LIQUID BIOFUELS POLICY FOR MAINE

A REPORT TO THE STATE LEGISLATURE

JANUARY 2008

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Acknowledgments: The author, Rebecca Rockefeller, is a masters student at the Rubenstein School of Natural Resources at the University of Vermont. This report was written on a volunteer basis for the Maine Office of Energy Independence and Security in fulfillment of her masters thesis.

Printed under Appropriation Number: 014 - 07DB - 5012 - 05 - 0082

EXECUTIVE SUMMARY

Liquid biofuels[1] can offer economic, environmental and security benefits compared to their petroleum equivalents. The Maine State Legislature is interested in supporting biofuels, and, in LD 1159 and LD 1347, asked for recommendations on how best to promote them. The purpose of this report is to fulfill that request.

Maine uses approximately 727 million gallons of gasoline and 712 million gallons of distillate fuel (both diesel and number 2 heating oil) per year. Diesel used for transportation accounts for approximately 192 million gallons of the distillate fuel use, and gasoline used for transportation accounts for 716 million gallons.

Maine's biofuel industry is small, but growing. Maine used over 600,000 gallons of pure biodiesel (.3% of the diesel market) in the last year, approximately ten times as much as 2004. Pumps supplying biodiesel have also increased ten-fold. Maine's only producer, Green Bean Bio-Fuel, produced approximately 150,000 gallons of biodiesel from waste grease in the past year and is currently expanding capacity. A number of other parties are interested in producing biofuels from a variety of feedstocks, including forest residues and canola. Ethanol is developing slower than biodiesel. Xtra Mart recently started offering 10% ethanol at its eight Maine pumps, and Safe Handling opened an ethanol terminal in December 2007, which may stimulate the market. The major barriers to the biofuels market include technology, capital, cost, uncertain demand and lack of pumps.

Maine has a number of policies in place to address these barriers, including: support of research and development; tax incentives for new pumps, production and consumption; state use; and revolving funds for capital investment. Some of these policies and programs are more effective than others – implementation problems include lack of funding, tight stipulations, complicated paperwork, and conflicting goals and time-lines.

To generate a menu of future policy options, this report examines common state policies, giving examples of states that might provide models for Maine. While evaluation is somewhat subjective, the renewable fuels standard appears to be the most effective state policy for encouraging biofuels production and consumption, followed closely by government leadership and per gallon tax incentives.

There are many policy options Maine could pursue. Distilled from interviews, policy white papers, best practices from other states and an evaluation of Maine's current policies, this report presents and analyzes 16 policy options: (1) doing nothing; (2) an alternative fuels grant incentive program; (3) hiring an alternative fuels point person; (4) sustainability certification; (5) a dedicated alternative fuels R&D fund; (6) increasing the producers' credit; (7) a pump pilot program; (8) a pump lease program; (9) reviving the Clean Fuel Vehicle Fund; (10) exempting biofuels from exclusivity contracts; (11) rewriting/reinstating the excise tax cut; (12) a renewable fuels standard; (13) a low carbon fuel standard; (14) Department of Transportation biodiesel use; (15) a school bus program; and (16) flex-fuel vehicles in state fleets. These options are evaluated for both impact and feasibility.

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1 While the term "biofuels" can include wood chips and pellets used for heat or biomass burned to produce electricity, this report deals exclusively with liquid biofuels, used primarily for transportation (though it does include bioheat – biodiesel blended with number 2 used as a heating oil). Throughout this report, the term "biofuels" refers only to liquid fuels derived from biomass.

A stakeholder workshop helped to narrow down, combine and refine these policy options. Eight recommendations (divided into four categories) are presented in this report:

1. POLICIES AIMED AT THE BIOFUELS INDUSTRY IN GENERAL

(a) Combine existing funds into a broader Clean Fuel Fund

Maine has two funds intended to support alternative fuels, neither of which are funded. Stakeholders suggested combining these funds into a single, compartmentalized fund that would support all three sectors (clean fuel production, distribution and consumption). The advantages of such a fund include the flexibility and capacity to support all three sectors and goals (economic development, energy independence and the environment) at once, giving the fund broad political appeal. The disadvantages include the difficulty of implementing effective grant and loan programs for biofuel production and distribution – such policies are not among the most effective in other states (though they can be beneficial), and they have not had a high success rate in Maine. This combined fund would be more likely to succeed than the previous funds, however, because it would be broader and the timing is right. Adding the fund to the list of Supplemental Environmental Projects would increase the flow of funds. Improving implementation capacity (discussed below) would increase the chance of success, as well.

(b) Study sustainability measures for biofuels

State investment in biofuels is only worthwhile if it yields public benefits. The environmental benefits of biofuels have recently been called into questions, however (see appendix V.1). To address these concerns, Europe is in the process of restricting its support of biofuels from all biofuels to only sustainability-certified fuels. This certification is not yet developed. State agencies should study this issue and produce a report on biofuels certification and other policies to support sustainable biofuels.

The benefits of certification include broadening support for biofuels (among the environmental community) and ensuring that public funds only support fuels that yield environmental benefits. The detriments of such a policy include potentially setting biofuels at a competitive disadvantage in a petroleum market, stifling a nascent industry and favoring large producers over small producers. A study should consider these costs and benefits more closely.

(c) Improve implementation of existing policies

Maine already has a number of potentially beneficial policies in place, some of which could be implemented more effectively. Maine could improve implementation of existing policies by hiring a dedicated alternative fuels staff-person, similar to Pennsylvania's alternative fuels program manager. Though there is concern over creating more "dead wood" in state government, increased staff-time could improve implementation, enhance the biofuels industry (applying for federal grants, for example) and create multiple benefits for a relatively small price.

2. POLICIES AIMED AT PRODUCTION

(a) Support research and development (R&D)

Maine's potential instate production is limited by the lack of cost-effective technology to convert forest

resources to biofuels. As such, research and development is an important priority among stakeholders, one which was recommended for legislation this term. The recent approval of the Maine Technology Institute (MTI) bond decreases the immediate need for legislation, but the State should make every effort to support R&D. Firstly, MTI should use at least part of its bond money to seek out and support biofuels R&D. Secondly, the State should commit to matching federal grant money for R&D when opportunities arise. Finally, Maine can increase its chances of receiving federal R&D grants by collaborating with other research institutions in the region. While R&D can be risky and expensive, a successful effort to access Maine's forest feedstocks would yield significant benefits.

3. POLICIES AIMED AT DISTRIBUTION

(a) Exempt alternative fuels from exclusivity contracts

Alternative fuel supply is constrained by franchise contracts which require retailers to buy and sell fuel solely from their parent company. If a parent company does not supply an alternative fuel, a franchise cannot sell it. New York recently exempted alternative fuels from such contracts. This policy is not a priority among Maine's current biofuels industry, but it costs nothing, is relatively straightforward to implement, and will remove a barrier to increased alternative fuel distribution in Maine. This could be achieved legislatively or through the Attorney General under the "Unfair or Deceptive Acts and Practices" statutes.

4. POLICIES AIMED AT CONSUMPTION

(a) Re-write and reinstate an excise tax cut on biofuels

Maine's excise tax cut on biodiesel was highly effective, doubling or tripling consumption and stimulating investment in blending infrastructure in at least four Maine terminals. This incentive is popular among Maine's biofuel industry. Though there were problems with the past incentive, including the cost to the State, a similar incentive could be written to reduce taxes on biofuels by ½ to ¼ cent per percent biofuel in the blend (a smaller, graduated incentive). As suggested at the stakeholder workshop, this tax cut could be funded through a small, revenue neutral tax shift to petroleum. Though this is potentially controversial, it has significant political support, would be economically efficient, and has proven to be effective.

(b) Department of Transportation (DOT) biodiesel purchasing requirement

State leadership is an effective way of moving markets. If the Maine DOT preferentially purchased biodiesel, it would increase market certainty for potential producers and retailers and set an example for others. While this policy may not be a high priority among stakeholders, it has broad support, little or no opposition and is easy to implement. Though it may cost the State money, it will yield climate benefits by reducing state greenhouse gas (GHG) emissions, and it will likely increase supply, production and consumption. This policy could be pursued through legislation or executive order.

