the potential environmental impacts of requiring the increased use of renewable fuels in the U.S. transportation fuel sector as related to the federal Renewable Fuel Standard. In April 2007, the agency released its analysis, which included a life cycle GHG analysis. U.S. EPA used the Argonne GREET model to predict the potential GHG impact of various alternative fuels. Agency staff used a common set of assumptions incorporating industry averages for certain categories of fuels.

Figure 14 shows the results of the EPA analysis. The GHG impacts shown represent an estimate for the percent change in lifecycle greenhouse gas emissions, relative to the petroleum fuel that is displaced by a

Figure 14



Source: U.S. EPA

range of alternative and renewable fuels. The fuels are compared on an energy equivalent (BTU) basis, and "GHG Emissions" in this case means carbon dioxide (CO2), methane and nitrous oxide. In its analysis, U.S. EPA recognized that the "life cycle emissions" field is a developing one. In other words, life cycle modeling is highly uncertain, and model inputs improve over time and are based on guided, but often contested, assumptions. The GREET model will need to be updated as data emerges.

In general terms, a comprehensive fuel-based climate policy includes both fuel efficiency and fuel diversification. Even if non-combustion technologies (e.g. fuel cells) emerge, it will take years for this industry to achieve high market penetration. Biofuels offer an immediate term solution to reducing GHG emissions from the fuel energy sector, and from within the current energy infrastructure. The key will be establishing policies that make sense for local and regional economies.

Biofuels in Massachusetts

As discussed, the opportunity for increased biofuel production and use in Massachusetts has at least two possible dimensions. First, the state can produce limited but significant quantities of biofuels using traditional production methods (from both imported and local feedstocks). With state commitment, this market could emerge very quickly. For example, Berkshire Biodiesel plans to construct a $50 million biodiesel production facility in Pittsfield and Dalton, MA. The project, which received support from the MA Executive Office of Transportation and the Massachusetts Technology Collaborative, is expected to be operational by 2008, producing 50 million gallons of biodiesel per year. This is the equivalent of more than 10 percent of the state's current diesel use. Twin Rivers Technologies in Quincy, MA is also pursuing plans to build a biodiesel plant.

> "The proposed $50 million biodiesel plant proposed for Pittsfield on land owned by Crane & Company is significant far beyond the 30 jobs it would bring. It is the kind of project that will have a long-term future as the nation looks for alternative energy sources and it provides further impetus for the Berkshires, with its proud environmental heritage, to pursue similar projects that can boost the economy in a progressive way."
>
> *- Berkshire Eagle, 5/4/07*

Second, Massachusetts has the opportunity to lead the northeast region toward sustainable "next generation" biofuel production. Again, several Massachusetts-based companies are leaders in the race to bring cellulosic ethanol, or next generation biodiesel, to market. These companies include BioEnergy International, Verenium (formerly Celunol), Mascoma, Agrivida, SunEthanol, and GreenFuel Technologies.

The question of feedstock is an important one. As discussed, Massachusetts is part of a region that could produce energy crops and has high existing biomass density (primarily rural and urban wood biomass). The quantity of biomass currently available in the northeast is the subject of recent and ongoing analysis. Northeast ethanol production capacity (from current biomass/cellulose) has been estimated to be about 2 billion gallons per year.[33] This does not mean that it is feasible to produce 2 bgy of ethanol from biomass feedstocks, but taken together with the potential for imported and locally grown feedstocks, local biofuel companies could drive significant

Biofuel for Energy Generation

In recent years, biofuels have shown increasing potential for use in other important energy sectors, such as home heating oil, and power generation. Roughly 40% of homes in Massachusetts rely on distillate heating oil for residential heating. This represents an important opportunity for distributors of BioHeat, a registered trademark for heating fuel blended with varying percentages of biodiesel for use in conventional heating oil burners. In addition to its air pollution and GHG benefits, the use of Bioheat has an ancillary benefit of encouraging major fuel terminals to invest in biodiesel supply and distribution infrastructure.

On a commercial scale, biofuels are being used for co-generation purposes, or combined heat and power systems. In rudimentary terms, by-products of biodiesel production can provide a bio-based feedstock for power generation, either internally, or available for sale to the electric grid. The Massachusetts Technology Collaborative (MTC) has provided grant funds to several biofuel co-generation facilities. The Cooley Dickinson Hospital in Northampton, MA received a $150,000 MTC grant to install an 80 kW boiler fueled by wood chips. The hospital also received $372,000 for a 245 kW advanced biomass combined heat and power generation system. Ecovation, Inc. received $18,000 for biogas CHP feasibility study at the Decar Cranberry Products wastewater treatment facility in Carver, MA.