(c) Pursue renewable fuels standard (RFS)/low carbon fuel standard (LCFS) at a regional level

The renewable fuels standard, which requires a certain percentage biofuel blended with petroleum

fuels, is the most effective state policy available for encouraging production and consumption. California is developing a technology-neutral version of the RFS, the low carbon fuel standard, which is intended to yield greater environmental benefits. It requires a 10% reduction in the GHG-intensity of transportation fuels by 2020. These policies would serve Maine well, but there is a concern that Maine's market is too small to require fuel dealers to make adjustments specific to Maine. Agencies should actively pursue these policies at a regional level.

	Action Item	**Description**	**Target**	**Initial Steps**	**Next Steps?**
Biofuels Industry in General	Clean Fuel Fund (CFF)	Combine existing funds into a single fund to support clean fuel and biofuel production, distribution and consumption.	Legislature AND	Pass legislation replacing existing funds with CFF	Add voluntary funding mechanisms
			DEP	Add CFF to list of SEPs	
	Study Sustainability Measures for Biofuels	Study sustainability certification, and, if recommended, restrict state support to certified biofuels	Legislature AND	Enact legislation requesting a study	Enact legislation restricting state support to certified biofuels?
			OEIS	Research sustainability certification and report to the legislature	
	Improve Implementation	Hire alternative fuels point person	Governor's Office AND	Allocate funding for additional staff time	
			OEIS	Seek applicants	
Production	Support R&D	Make state resources available for R&D and work to attract federal grants	MTI AND	Seek out and support biofuels R&D with bond	If and when necessary, replenish MTI's biofuels R&D money
			Legislature AND	Commit to matching federal grants with MEIF	
			Agencies, and Universities	Form a research consortium to attract grants	
Distribution	Exempt Alternative Fuels from Exclusivity Contracts	Allow retailers to provide alternative fuels when parent company does not offer them	Legislature OR	Enact legislation	
			Attorney General	Exempt alternative fuels from exclusivity contracts under Unfair or Deceptive Acts and Practices statutes	
Consumption	Biofuels Excise Tax Cut	Decrease the excise tax on biofuels – possibly shift excise taxes to petroleum equivalent	Legislature	Enact legislation	
	DOT Biodiesel Purchasing Requirement	Require the DOT to use B20 in its fleet	Legislature OR	Enact legislation	
			DOT OR	Purchase B20 preferentially	
			Governor	Issue an executive order	
	Pursue LCFS/RFS at Regional Level	Seek regional adoption of fuel standards either requiring a percentage biofuel or reducing the GHG-intensity of fuel	DEP AND	Raise as a priority at NESCAUM	Enact RFS triggered by regional RFS & production, feeding into LCFS?
			DOT	Raise as a priority at NEG/ECP	

For the text of the resolves, draft legislation, the methodology and limitations of this research, additional background on biofuels (including controversies and emerging technology), further reading, and a list of abbreviations, please see the appendix.

ADDENDUM

Distributed to the Utilities & Energy Committee February 14, 2008

A recent New York Times article (Rosenthal, 2008) questions the greenhouse gas benefits of biofuels. This article is based on two pieces in *Science Magazine* (Searchinger et al, 2008; Fargione et al, 2008),which examine the impacts of converting land to produce biofuels. The *Science* articles claim that biofuels will not yield greenhouse gas benefits unless growing biofuel feedstocks will store and sequester more carbon than the previous land-use. Otherwise, clearing the land will incur a "deficit" (by releasing GHGs) that it may take the biofuels years to pay back (by displacing fossil fuel emissions). According to Searchinger et al (2008), prohibiting land conversion for biofuels will only lead to indirect emissions by shifting food production elsewhere – causing land to be cleared for food. It is unlikely that these two articles will be the last word on this issue, as other scientists and policy analysts are already raising a number of counterarguments. Nevertheless, both articles add important insights to the debate. In light of these articles, I would like to make the following points regarding the recommendations of this report.

1. Sustainability measures provide a critical compliment to both the tax shift and DOT biodiesel purchase requirements. Without consideration of feedstock sources and sustainability, DOT biodiesel use and the tax shift may not provide greenhouse gas benefits and may, according to the recent articles, contribute to GHG-emissions. Furthermore, public support for biofuels (particularly from the environmental community) may erode if the State does not address sustainability.
2. The "default" measure for the the sustainability study (pp. 55 and 70) might be altered to restrict state support from all biofuels to biofuels produced from waste or byproduct feedstocks rather than to feedstocks with existing third-party certifications. This may merit more discussion.
3. It makes more sense to pursue the Low Carbon Fuels Standard at a regional level than to pursue the Renewable Fuels Standard. The Low Carbon Fuels Standard is designed to yield greenhouse gas benefits, while a Renewable Fuels Standard may not yield greenhouse gas benefits and, according to the recent articles, may contribute to the problem.
4. The recent articles should not affect the merit of the other recommendations:
   (a) Hiring an alternative fuel point person would still provide important capacity to improve implementation of existing policies, enhance Maine's industry, and increase the likelihood of success for future policies, particularly a sustainability study and the Clean Fuel Fund.
   (b) Combining the existing funds into a broader Clean Fuel Fund would benefit all clean fuels. Grant and loan applications can be evaluated for their environmental impact based on emerging information.
   (c) Supporting R&D is doubly important, as large-scale instate biofuel production is likely to be from forest products rather than crops, which do not involve land-use change, and thus may have a competitive edge as new policies emerge favoring low-carbon fuels.
   (d) Exempting clean fuels from exclusivity contracts will benefit all clean fuels, not just biofuels, and will remove a barrier in the market.

Biofuels are a moving target. The State nevertheless has an important role to play in building capacity for instate production, diversifying the market for all clean fuels and maximizing the benefits of biofuels through sustainability measures and/or a Low Carbon Fuel Standard. If the State chooses to take a leadership role, the recommendations above (discussed in greater detail in the report) offer effective policies to do so.

I. PROBLEM DEFINITION AND CLARIFICATION OF GOALS

The Maine state government (State) is interested in supporting alternatives to oil, and, in LD 1159 and LD 1347, the legislature asked for recommendations on how best to promote them. This report responds to those requests. On November 16, 2007, Governor Baldacci issued an executive order creating a task force to, among other things, "propose specific measures to promote the availability and use of alternative fuels, including biodiesel and ethanol for use as heating and transportation" (Baldacci, 2007). Now, with the price of oil close to $100 a barrel, this issue is of critical importance, deserving a timely response.

There are not enough alternatives to oil. Maine's over-dependence on petroleum may hurt its economy, threaten its independence and security and harm Mainers' health and environment.

Oil comes exclusively from beyond Maine's borders, and 60% nationally comes from other countries (Energy Information Administration [EIA], 2007a [data from 2005]). Every year, the average Maine household spends over $2,000 on transportation fuel. In addition, 78% of Maine households heat their homes with oil (Douglas, Maine State Economist, 2006). In 2003, Maine spent $2.6 billion on petroleum, only about 20% of which recirculates in state (Coleman, 2007a). Theoretically, if it remained in state, that money could help pay for 56,000 jobs (Coleman, 2007a). Mainers presumably spend significantly more on fuel now than in 2003, as prices climbed 20% in the last year alone (Baldacci, 2007).

Over-dependence on oil makes Maine vulnerable to disruptions in supply from natural disasters, such as Hurricane Katrina, and man-made disruptions, such as the Organization of Petroleum Exporting Countries (OPEC) embargo and deliberate terrorist attacks. Over-dependence on foreign oil is also destabilizing and can contribute to military involvement and expense. Furthermore, oil is a finite resource. While estimates for a global peak in oil production generally fall between 2004 and 2020 (Commission on Oil Independence, 2006; Lovins et al, 2005), Exxon Mobil, a conservative oil company, expects oil production to peak everywhere but OPEC just after 2010 (Exxon Mobil Corporation, 2006). Given America's unstable relationship with much of OPEC, this may be cause for concern.

In addition to its impact on Maine's economy and security, over-dependence on petroleum contributes to a number of environmental problems, including poor air quality and global climate change. The American Lung Association ranks several counties poorly for ozone and particulate pollution (American Lung Association, 2007), and Maine has the highest child asthma rate in New England (American Lung Association of Maine, 2007).

Mainers are also beginning to feel the effects of climate change. Temperatures are rising as precipitation declines (New England Climate Coalition, 2007). Global warming threatens to move Lyme disease and West Nile virus north and increase outbreaks of red tide (Sierra Club Maine Chapter, 2007). A recent study by the Natural Resources Council of Maine (NRCM) reveals the dramatic effect sea level rise would have on Maine, flooding Portland and other important coastal centers (NRCM, 2006). Maine's recent ratification of the Regional Greenhouse Gas Initiative (RGGI) demonstrates its commitment to reduce emissions in order to prevent such problems.

While over-dependence on oil is implicated in the problems discussed above, the market does not

adequately reflect these costs. Some estimate that if the price of these externalities were factored into gas prices, we would pay $10.86 per gallon (Copulos, 2006) and possibly more (International Center for Technology Assessment, 1998). Mainers have little alternative to oil, however; the recent increase in petroleum prices has not significantly reduced demand (EIA, 2007).

To correct these market failures and encourage diversity in the marketplace, the State can help support alternatives to petroleum and give Mainers a choice.

1. GOALS

Over-dependence on oil can send money out of state and overseas, diminish Maine's independence and security and contribute to environmental and health problems. It therefore makes sense to promote fuels that do not replicate these problems, but rather provide a true alternative, improving the economy, increasing energy independence and mitigating environmental problems. The Maine Office of Energy Independence and Security (OEIS) defines these goals as the "three 'E's" - three points of a triangle:

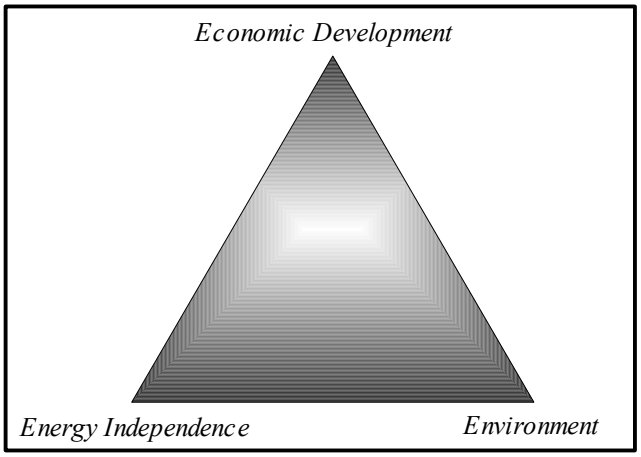

FIGURE 1: THE "THREE 'E'S"

2. ALTERNATIVES

Increased efficiency and reduced vehicle miles traveled are critical to mitigating our dependence on oil and should be a priority - it is difficult to find an alternative fuel that can make a dent in the petroleum market, truly offering a choice, without reducing consumption. Conservation, however, cannot be the sole alternative; there is warranted skepticism over the degree of lifestyle change Americans are willing to tolerate:

> "We do not think that it is a realistic possibility that this [reduced greenhouse gas emissions] target could be met by convincing North Americans to drive 75-85% fewer miles (or kilometers) by mid-century than they do today. Nor do we think it is realistic that manufacturers can make all gasoline-powered internal combustion engines use less than one-quarter the fuel they use today..." (Stoddard & Murrow, Environment Northeast, 2006. p. 138).

It is therefore important to provide alternative transportation fuels, not in place of, but as a complement to efficiency measures. There are several possible approaches, including electric and fuel cell vehicles and biofuels. There are also other alternative petroleum-based fuels, such as propane and compressed natural gas, which offer significant air quality and environmental benefits.

The primary purpose of this report, however, is to address biofuels,[2] as they represent the only near term alternative with the capacity to combat all three problems discussed above – economic development, energy independence and environmental health. It may be desirable, however, to design biofuels policies that do not "pick winners" and benefit other alternatives as well.

Biofuels should only be encouraged to the extent that they can contribute to economic development, energy independence, economic development and/or environmental health.[3] Policies to promote biofuels should therefore be designed with the "three 'E's" in mind.

3. BIOFUELS AS A SOLUTION

Biofuels are defined as liquid fuels produced from biomass (Demirbas, 2006). There are first-generation and second-generation biofuels. Second generation biofuels (discussed in appendix V.2), which include renewable diesel and bio-oil, rely on novel conversion tactics that have not yet reached economic feasibility. First generation biofuels – ethanol from starch and biodiesel from tallow or vegetable oil – are relatively common. Ethanol, which is similar to gasoline and usually blended with gasoline, is made from fermenting sugars in a manner similar to brewing alcohol. It is commonly made from sugar cane (in Brazil) and corn (in the U.S.) (Andersen, 2007a). All gasoline-powered vehicles can run on a blend of 10% ethanol, 90% gasoline (E10). Only "flex-fuel" (flexible fuel) vehicles (FFVs) can run on a blend of 85% ethanol, 15% gasoline (E85) (EthanolToday, 2007).

Biodiesel is similar to diesel fuel, and is commonly blended with diesel or other types of distillate fuel, such as number 2 heating oil. It is generally made through a process called transesterfication, which removes the glycerin from vegetable oil, making it less sticky and viscous, resulting in a consistency compatible with diesel fuel vehicles (Pahl, 2005). All diesel-powered vehicles can run on biodiesel, although pure biodiesel may dissolve rubber parts in older cars, and, because it is a solvent, may initially clog filters. Biodiesel also has a higher gel temperature than diesel, so pure biodiesel can cause problems in cold weather. Biodiesel is often blended with diesel in a 20% biodiesel, 80% diesel ratio (B20) or in a 5% biodiesel, 95% diesel ration (B5). It is commonly made from canola oil (in the EU), palm oil (in the EU) and soy oil (in the U.S.) (Pahl, 2005).

Biofuels are politically appealing because they appear to offer an alterative to oil with economic development, energy independence and environmental benefits.

(e) Economic development

2 Due to constraints of time and resources, this report does not deal directly with biogas or landfill gas (a gas produced from the anaerobic decomposition of organic waste, which is similar to natural gas, and can be used for heat, electricity or as a transportation fuel). Biogas is discussed in greater detail in appendix V.3.d. Though it is omitted here, biogas holds promise for Maine, and should be addressed in future studies. Some of the policy options discussed in this report could benefit biogas as well as other biofuels, however, and this should be considered in their evaluation.

3 For a discussion of biofuels' critiques and controversies, see appendix V.1

Over the last half-century, both the number of farms and the total acreage have declined more in Maine than in the nation as a whole – 80 and 62% respectively (Allen & Boyle, 2000). Manufacturing jobs in Maine have also declined more than the rest of the U.S. During the 1990's Maine lost 18.2% of its manufacturing jobs, compared to 5.4% nationally (Northeast-Midwest Institute, 2002). Biofuel feedstocks and production may have the potential to breathe life into both sectors. For example, northern Maine potato growers are considering growing canola for biodiesel production as a rotation crop with potatoes, which could increase revenue to farms. Others have suggested growing sugar beets as a feedstock for ethanol (Arnold, 2007). Sugar beets have a higher energy content than corn and grow well in Maine. The paper industry accounts for over a quarter of Maine's manufacturing jobs (Northeast-Midwest Institute, 2002), and there are ongoing research projects investigating making biofuels from the waste in the paper making industry or other sources of woody biomass, adding value and potentially reviving this declining industry. One of these projects expects to begin production in the next two years.