There is also a number of biomass, or waste to energy, facilities in cities and towns. In 2001, 138 municipalities were awarded a total of $54 million in grants from MTC. While this technology can provide local and regional benefits, policymakers should be aware of concerns regarding the content of the waste used as feedstock. Similarly, the use of biodiesel as the main component for stationary power generation has been proposed. It should be noted that burning bio-based liquids, both refined biodiesel and pure vegetable oils, for primary electric generation is relatively unchartered and will require feasibility and sustainability analysis.

quantities of biofuel product into regional fuels markets in the near to intermediate term. The further development of high yield feedstocks such as microalgae could fundamentally change the northeast biofuel production outlook.

In addition, there are several Massachusetts-based companies taking the lead on bio-based fuel product distribution. One of the largest biodiesel distributors in the country, World Energy, is headquartered in Chelsea, MA. Another major biodiesel supplier, Mass Biofuel, is also located in Massachusetts. These companies are well positioned to support the growing interest in biodiesel/home heating oil blends. Several local fuel oil companies have invested in biodiesel storage for the heating oil markets, including Burke Oil (Chelsea, MA), Sprague Energy (terminals in MA), Alliance Energy Services (Holyoke, MA) and Loud Fuel (Falmouth, MA).

Massachusetts has recognized the role biofuels can play in the state's infrastructure in terms of the state fleet and government buildings. In 1996, Executive Order 388 required roughly 75 percent of vehicles purchased by the Commonwealth to be the "cleanest alternative fuel vehicles available and practical."[34] In August 2006, the Secretary of Administration and Finance issued Executive Bulletin 13 (EB13) establishing baseline requirements for biofuel use in state-owned vehicles and facilities. Included in EB13 was a provision that by July 1, 2007 all state agencies must use 5 percent biodiesel for on-road and off-road vehicles, and that by 2010, agencies must use 15 percent biodiesel for their diesel fleet (unfortunately, many state organizations, such as the Massachusetts Bay Transportation Authority and the Massachusetts Turnpike Authority, are exempted). Similarly, state buildings

Energy Land Easements
A Case for Cape Cod Feedstock Production?

Energy Land Easements
Energy land easements ("ELEs") are similar to conservation land easements, except that an energy feedstock buyer (i.e. the biofuel producer) becomes a third party to the conservation agreement.[35]

Feedstock Production & Land Preservation
Buyers are guaranteed feedstock in return for a contractual agreement to purchase the crop for a predetermined period of time. ELEs create value for the landowner (crop sales), the feedstock buyer (local feedstock) and the state (rural preservation, less sprawl).

Massachusetts Agriculture
The Commonwealth has over 570,000 acres of farmland; 93% is "small farms".[36] MA agricultural sales account for 40% of total agricultural sales in New England.[37]

Policy Application
ELEs can be applied to income from energy crop sales to minimize property tax implications. Benefits include: (1) helping small farms accrue value not available via lower federal estate taxes;[38] (2) allowing local governments to preserve agricultural land without decreasing local tax base as much as conservation easements; (3) localizing the economic benefits of the growing biofuels industry; (5) helping attract biofuel producers via local feedstock availability.

Theoretical Cape Cod Application
There are 12,000 acres of cranberry bogs on Cape Cod worth roughly $6,000 per acre; each acre of bog corresponds to ~ 4 acres of "upland" unfit to grow cranberries.

- Securing just 10% of fallow uplands for energy crops could protect 4,000 acres;
- Algae farms on 4,000 acres could produce up to 200 mgy of biodiesel;[39]
- Canola production on 4,000 acres could produce yields up 7.2 million pounds; providing an additional $792,000 of income to Cape Cod cranberry farmers.[40]

burning #2 diesel are required to burn 3 percent biodiesel by winter 2007. Governor Patrick extended the commitment via Executive Order 484, which, among other things, requires state buildings to use 10 percent biodiesel blends by 2012.

While a state fleet policy represents an important first step toward biofuel market development, the state still faces the more substantial challenge of opening consumer markets to increased biofuel use. Broader state policy will provide biofuel producers, distributors, retailers and venture capitalists with the confidence that their products and investments will have opportunities to succeed in the northeast marketplace.

STATE POLICY RECOMMENDATIONS

Clean energy research and development should be coupled with aggressive public policy in order to catalyze regional interest from capital markets and unlock the energy sector for new alternatives. Public policy is important because cost is not the only challenge for clean energy markets. There are legal, regulatory, infrastructural and industry-driven market barriers to all clean energy solutions.

Biofuels are becoming an increasingly important part of the effort to improve and diversify U.S. energy markets. History shows that biofuels development occurs in states that make concrete commitments to the industry. For example, Midwest states have plentiful agricultural feedstock, but they also enforce the most aggressive public policies in the country to support the biofuels industry, including performance standards and tax incentives. States with aggressive renewable fuel policies have significantly reduced their dependence on imported petroleum while simultaneously creating new jobs, increasing state and local tax revenue, and improving the environment.

In the northeast, the biofuels industry faces many of the same challenges as abroad: contractual confinements on fuel retailers, infrastructural restrictions on fuel distributors, an uncertain and shifting regulatory environment, and vehicles not designed to run on alternative fuels. Massachusetts can alleviate many of these market restrictions with more progressive state fuels policy.

Given that some policies have demonstrated benefits in other states, and others require a more deliberative process to ensure that they promote the economic and environmental interests of the Commonwealth, this paper recommends two parallel processes: (1) the implementation of critical early action measures; and, (2) the appointment of a Massachusetts Biofuels Task Force to develop a more comprehensive approach to supporting the biofuels industry in the state.

The critical early action measures should be pursued immediately. The Biofuels Task Force should be appointed as soon as possible, and issue recommendations to the Legislature by March, 2008.

CRITICAL EARLY ACTION MEASURES:

EARLY ACTION MEASURE A: STATE PRODUCER CREDITS

Biofuel producer credits (tax credits per gallon of biofuel produced in-state) are utilized by many states to attract the biofuel industry. The average U.S. biofuel producer payment is 15-20 cents per gallon (cpg) of production, capped at a certain annual production output and/or fiscal amount.

Producer credits make sense for Massachusetts because the strategy is low risk: payments are made only after the facility brings product to market, which ensures that the job creation and state tax revenue benefits will accrue. States also report very positive economic returns on these programs in the form of increased jobs and state sales and income tax revenue. Producer incentives are a central driver for biofuels plant siting decisions.

In the northeast, Maine and New York already offer them for biofuels production, creating a competitive advantage over Massachusetts. Connecticut offers a biodiesel producer payment program.

EARLY ACTION MEASURE B: REQUIRE MINIMUM BIODIESEL CONTENT IN DIESEL AND OIL HEATING MARKETS

All diesel automotive and heating oil blends should be required to have a minimum percentage of biodiesel – beginning at 2 percent and expanding to 5 percent by volume over time. A common way to launch this type of program is to trigger its implementation with in-state or in-region biodiesel production targets. A reasonable approach would be to require B2 (2% biodiesel blends) within six months of the date that the state or proximate region achieves a biodiesel production capacity of 10 million gallons per year. B5 blends could be required three years later, or be triggered by higher in-state or in-region production capacities. Alternatively, the program could have specific implementation dates.

The MA Office of Consumer Affairs and Business Regulation would implement the law and would have the ability to delay the requirements due to lack of supply, blending issues, or unreasonable costs.

The biodiesel content requirement should be viewed as a catalyst for a Massachusetts biodiesel production industry. Ultimately, biodiesel should compete with other renewable fuels as part of a more comprehensive policy commitment to renewable and/or low carbon fuels.

EARLY ACTION MEASURE C: MAKE CURRENT E10 BLENDING MANDATORY

Nearly every gallon of gasoline sold in Massachusetts contains ten percent ethanol (in E10 blends). This means that roughly 280 million gallons of the 2.8 billion gallon per year "gasoline market" in the Commonwealth is actually ethanol (Figure 3). This market exists because ethanol was the only commercially viable alternative to MTBE when MTBE was phased out in 2005 because of liability concerns from drinking water contamination. The market for MTBE (and then ethanol) existed in the first place because the federal Reformulated Gasoline (RFG) program enforced a minimum oxygen content requirement, and both MTBE and ethanol are fuel oxygenates.

The current state market for ethanol is uncertain because federal energy legislation replaced the federal oxygen standard with a national Renewable Fuels Standard (RFS) in 2005. While the national RFS does require increasing volumes of ethanol use nationally, it does not include a regional requirement.

As such, requiring E10 blends would have the following benefits:

(1) Prevents backsliding toward increased foreign oil dependence in the near term;

(2) Provides a ready-market for ethanol produced locally, from second-generation feedstocks and using advanced technologies.

(3) Takes the uncertainty out of the current MA ethanol market, which in turn reduces local investment risk.

(4) Keeps ethanol "on the books" with regional distributors and marketers, which in turn eases market penetration for local companies and/or second generation ethanol production.

(5) Locks in current GHG benefits of ethanol, while providing a market foundation for more aggressive reductions with advanced technologies.