Producing biofuels in state could provide jobs in Maine's dwindling manufacturing sector and increase state revenues. Worldwatch Institute and Center for American Progress (2006) credit the U.S. ethanol industry with creating 154,000 new jobs in 2005 alone. A single 50-million gallon per year (mgy) ethanol plant can add $140 million to the local economy for construction, increase gross state output by $115 million annually, and add 40 full-time jobs (Urbanchuk, 2002; Urbanchuk, 2006; Coleman, 2007a). A Minnesota Department of Agriculture economic analysis credits the state's 60 mgy biodiesel industry with, among other benefits, increasing state output by $928 million and creating 122 direct jobs (Ye, 2006). A Northeast Regional Biomass Program (NRBP) report from 2000 estimates that a 50 mgy wood to ethanol plant in the northeast would yield $170-$200 million and 4,000-6,000 jobs from construction, $41-48 million in annual income and 540 to 830 new jobs (Resource Systems Group, Inc., 2000). A recent study by the University of Maine at Orono Forest Bioproducts Resource Insitute (UMO FBRI) estimates that producing ethanol from forest products in Maine would yield $884 per harvested acre from forest residues and $2,833 per harvested acre from roundwood products annually (it is unclear how revenue would be distributed among the interests involved) (Dickerson et al, 2007). It may be some time before Maine sees large-scale biofuels production, but the potential impact on Maine's economy is appealing.

There is some concern, however, that biofuels production from forest biomas may compete with existing industries for this resource. There is also a concern among the forest products industry that government policies supporting fuels from forest products is disrupting the market (Strauch, 2007). Policymakers should be aware of these concerns and potential negative consequences for Maine's existing industries.

(f) Energy independence

As discussed above, dependence on foreign oil can be politically destablizing. Most of Maine's oil comes from Canada and Venezuela (Elder, 2007). The growing antagonism between the United States and Venezuela is disconcerting; Maine and other New England states are caught in the dispute.[4] Increasing the domestic supply of oil through biofuels may help alleviate political instabilities associated with oil, providing a renewable and sustainable fuel supply. Second-generation technologies may

4 In the winter of 2005 and 2006, Venezuela gave discounted heating oil to Maine and other New England States. Some viewed this as an autocratic country attempting to buy friends in the U.S. (Pesca, 2006).

enable Maine to meet a significant portion of its fuel needs through indigenous resources (discussed in greater detail in chapter II).

Not all feedstocks are locally grown, however, and there are trade-offs to consider when focusing on energy independence versus other goals. Producing biofuels in state may yeild many long-term benefits, but, with current technology, Maine is unlikely to produce biofuels on a large scale. There are still potential environmental benefits from importing biofuels from the Midwest that may be missed if Maine focuses purely on instate production. Likewise, developing countries in the Global South are in a better position to produce biofuels with a high energy balance (little energy invested for a high energy return) and erecting trade barriers may raise food prices in the developing world while yielding little benefit for Third World farmers (Worldwatch Institute, 2007). This complex interplay is discussed in greater detail in appendix V.1. Biofuels nonetheless have potential to increase energy independence as compared to their petroleum counterparts.

(g) Environment

i. Air quality

Biofuel proponents also argue that biofuels have the potential to improve urban air quality and decrease lung disease. Pure biodiesel (B100) emits half as much particulate matter (soot) as diesel, which may reduce the risk of respiratory disease and premature deaths (Union of Concerned Scientists, 2004). Biodiesel also produces fewer unburned hydrocarbon and carbon monoxide emissions than diesel. It is lead free, (Pahl, 2005) and pure biodiesel emits 60-90% fewer air toxics such as formaldehyde, benzene and xylene, which increase the risk of cancer, immune system disorders and reproductive problems (Union of Concerned Scientists, 2004). There is some controversy over biodiesel's effect on nitrogen oxides (NOx), a pollutant regulated under the Clean Air Act. A National Renewable Energy Laboratory (NREL) study showed that B20 increased NOx emissions 2.3% (Morris, 2003). A more recent study in the City of Richardson (2006) found that B20 reduced NOx emissions 13.4 – 16.9%. Another recent study found differences between B20 and ultra-low sulfur diesel to be negligable (Holden et al, 2006). Further research is needed to settle these discrepancies.

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		?	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), and assume all other fuel parameters (e.g. sulfur, aromatics) are held constant.
(2) "( )" indicates a "likely" impact; "?" indicates incomplete data or scientific uncertainty.

FIGURE 2: BIOFUELS AND AIR QUALITY. SOURCE: COLEMAN, 2007.

Because of its high oxygen content, ethanol proponents argue that it improves air quality as well. Blends may reduce smog-forming emissions by 25% and carbon monoxide 10-30% (American

Coalition for Ethanol, 2007a). There is some controversy over its effect on ozone, as some studies based on computer models predict that ethanol blends could increase ozone. Other studies, based on collected air quality data, suggest that ethanol blends decrease ozone (Hulsey & Coleman, 2006). Final judgment on this is suspended until all the research is available.

ii. Climate change

As discussed above, climate change is a problem threatening Maine's quality of life, which the State Government is working to address. Biofuels have the potential to reduce Maine's greenhouse gas (GHG) emissions. Although burning biofuels releases carbon dioxide (CO2), the net emissions from biofuels are generally less than petroleum (U.S. Environmental Protection Agency [EPA], 2007a). This is because, rather than digging up a source of carbon dioxide which has remained sequestered for millions of years, biofuels are produced from plants, which have only recently taken carbon dioxide out of the atmosphere. Assuming that the feedstocks harvested to produce biofuels are replanted, those plants should take a comparable amount of carbon dioxide out of the atmosphere, reducing the net amount of greenhouse gases emitted. The actual net reduction depends on how the biofuel is produced, specifically on whether land was disturbed or cleared to grow the crops, how much petroleum is used to grow, harvest and process the feedstock, as well as the energy content of the feedstock, how the feedstock is processed and how far the feedstock and fuel are distributed. The complexity involved in this life cycle analysis, as it is called, has led to disagreement among the scientific community regarding the net benefits of biofuels. This controversy is discussed in greater detail in appendix V.1.

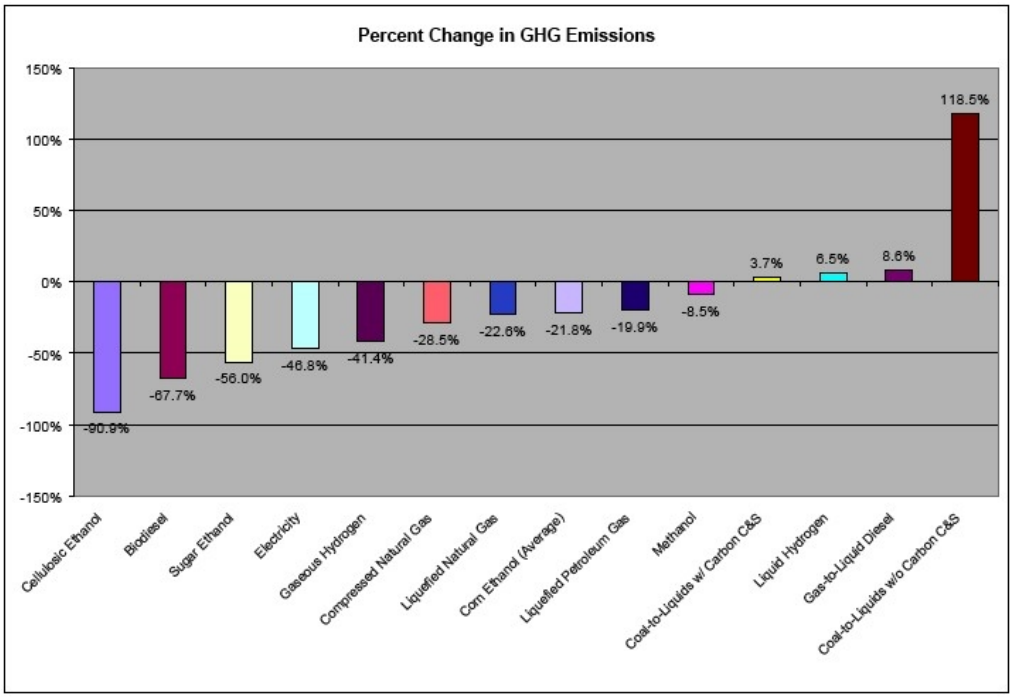

FIGURE 3: ESTIMATES FOR THE GHG IMPACTS OF ALTERNATIVE FUELS PER BTU, AS COMPARED TO THEIR PETROLEUM EQUIVALENTS (U.S. EPA, 2007a)