Early Action Measures A through C signal a foundational commitment to produce and use biofuels in Massachusetts. The MA Biofuels Task Force will develop an overlying state biofuels policy to maximize the economic and environmental benefits of the program, and establish Massachusetts as a leader in advanced biofuels development.

MA BIOFUELS TASK FORCE:
DEVELOP COMPREHENSIVE BIOFUELS PLAN

The Northeast Biofuels Collaborative recommends the establishment of a Massachusetts Biofuels Task Force, comprised of members appointed by House Speaker DiMasi, Senate President Murray and Governor Patrick. The Task Force should be charged with recommending a set of comprehensive biofuels policies, by date certain (March 2008), that will reduce the state's dependence on petroleum imports, increase the production and use of biofuels, and position the Commonwealth as a leader in the move toward low-carbon and sustainable transportation and heating fuels.

The policy recommendations should take into account the costs of ongoing petroleum dependence, the economic and environmental benefits of fuel market diversification, sustainability and land use, climate change and public health. The Task Force should issue policy recommendations that encompass at least the following four policy categories: (1) vehicles; (2) fuels; (3) market and regulatory issues; and, (4) state economic and technology incentives.

(1) VEHICLES

- STATEWIDE FFV REQUIREMENT
- STATE FLEET FFV REQUIREMENT
- CONSUMER SIDE PURCHASE INCENTIVE

Ninety-nine percent of passenger cars and trucks on the road in Massachusetts today operate on only one type of fuel: petroleum.[41] As a result, fuel retailers and distributors are hesitant to invest in biofuel blends (or biofuel blending infrastructure) even if the economics are favorable.

While it is inexpensive for automakers to manufacture Flex Fuel Vehicle (FFV) – vehicles that can run on virtually any blend of ethanol and gasoline – and diesel vehicles generally do not experience problems operating on biodiesel blends, automakers have demonstrated an unwillingness to manufacture FFVs and amend diesel warranties until the fuel is available.[42]

REQUIRE FLEX FUEL VEHICLE SALES

Massachusetts should require an increasing percentage of new vehicles sold in the state to be FFVs. A FFV requirement is the simplest, lowest cost solution for states to address the "chicken or the egg" fuel/vehicle problem. It costs the state virtually nothing, yet opens the door for very significant expansion of biofuels markets statewide.

A reasonable compliance schedule requires 50 percent of all new vehicles sold in Massachusetts to be FFV by 2015, in 10 percent increments starting in the 2010-11 timeframe. This is consistent with FFV compliance schedules proposed in other states and in Congress. Manufacturing FFVs does not interfere with emerging technologies and is very inexpensive, with costs ranging from $35-$150 per vehicle.

Some experts believe that once FFVs become part of the standard manufacturing process, the cost is negligible. Automakers including GM, Ford, VW, Toyota and Honda already provide FFVs to the Brazilian automobile market. Brazil required FFV sales in 2003; within two years 50 percent of new cars sold were FFV. As of November 2006, 81 percent of new vehicles sold in Brazil were FFVs.[43]

REQUIRE ALL STATE VEHICLES TO BE FLEX FUEL

Massachusetts should require all state vehicles, including those used for public transportation, to be FFV. FFV use in public fleets will introduce automobile dealerships to FFVs, and if adopted with a state commitment to refuel with E85 or biodiesel blends, the program could increase demand for high biofuel blends throughout the state.

CONSUMER PURCHASE INCENTIVES

Consumer purchase incentives for FFVs are likely not necessary if the state requires FFV sales. This type of incentive is not revenue neutral. However, as with hybrid vehicles, incentives have been shown to catalyze consumer interest and dealership response in the passenger vehicle markets.

(2) FUELS

- **MA FUEL PERFORMANCE STANDARD**
  - **STANDARD RFS**
  - **INCENTIVE RFS**
  - **LOW CARBON FUELS STANDARD**
- **ALTERNATIVE FUEL CORRIDOR PROGRAM**

Massachusetts is overwhelmingly dependent on imported oil. The Commonwealth will not be a player in the petroleum fuels industry, as either a refining or oil producing state. In addition, petroleum dependence exacts major environmental and economic harms on Massachusetts consumers, especially during supply shortages. It therefore makes sense to start the process of incrementally diversifying state petroleum fuels markets with non-petroleum fuels.

The best strategy for accomplishing this goal, with the necessary level of regulatory certainty, is to adopt a fuel performance standard. A fuel performance standard is similar to a Renewable Portfolio Standard (RPS), [44] in that it commits the state to certain incremental usage targets for non-petroleum or lower-carbon fuels.

The two models already implemented at the state level are the Renewable Fuel Standard (RFS) and the Incentive RFS. The Low Carbon Fuel Standard (LCFS) proposed in California – and being considered by U.S. EPA – is a third concept under development. The primary difference between a RFS and a LCFS is the compliance metric (i.e. renewable content versus carbon content). This is an important difference, because a fuel-carbon compliance metric (which would be the foundation of such a program) does not yet exist. However, it has the added benefit of encompassing more alternative fuel sectors.

ESTABLISH A MASSACHUSETTS FUEL PERFORMANCE STANDARD

The Biofuels Task Force should make a recommendation for which type of fuel performance standard makes sense for Massachusetts. The Task Force should be sensitive to regional oil distribution limitations in the northeast, and emerging fuel regulatory trends (e.g. the LCFS). Some programs to consider include:

(1) Standard RFS: A RFS requires an increasing volumetric percentage of renewable fuel content over a given period of time. A reasonable place to start is 10 percent (of gasoline and diesel markets), given that gasoline is already 10 percent ethanol in Massachusetts.

Among the issues to be considered by the Task Force in the RFS context are:

(1) How to fold a broader set of renewable "fuels" credits into program compliance (e.g. biobutanol, renewable diesel, eDiesel, renewable electricity via plug-in hybrid electric vehicles, and renewable hydrogen via fuel cell vehicles). A true RFS is performance based.

(2) How to set an overlying performance requirement for advanced biofuels, such as cellulosic ethanol and biodiesel made from advanced feedstocks. Massachusetts could require that an increasing percentage of renewable fuels used to comply with the program utilize advanced feedstocks, such as those used to produce cellulosic ethanol and second-generation biodiesel.

Some states "trigger" the implementation of RFS targets on in-state or in-region biofuel production capacities to ensure that the programs catalyze local economic growth.

The program is enforced at the fuel marketing or distribution level. The primary benefit of the RFS approach is that it creates regulatory and market certainty (to spur private sector interest) without substantial state expenditures, and has state-level precedent.

(2) Incentive RFS: An incentive RFS establishes annual targets for *retailers* to increase their sales of biofuels. But instead of enforcing them legally, the state provides tax credits (cents per gallon of renewable fuel sold) based on compliance or near-compliance with the targets. As such, retailers choosing not to diversify fuels are at a financial (instead of legal) disadvantage.

Iowa pioneered this approach in 2006. There are state revenue costs in the form of reduced gas tax revenue, but the investment is low risk: the credit applies only when the biofuel hits the market, which virtually guarantees the economic return if coupled with a commitment to in-state production.

(3) Low Carbon Fuel Standard: A LCFS is similar to a RFS in that both are fuel performance standards, and the goal is to support non-petroleum fuel markets, reduce GHG emissions and stimulate technological innovation. However, a LCFS does so via a different compliance metric: the carbon intensity of the saleable fuel.

The carbon compliance metric is intriguing because it does not limit itself to renewable fuels and pushes the market to determine the best technologies to achieve lower carbon fuels. The primary downside to this approach is: a) a carbon-based compliance metric does not yet exist; and, b) program implementation will be complicated, especially in a single northeast state.

Nonetheless, there may be ways to commit to the eventual LCFS framework: (1) the state could adopt an interim RFS that shifts to a LCFS once the metric emerges; (2) Massachusetts could lead an effort to implement a *regional* LCFS among New England or northeast states; (3) the state could promulgate its own LCFS.

In this context, the argument can be made that any fuel standard enacted in the northeast should be regional, because northeast states are small and fuels are distributed regionally. This is generally true. However, it is important to note that most northeast states have RPS programs in addition to the Regional Greenhouse Gas Initiative, and likewise, Massachusetts should not hesitate to implement fuel performance standards to create state economic and environmental opportunity.

ALTERNATIVE FUEL CORRIDOR PROGRAM:

Alternative fuel corridor programs are designed to increase the availability of alternative fuels in major transportation corridors. The goal is to create a high level of alternative fuel market penetration with a relatively modest infrastructural investment.

There are two primary options for creating the program:

(1) Fuel Corridor Requirement: The Commonwealth could require gas stations with sales volumes in excess of a certain level to offer at least one alternative fuel pump. This requirement is attractive for several reasons: (1) it is a no cost option for the state with guaranteed results; (2) it maximizes the availability of the fuel and immediate-term market penetration; (3) it focuses on the stations that can afford to make the investment while protecting smaller (usually independent) fuel retailers, which have a more difficult time competing.