The Environmental Protection Agency estimates that, per Btu (British thermal unit), pure corn ethanol reduces GHG emissions as compared to gasoline by 21.8%, biodiesel reduces emissions compared to

diesel by 67.7%, and cellulosic ethanol reduces GHG emissions by 90.9% (U.S. EPA, 2007a). Blends, which are more commonly used than pure biofuels, reduce emissions proportionately, depending on the ratio of biofuel to petroleum. In Maine's Climate Action Plan to meet Maine's emission goal of 10% below 1990 levels by 2010 (written through a stakeholder process in 2004), requiring 10% ethanol and 5% biodiesel in all fuel would yield the sixth highest GHG reduction of all 54 options by 2020 and result in multiple co-benefits (though 33 of the options would provide less expensive GHG mitigation) (Maine Department of Environmental Protection [DEP], 2004). The action plan also recommended biofuels in state fleets.

In sum, biofuel proponents argue that biofuels can encourage economic development, increase energy independence, decrease greenhouse gas emissions and improve air quality and health. Though biofuels have the potential to yeild multiple benefits, their actual impact depends on the specifics of the fuel – the feedstock and means of production. Moreover, there is controversy among the scientific and environmental community over whether benefits outweigh detriments. These controversies are complex and therefore not discussed in great detail in the body of the report. Please see appendix V.1 for more detail.

While biofuels have the potential to yield multiple benefits, different policies to promote biofuels invariably have trade-offs. It is difficult to promote all "Three 'E's" – economic development, energy independence and the environment – through a single policy.

4. TRADE-OFFS AND POLICY EVALUATION

Biofuels have potential to be win-win-win – promoting economic development, energy independence and environmental health. Policies to promote biofuels necessarily promote one or two of these goals more than others, however. Investment in instate production for example, may yield the greatest economic benefits, but, at least for the near term, may have little impact on GHG abatement or energy independence (because near term instate production is limited by lack of feedstock and cost-effective conversion technologies). Conversely, policies that focus on consumption and distribution may have greater benefits in terms of GHG reduction and energy independence but may yield little economic benefit. While the division between distribution and consumption can seem arbitrary, for the purposes of this report, policies aimed at distrubution focus on encouraging distribution infrastructure (such as pumps and tanks). When evaluating policy alternatives, policy-makers should consider these trade-offs. The purpose of the following model is to generalize and conceptualize trade-offs:

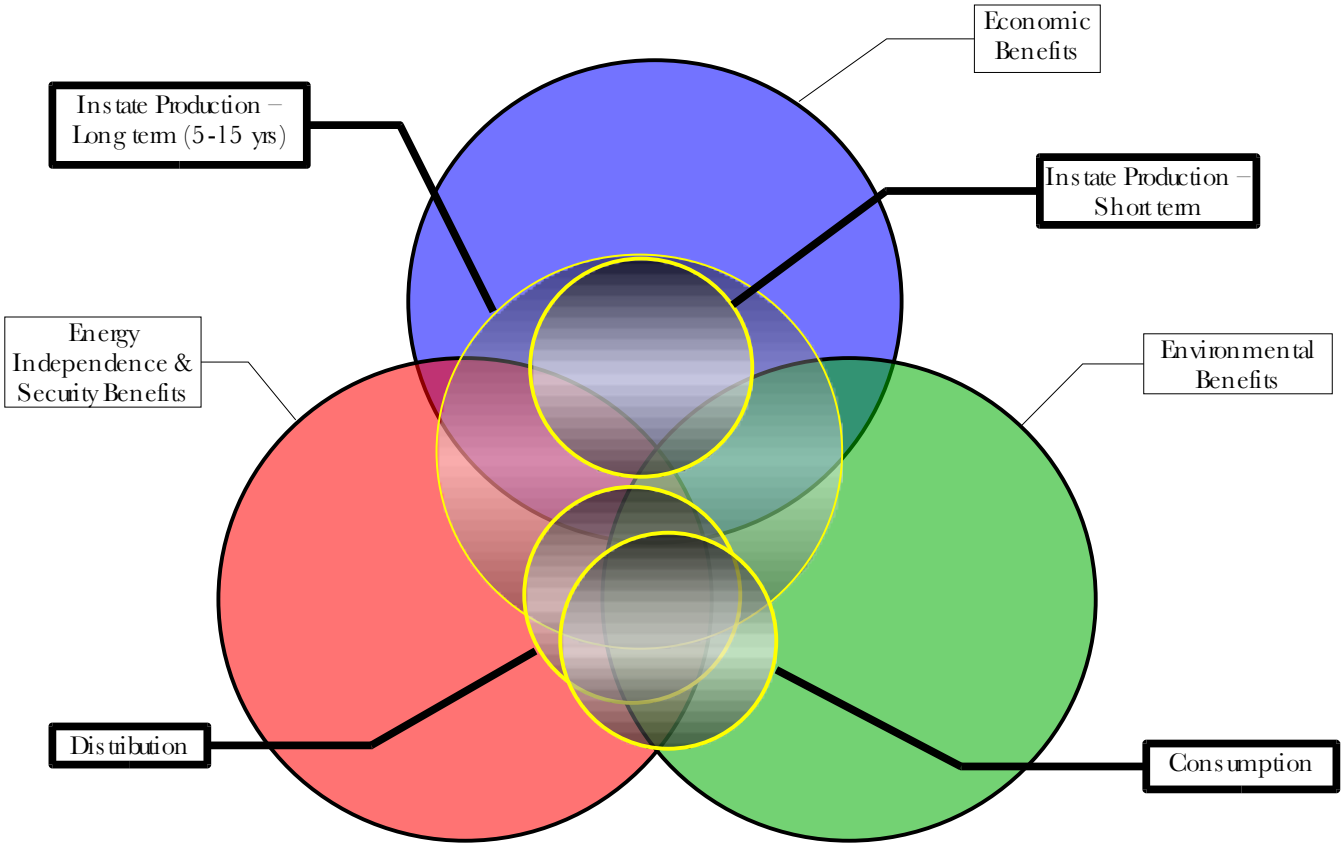

FIGURE 4: EVALUATING THE TRADE-OFFS: Overlap between sectors and goals

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- *The large, colored circles represent the "three 'E's": economic development (blue sphere),energy independence (red sphere) and the environment (green sphere).*
- *The smaller, shaded gray spheres with yellow borders represent policies which focus on different sectors – production, distribution and consumption.*
  - → *There are two spheres for instate production – a small one to represent short term instate production and a large one to represent long term instate production.*
- *The gray "sector" spheres overlap with the colored goal spheres differently:*
  - → *Production falls mostly in the economic development goal, at least for the short term, with long term production overlapping with all three spheres (long term means 5-15 years).*
    - *Production is limited in its short term potential for energy independence and environmental benefits because there is a limited amount of biofuels that can be produced cost-effectively, with existing technology, from indigenous resources. Instate production is likely to yield greater environmental and energy independence benefits once the technology to convert cellulosic feedstocks to biofuels is economically viable.*
  - → *There is a fine distinction between distribution and consumption because the two closely mirror each other. They diverge, as has happened in Maine, when significant consumption among large fleets does not lead to new pumps or supply infrastructure accessible to the public:*
    - *Consumption has potential for both energy independence and environmental benefits.*
    - *Distribution also has energy independence and environmental benefits, though it falls more in the energy*

independence sphere because more public access to pumps leads to more energy security. It also falls more in the economic development sphere because of the potential economic gains for new suppliers.
- *(Policies to promote consumption generally drive distribution, however, more than vice versa)*

In addition to recognizing the policy trade-offs in terms of goals, there are other criteria for evaluating policy alternatives. The following questions are used to inform policy analysis in the following chapters, particularly chapters V and VI.