(2) Fuel Corridor Fund: The Commonwealth could simply invest general fund dollars in biofuel pumping infrastructure in major transportation corridors. The benefits are the same as above, although there is some uncertainty about the availability of funding. The primary downside of this approach is the state pays for the program, and it is unclear how successful it will be without a revenue-generating aspect.

(3) Market and Regulatory Forces

- **Exempt Biofuels From Exclusivity Contracts**
- **State SIP Directive**
- **UL Waiver**

As discussed, cost is not the only challenge for clean energy markets, including biofuels. Among the regulatory challenges that can be addressed by state authority are exclusivity contracts, SIP protocols and UL waivers.

Exempt Biofuels From Exclusivity Contracts

Exclusivity contracts – agreements between fuel providers and retailers in which retailers agree to sell only the product supplied by that particular fuel supplier – prevent retailers from reaching outside of the supply agreement to secure any other source of fuel, including biofuels, even if the supplier does not offer the desired fuel. In some cases, exclusivity contracts (also called contracts of adhesion) enforce minimum sales volume requirements.

There are two primary ways to solve the problem:

(1) Exempt Biofuels From Fuel Exclusivity Contracts Via UDAP Rulemaking: State "Unfair or Deceptive Acts and Practices" (UDAP) statutes provide state attorneys general with the broad authority to prohibit the sale of unsafe and defective products and unfair business practices. In more than twenty states, including Massachusetts,[45] attorneys general also have the authority under UDAP to conduct administrative rulemakings to define exactly what constitutes an unfair or deceptive act or practice within their particular state.

State attorneys general have used UDAP rulemaking to establish standards governing sales of products, mortgage broker practices, insulation installation, sales of defective meats, and electrical system safety.[46] Massachusetts utilized UDAP rulemaking authority to establish safety requirements for guns.[47]

One of the advantages of banning fuel exclusivity contracts via UDAP is efficiency and simplicity; the state would only need to comply with administrative procedural rules (notice and comment), instead of the full legislative process. In addition, state attorneys general could work collaboratively on a multi-state rulemaking to ban fuel exclusivity contracts regionally.[48]

(2) Exempt Biofuels From Fuel Exclusivity Contracts Via Legislation: Massachusetts could also legislate an exemption for biofuels from fuel exclusivity contracts. In 2006, New York passed a law which exempted renewable fuels from the provisions of any future motor fuel franchise agreement between a fuel provider and a retail station. In essence, future franchise agreements cannot prohibit or discourage a service station from selling alternative fuels.

Direct SIP Managers to Focus on Fuel Diversification

Air quality regulators are legally bound by the Clean Air Act (CAA) to achieve attainment with NAAQS. Under the CAA, states with "nonattainment" areas must submit SIPs to U.S. EPA, laying out how they plan to achieve compliance with the applicable limits. Increased biofuel use can conflict with SIP goals, even if the net impact of biofuels is positive. Fortunately, there is flexibility in the SIP program. SIPs can include short and long term emissions reduction strategies.

A reasonable first step for encouraging SIP managers to focus on fuels diversification is to provide a formal directive. This directive would be completely consistent with the spirit of federal and state air quality control programs, because fossil fuel dependence is the central cause of air pollution in the United States. Such a directive could be general in nature, but would be critical for empowering state air quality experts to utilize their skills to help solve fuel diversification challenges.

Grant a State Waiver for Underwriter Laboratories (UL) Certification

To date, E85 dispensing systems have not been fully tested by a nationally-recognized standards development organization (UL). This does not mean that the dispensers are unsafe. The federal Dept. of Energy has partnered with UL to accelerate the certification process so that E85 pumps can start to become more readily available.

As UL and DOE develop procedures for evaluating and certifying E85 dispensing equipment, Massachusetts should investigate the option of adopting a state waiver that would allow state and local fire officials to permit existing and new dispensing equipment to be installed. The following states have adopted such waivers: CO, IL, IA, MI, MN, NY, OH, OR, WV, and WI.

(4) State Incentives

- **MA Biofuel Development Program**

More than 40 states, including several northeast states, offer economic incentive programs dedicated (at least partially) to promoting biofuels development. State biofuel incentives attract the industry, but can also be used to orient industrial development toward, the use of local feedstocks or into certain energy sectors.

Massachusetts does not have any major incentives for biofuels. As mentioned above, the Collaborative recommends the adoption of a biofuels production tax credit program.

The following additional incentive programs should be considered by the Task Force:

MA Biofuels Development Program

The Commonwealth of Massachusetts should develop a program specifically designed to spur biofuels research and development and/or deployment. The Task Force should explore potential revenue sources for the program, including: (a) a small (less than one cent per gallon) public goods charge on motor fuel; and, (2) fee increases for vehicle registration and/or inspection.