- Impact:
  - Costs:
    - How much will this policy cost the State?
    - Will it impose costs on others?
  - Benefits:
    - Goals:
      - Will this policy option provide diversity and choice in Maine's liquid fuel market?
      - What goals does this policy help fulfill, and how well will it fulfill them?
        - Economic development
        - Energy independence
        - Environmental health
    - Barriers:
      - What barriers to Maine's biofuel market will this policy address and how well will it address them?
      - How fundamental are these barriers?
    - Multiple benefits:
      - Will investment in one area drive others? (ie, should we focus more on production, distribution or consumption?)
      - Are there other co-benefits?
  - Time-line:
    - What is the time-line? When will impacts occur?
- Feasibility:
  - Is there political resistance?
  - Is there political support?
  - Is this policy politically appealing?
  - Does Maine have the capacity to implement this policy?
  - How likely is it that it will fulfill its intended purpose?
    - Has this policy been effective in Maine in the past?
    - How effective is this policy in other states?

II. MAINE'S BIOFUEL MARKET

Maine uses roughly 727 million gallons of gasoline and 712 million gallons of distillate fuel per year (EIA, 2007a[data from 2005]). Diesel used for transportation accounts for approximately 192 million gallons of the distillate fuel use, and heating oil accounts for 350 mgy. Gasoline used for transportation accounts for approximately 716 million gallons a year mgy (EIA, 2007a). The remainder is used for commercial and industrial uses.

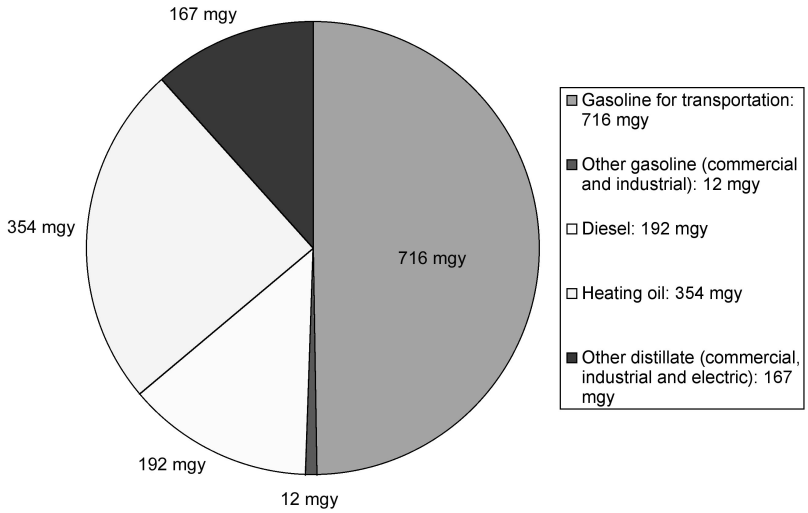

FIGURE 5: MAINE PETROLEUM CONSUMPTION IN MILLIONS OF GALLONS PER YEAR *(not including liquefied petroleum gases or jet fuel). Data compiled from the Energy Information Administration, 2007a (figures from 2005).*

1. PRODUCTION POTENTIAL FROM INDIGENOUS RESOURCES

A number of studies estimate the total potential of instate biofuels production to displace petroleum use in Maine. In 2002, the Finance Authority of Maine (FAME) commissioned a study of ethanol production, which concluded that a first phase plant using barley as a feedstock could produce about 5 million gallons a year (using half the state's barley crop). The second phase, using less than one third of Maine's wood residue could produce about 32 million gallons of ethanol (BBI International, 2002). This represents about 4.5% of Maine's gasoline use. In 2006, the Fractionation Development Center (FDC) commissioned a report that suggested that the thermal conversion of sustainably harvested forest biomass in Maine could meet 50% of Maine's fuel needs (Evans & McCormick, 2006), and staff at the Fractionation Development Center claimed it could meet 100% (Christiansen, 2007). A proprietary study conducted in 2003 suggested that much of Maine's fuel needs could be met using waste biomass (Morgan, 2007).

More recently, in the fall of 2007, the University of Maine at Orono's Forest Bioproducts Research Initiative released a study suggesting that Maine could meet 18% of its gasoline needs with sustainably harvested forest residues and an additional 58% from roundwood, for a total of 77% of gasoline consumption. If forest resources were directed instead towards production of renewable diesel, 39% of Maine's diesel consumption could be displaced. Roundwood could displace an additional 109% (Dickerson et al, 2007).

When estimating indigenous potential, it is important to look at the current use of feedstocks. Some

feedstocks, such as barley, would have be diverted from their current use. Other feedstocks, such as canola, could be grown as a rotation crop with existing crops to improve crop heath and increase revenues. To use the example above, forest residues are not generally harvested (Dickerson et al, 2007), so harvesting them for biofuels (while leaving enough to regenerate soil and prevent erosion) would not likely compete with other uses. There are a number of competing uses for roundwood including pulp and paper, however, which should be taken into account – there is concern among the existing forest products industry that biofuels may compete for resources, particularly if heavily subsidized (Strauch, 2007).

Maine is a long way from reaching the fuel-production potential outlined in any of these estimates.

2. ETHANOL

The oil shock of the 1970s sparked some early investment in producing ethanol from sugar beets, but, when oil prices dropped, the project failed (Linnell, 2007). More recently, a small trial in northern Maine using potato waste failed due to low yields and a barn fire, which destroyed equipment (Carroll, 2006). Peter Arnold of Chewonki's Pathways to a Sustainable Future has a license to produce ethanol and expects to have a small distillery to make ethanol from corn, for educational purposes only (Arnold, 2007). There is at least one plan to build a commercial ethanol plant, which would make ethanol out of hemicellulose extracted from the pulp and paper process at a mill in Old Town – Red Shield Environmental hopes to begin production within two years. (Bilodeau, 2007).

Safe Handling, Maine's primary biodiesel importer, recently opened an ethanol terminal in Auburn, providing a less circuitous route to the Boston area market (Meyer, 2007). This may stimulate the market in Maine, as well. The eight Xtra Mart stations in Maine have recently begun supplying E10 (10% ethanol, 90% gasoline). It is unclear whether they will continue to do so year-round, as air quality standards vary.[5] There are no E85 ethanol pumps in Maine, though there is some interest in putting in E85 pumps in the Portland and Bangor areas (Linnell, 2007). While there are over 125,000 flex-fuel vehicles in the state (Linnell, 2007 [data from the Bureau of Motor Vehicles, 2003]), none of them run on E85.

3. BIODIESEL

The biodiesel market is developing faster than ethanol. In 2001, Maine's first biodiesel supplier, Frontier Energy, began offering biodiesel at a pump in China, Maine. Frontier became the first oil company to offer bioheat (biodiesel mixed with number two heating oil for use in home furnaces) in the country. That same year, the Chewonki Foundation, a camp and environmental education center, received a grant from the Maine Technology Institute (MTI) to demonstrate biodiesel production in Maine (Chewonki Foundation, 2007). Chewonki and Frontier Energy have been leaders promoting biodiesel in Maine ever since, working on several grants together to develop the biodiesel industry.

(a) Production

There is now officially one instate biodiesel producer, Green Bean Bio-Fuel, which produced

5 Though currently unconfirmed, it is likely that the Xtra Mart is importing E10 to Maine pre-blended from another state. If that is the case, it is unlikely that the gasoline component would meet Maine's summertime air quality standards for reid vapor pressure (Morrill, 2007).

approximately 150,000 gallons in the past year (September 2006 – September 2007) from waste grease, but recently expanded capacity. Green Bean is now producing at a rate of about 300,000 gallons a year, with plans to gradually increase to just under a million. It is estimated that 1.8 million gallons of waste grease are collected from restaurants every year (Chewonki, 2007), but Mainers may produce as much as 4.9 million gallons a year.[6] At least two other potential producers are interested in utilizing this feedstock, as well.

	Feedstock	**Total Quantity**	**Producer**	**Quantity**	**Phase**	**Product**
Waste	Yellow grease	1.8-4.9 mgy (0.93-2.56% of diesel market)	Green Bean Bio-Fuel, Vassalboro	Just under 1 mgy	Expansion	Biodiesel
			Maine Bio-Fuel, Inc, Portland	250,000 gy +	?	
			?, Fairfield	?	?	
			Chewonki Foundation, Wiscasset	Demonstration	Production	
	Organic waste	*100%*	*Theoretical*[7]	*n/a*	*n/a*	*Renewable diesel*
Crops	Canola	0.5-1 mgy (0.26- 0.5%)	Maliseet, Aroostook County	?	Planning	Biodiesel
	Cull Potatoes	?	Farmers Group Bio-Energy, Frenchville	?	Planning	Ethanol
	Barley	*5 mgy (0.68%)*	*Theoretical*[8]	*n/a*	*n/a*	
	Sugar Beets[9]	*?*	*?*	*?*	*?*	
Forest Products	Hemicellulose	See section II.1 above for estimates	Red Shield Environmental, Old Town	~ 2 mgy?	Planning	Ethanol
	?		Maine Biofuels, Cumberland County	?	?	?
	Waste fiber		Dynamotives	10 mgy?	Planning	Bio-oil
Imported feedstocks	Soy and other vegetable oils	?	Dirigo Biofuels, Bucksport	30 mgy	Planning	Biodiesel

FIGURE 6: FEEDSTOCK AND PRODUCTION POTENTIAL. *This table shows the major feedstocks available in Maine, the total quantity of biofuel possible from that feedstock in million gallons a year (mgy), gallons a year (gy) or as a percentage of Maine's fuel use (a percentage of the diesel market for biodiesel, or a percentage of the total gasoline market for ethanol). It also shows potential producers hoping to utilize that feedstock, the quantity they plan to produce, their status or phase (planning, construction or production), and the product they plan to produce (ethanol, biodiesel or seocond generation biofuels, such as renewable diesel or bio-oil). Theoretical production is listed in italics. This is not a comprehensive list of potential producers in Maine. There are other individuals or organizations who do not appear here either because there is no public information about them, or because they are too early in the process to merit mention. Some information is intentionally left blank, or marked with a question mark, due to privacy concerns.*

There are a number of other individuals or organizations interested in producing biofuels in the state from a wide array of feedstocks, including canola grown as a rotation crop with potatoes, forest residues

6 A Chewonki study estimated that approximately 1.8 mgy waste restaurant grease are recovered. A National Renewable Energy Lab study estimates that the average person produces approximately three gallons of waste grease per year (Coleman, 2007a). With a population of roughly 1.3 million, Maine could be producing as much as 4.9 mgy waste grease per year. Not all of that is currently collected, however.

7 According to a 2003 proprietary study.

8 In 2002, BBI International study the potential for ethanol in Maine and concluded that, with half the State's barley crop, an ethanol plant could produce 5 mgy.

9 In the 1970s, investors planned to produce ethanol from sugar beets. The project failed due to falling oil prices and declining subsidies (Linnell, 2007). Sugar beets are a valuable feedstock for biofuels in France, and are second only to sugar cane in gallons per acre. Because they are a root-crop, they are more chemically and energy intensive, however. Also, due to disease, they should not be planted more than once every three years in the same field (Worldwatch Institute, 2007).

and wood waste, and imported soy oil from the Midwest. While these potential producers remain optimistic, progress is often slow. Barriers to production are discussed in greater detail below.

(b) Distribution

Biodiesel distribution is increasing rapidly. There are ten or so pumps in Maine, roughly twice as many as last year, and ten times as many as 2004. These include Solar Market in Arundel, Frontier Energy in China, Green Bean Bio-Fuel in Vassalboro, Maritime Energy in Union and Rockport, Dead River in Brunswick, C.N. Brown in South Portland, Poland and Waterville, and MDI Biofuels on Mount Desert.[10] Irving and Dysart's were also blending 2% biodiesel into their diesel, but stopped when the excise tax cut ended (discussed below). Other companies, including Downeast Energy, Giroux Oil, Harvest Fuels, Independence Fuel, Webber Energy and Winthrop Fuel offer bioheat. Figure 7, below, shows the biodiesel suppliers in Maine and the services they offer. Seven of these companies are newly involved in the biodiesel market this year.

Biodiesel Suppliers	Heat	Transport	Marine	Large Fleets	Imports	Produces
CN Brown	B2-B20	Pumps in S. Portland, Poland & Waterville				
Dead River		B5 – pump in Brunswick				
Diesel Direct						
Downeast Energy	B5					
Frontier Energy	B5&B20	B20 – pump in China				
Giroux Oil	B5					
Green Bean Bio-Fuel	Custom	Pump in Vassalboro – blend varies				
Harvest Fuels	B20					
Independence Fuel	B5&B20	B5&B20 off-road in Durham				
Irving						
Maritime	B5	B20 – pumps in Union & Rockport				
MDI Biofuel		Custom - will deliver within 50 mi of MDI	Custom			
Safe Handling						
Solar Market		B100 in Arundel				
Sprague						
Strouts Point			B20			
Webber	B5					
Winthrop Fuel	B5					

FIGURE 7: BIODIESEL SUPPLY IN MAINE *Boxes in gray indicate the services offered by a supplier. "Heat" means a supplier will deliver bioheat – the blend is indicated in the box. "Transport" means that the supplier either has pumps available to the public, or will deliver directly to vehicles. "Marine" indicates that a supplier offers biodiesel for marine use. "Large Fleets" means that a supplier will accommodate large fleets. Some suppliers, such as Sprague, Irving, and Diesel Direct will only offer biodiesel blends for large fleets. "Imports" means that this supplier imports biodiesel from out of state. "Produces" means that this supplier produces its own biodiesel.*

10 This is not technically a pump, but rather a delivery truck with the capacity to pump into vehicles.

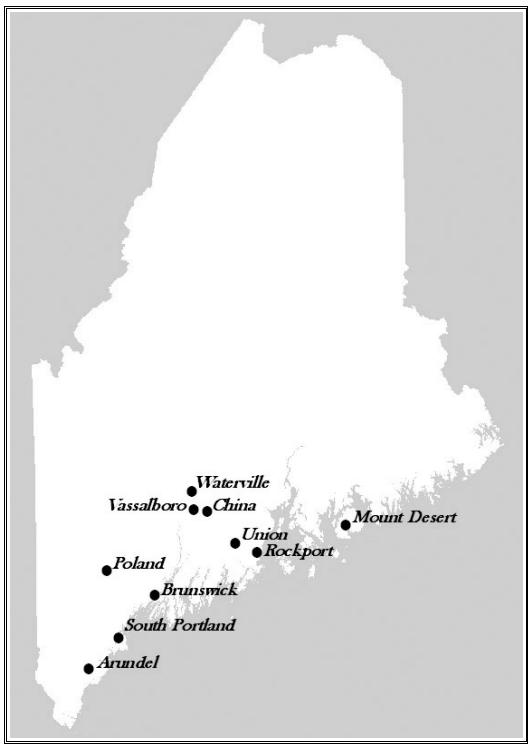

FIGURE 8: MAP OF BIODIESEL PUMPS IN MAINE

(c) Consumption and demand

Biodiesel consumption has also increased ten-fold in the last three years. In 2004, Maine used approximately 60-70,000 gallons of biodiesel. During the past year (September 2006 – September 2007), Maine used over 600,000 gallons of pure biodiesel (Meyer, 2007; Glatz, 2007; Bean, 2007). Consumption has dropped, however, now that the excise tax cut has ended (Meyer, 2007) (see section V.3.b. below).