The State of California passed a bill in 2007 increasing vehicle and equipment registration and smog check fees to support an alternative fuel research, development and deployment program (AB118). Massachusetts could develop a similar program to support some of the following initiatives, as determined by the Task Force. Most of the following policy options have precedence in other states:

(1) Advanced Biofuels Research & Development Program: Massachusetts hosts several companies dedicated to cellulosic ethanol development. There are similar companies interested in developing technology to produce biodiesel from feedstocks such as micro algae. The state has provided the biotechnology industry with significant funds, and should provide similar financial support to the bio-energy field. The program could include loan guarantees, grant programs and income tax credits. It could be funded in a variety of ways, including those mentioned above.

(2) Mass Agricultural Energy Feedstock Development Program: Maximizing the availability of local feedstocks is important for at least two reasons: (1) it reduces operating costs for producers, thereby attracting the industry to the region; and, (2) it localizes the economic benefits of any biofuels production program.

Massachusetts has more than 500,000 acres of farmland, accounting for 40 percent of total agricultural direct sales in New England.[49] Much of this success results from the Commonwealth's Agricultural Preservation Restriction Program (APR), in which farmers can receive the difference in price between the fair market value and the agricultural value of their property, in exchange for a permanent deed restriction to maintain the land in active agricultural use.[50]

There are thousands of acres of fallow land on dairy farms, Cape Cod cranberry plantations, and in regional open space. Much of this land is threatened by commercial or residential development. An expansion of the APR Program budget might provide farmers with an incentive to produce biofuel feedstock, while preserving open space. Several biofuel feedstocks are viable in Massachusetts, including canola, mustard seed, soybeans, switch grass and willow.

Another concept that should be explored is energy land easements. Energy land easements are similar to conservation land easements, except that an energy feedstock buyer (i.e. the biofuel producer) becomes a third party to the conservation agreement. Energy land easements create value for the landowner (revenue from energy crop), the feedstock buyer (local, competitively priced feedstock) and the easement grantor (open space, increased economic output, agricultural preservation, etc.).

The Commonwealth should also investigate the potential for using state-owned land for energy crops. For example, in May, 2007 the Utah Department of Transportation instituted the Freeways to Fuel Initiative, in which Utah State University is examining the potential for growing biodiesel feedstock (canola/safflower) along Utah state highways. Through this venture, Utah officials hope to produce enough biodiesel to fuel the entire transportation department's fleet.[51]

(3) Biofuels Infrastructure Assistance Program: Massachusetts could authorize the state department of transportation to develop public-private partnerships with fuel providers to develop a supply network for biofuels, including B20 and E85. The Commonwealth could also provide authorization for the DOT to establish a grant program to assist in the purchase and installation of storage tanks and dispensing infrastructure at private fueling sites, as well as metered biodiesel blending units, which eliminate some of the challenges of shipping and storing biodiesel blends.

At least 16 U.S. states offer incentives to fuel distributors and wholesalers, and other entities for developing biofuel storage and distribution infrastructure. New Jersey reimburses local governments, state colleges and universities, school districts, and governmental authorities for up to 50 percent of the cost of purchasing and installing refueling equipment for alternative fuels. New York provides a tax credit for up to 50 percent of the costs incurred to store or dispense clean burning fuel. Maine is the only New England state with a similar incentive.

(4) Biofuels Consumer Income Tax Credit Program: Consumer side income tax credits spur consumer demand in alternative energy markets. The program could offer an income tax credit of $0.50 per gallon of biodiesel (B99) or ethanol (E85) blended fuel purchased by a Massachusetts taxpayer up to a maximum of $500 per year per MA-registered vehicle. This incentive could be particularly important if the price of petroleum falls, as it provides a hedge for drivers committed to using biofuels.

(5) BioHeat® Consumer Income Tax Credit Program: BioHeat (heating oil blended with biodiesel) can be more expensive than conventional heating oil (~3-15 cpg). While heating oil consumer alliances have periodically eliminated the additional expense, and at times the retail cost of BioHeat has been lower than regular heating oil,[52] short term price increases can dissuade BioHeat blending. One way to increase BioHeat use is to offer consumer-side state tax incentives. New York currently offers heating oil customers an income tax credit of 1 cent per gallon of biodiesel used for BioHeat (i.e. 20 cents credit per gallon of B20-blend BioHeat; 5 cents per gallon of B5 BioHeat).[53] The credit could be adjusted (i.e. reduced) by the state on an annual basis to create price parity.

Two leading biodiesel distributors, World Energy, LLC and Mass Biofuel, are located in the Greater Boston area. Burke Oil in Chelsea, MA is also a leader in the field of biodiesel blending and distribution. Local air quality control agencies, including NESCAUM, publicly support the increased use of BioHeat, based on the superior emissions characteristics of the fuel.[54]

(6) Excise Tax Exemptions: Unlike producer tax credits, which incent in-state production, excise tax exemptions are designed to spur demand (or use). The state could provide full or partial excise tax exemptions for certain types of fuels (e.g. advanced biofuels) or for the sale of specific blends (e.g. E85).

This type of policy increases the chances for biofuel producers to secure offtake agreements. However, the economic stimulus does not necessarily occur in-state without complementary policies.

*** End of Report ***

ENDNOTES

[1] See www.energy.gov/Massachusetts.

[2] Energy Information Administration <http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=MA> (accessed June 1, 2007).

[3] Energy Information Administration, < http://www.eia.doe.gov/emeu/states/sep_fuel/html/fuel_use_df.html> (accessed June 1, 2007).

[4] MA Executive Office of Transportation, 2004 <http://www.eot.state.ma.us/downloads/factbook.pdf> (accessed June 1, 2007).

[5] Not all "conventional gasoline" is the same. For example, Maine utilizes a low-RVP conventional gasoline blend based on specifications established by the State of Maine to meet its CAA requirements for ozone.

[6] See www.eia.doe.gov.

[7] Energy Information Administration <http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=MA> (accessed June 5, 2007).

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[9] ICF Consulting, *A Study of New England and Massachusetts Petroleum Infrastructure and Distribution Systems*, RFR-2002-ENE-002, prepared for MA Division of Energy Resources, p. 51.

[10] See http://www.massport.com/ports/about_ports.html. There are roughly 308 gallons of petroleum in a metric ton.

[11] US Dept. of Energy, Energy Information Administration, Petroleum Navigator, Company Level Imports.

[12] ICF Consulting, *A Study of New England and Massachusetts Petroleum Infrastructure and Distribution Systems*, RFR-2002-ENE-002, prepared for MA Division of Energy Resources, p. 45.

[13] US Army Corps of Engineers, Waterborne Commerce Navigation Data Center.

[14] www.irs.gov/businesses/page/0,id=6964,00.html.

[15] See U.S. EPA NPDES Permit No: MA0001929 (Fact Sheet).

[16] ICF Consulting, *A Study of New England and Massachusetts Petroleum Infrastructure and Distribution Systems*, RFR-2002-ENE-002, prepared for MA Division of Energy Resources p. 51.

[17] See Federal Trade Commission, *Investigation of Gasoline Price Manipulation and Post-Katrina Gasoline Price Increases*, Spring 2006.

[18] *Id.*, at p. 73.

[19] U.S. Energy Information Administration, <http://tonto.eia.doe.gov/dnav/pet/hist/mgfstp11A.htm> (accessed Dec. 15, 2006).

[20] See United States General Accounting Office, *ENERGY MARKETS-Effects of Mergers and Market Concentration in the U.S. Petroleum Industry*, Report to the Ranking Minority Member, Permanent Subcommittee on Investigations, Committee on Governmental Affairs, U.S. Senate, May 2004.

[21] *Id.*, at p. 9.

[22] Federal Trade Commission, *Investigation of Gasoline Price Manipulation and Post-Katrina Gasoline Price Increases* (Spring 2006).

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[27] New Energy Finance Limited, *Venture Capital/Private Equity Investment in Clean Energy Surges 167% in 2006*, < http://www.earthtoys.com/news.php?section=view&id=2051> (accessed Feb. 2007).

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[35] Mitchell, Steven and Bruce Johnson. *Valuing Farmland Conservation Easements*. 2001.
[36] Massachusetts Department of Agricultural Resources. *Ag Facts: Massachusetts*. 2006.
[37] *Id.*
[38] Federal estate taxes are based on the value of the property. Therefore, deductions to estate taxes are much more valuable for high-priced property (e.g. urban open space, suburban large estates etc.) and not as financially significant for lower-priced property (e.g. rural farms) - estate tax is applicable to properties worth more than $2 million.
[39] Telephone interview with Allen Giles, President, Amelot Holdings, Inc. (Dec. 12, 2006).
[40] University of Maine: Cooperative Extension. *Potato Facts: Spring Canola an Oilseed Crop for Potato Growers*. 2003.
[41] Roughly 70,000 of 5.3 million MA registered vehicles are Flex-Fuel. Most U.S. carmakers warranty ethanol use up to only 10 percent (E10) and biodiesel use up to only 5 percent (B5).
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