Pioneer biodiesel-user L.L. Bean is now joined by Acadia National Park, Dragon Cement, Safe Handling, Poland Spring, Hannaford Brothers Grocery and Oakhurst Dairy, among others. Colleges and universities, including Bates, Bowdoin, Unity, Colby and the University of Southern Maine, also use biodiesel or bioheat. Both Portland and Bangor run their fleets on biodiesel, as do Falmouth, Cape Elizabeth, Scarborough, South Portland, Biddeford, Saco, and Old Orchard Beach.[11]

Demand for biodiesel in Maine is robust. A joint grant between the Chewonki Foundation and Maine Energy Investment Corporation (MEIC) called "Biodiesel for Maine" (BFM) documented demand for over 3 million gallons of pure biodiesel a year (Rockefeller & Morgan, 2006a). BFM is discussed in greater detail below.

There are a number of organizations in Maine researching and promoting biofuels. These include: the Chewonki Foundation, a camp and educational organization; Maine Energy Investment Corporation, which helps "mainstream" renewable energy; Maine Technology Institute, which fosters the renewable energy industry through grants; Maine Clean Communities, a non-profit promoting alternative fuels as part of a national network; Environmental/Energy Technology Council, an association of private and

11 This is not a comprehensive list. There are many biodiesel-users and new users all the time.

non-profit organizations promoting the renewable energy sector; the Northeast Regional Biomass Program; Maine Bioenergy Alliance; and the University of Maine at Orono, which has several federal grants to foster bioproducts research and create a forest biorefinery for cellulosic ethanol. Some of these organizations and their efforts are discussed in the following chapter.

4. BARRIERS

Maine has a nascent biodiesel industry with growing demand and consumption, but little ethanol industry to speak of. While fleets are commonly switching to biodiesel, and the bioheat market is growing, there are still relatively few biofuel pumps available to the public. Maine currently imports biodiesel from out of state, and, with Safe Handling's new ethanol terminal, now imports ethanol, as well. The state produces some biodiesel, but no ethanol yet. At every link in the supply chain, there are major barriers to overcome:

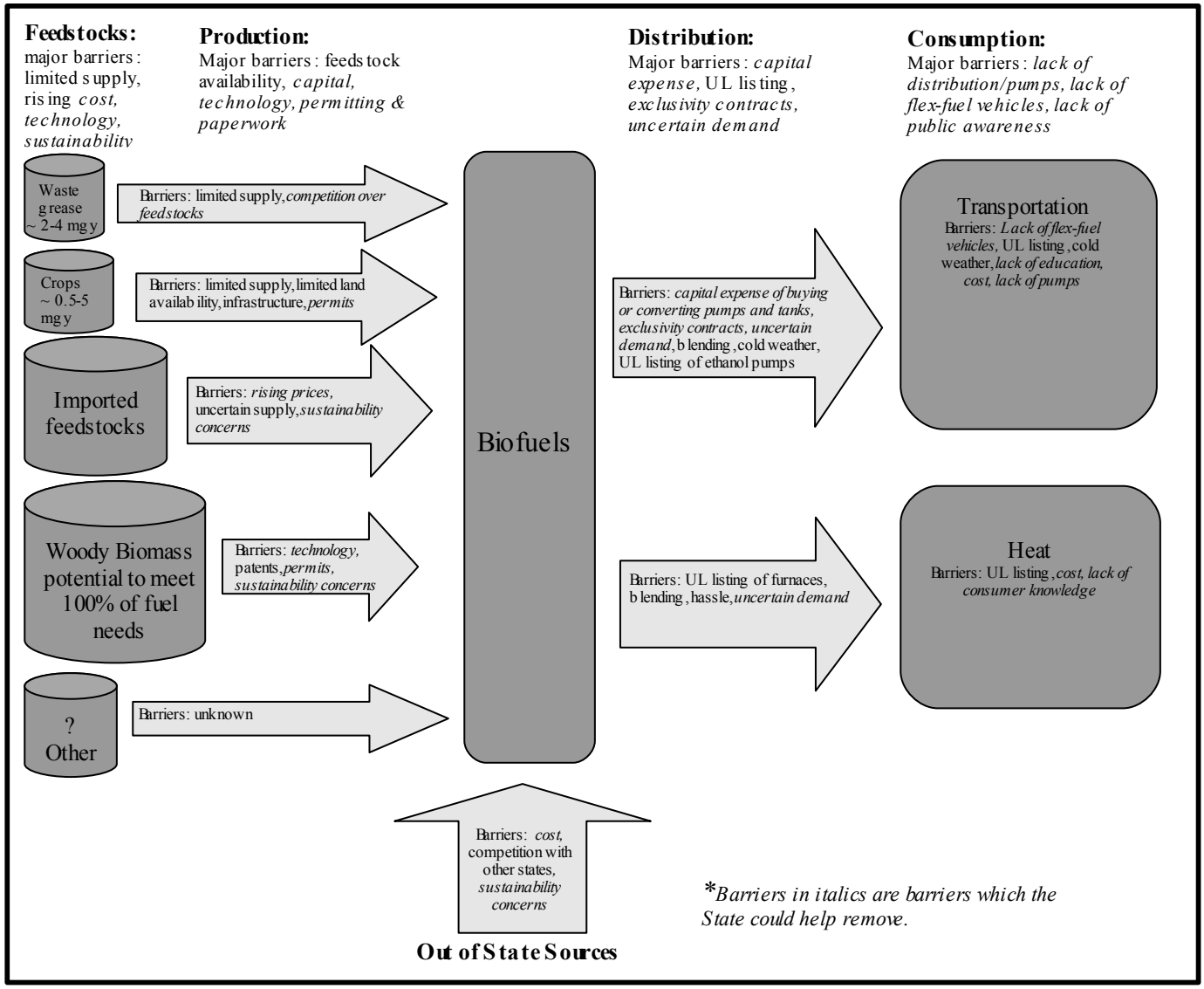

FIGURE 9: MODEL OF BIOFUELS MARKET AND BARRIERS IN MAINE

Figure 9 illustrates the biofuels market in Maine, with barriers listed at every stage. This model moves

along the supply chain, beginning with "feedstocks" on the left, and ending with "consumption" on the right. Barriers are indicated within the components of the model, and major barriers for each stage are listed at the top. The State cannot control all of these barriers (such as limited land availability). In the model above, those barriers that the State can address are in italics. Barriers are described in detail below. They are grouped loosely by sector, but there is overlap – some barriers belong in more than one sector, as illustrated above.

BARRIERS THE STATE CAN ADDRESS:

	Sustainability Concerns:	*There has been a recent flurry of bad press surrounding biofuels and their feedstocks. The details of this are discussed in appendix V.1. These concerns are particularly relevant for imported feedstocks, but some Mainers are also concerned about the sustainable use of Maine's forests. In order to gain environmentalists' support and maximize the benefits of biofuels, it may be important for the State to address these concerns.*
Production	**Technology:**	*The technology to convert woody biomass to biofuels is still emerging and is not yet cost-competitive. Maine is 90% forested, so cost-competitive technology could remove the single largest barrier to instate production – lack of feedstocks.*
	Feedstock competition:	*Feedstock competition is emerging as a barrier to instate production. Competition over waste-grease is particularly severe as out of state haulers see their business threatened and fight to maintain territory. Competition over forest products with paper companies is also problematic. Competition over imported feedstocks is driving up prices.*
	Permitting & Paperwork:	*Several of Maine's potential producers believe Maine's permitting process is time-consuming and burdensome. This applies to the paperwork required to get grants and incentives, as well.*
	Capital:	*The infrastructure and equipment required to produce and supply biofuels can be capital-intensive. In some cases, on the production side, lack of investors has stalled the process. However, this is not true for the producers who control their feedstocks, which seems to indicate that feedstocks are a more fundamental barrier.*
Distribution	**Exclusivity Contracts:**	*Many oil companies have contracts with their franchises that prohibit them from buying fuel from another source. These contracts can prohibit franchises from offering biofuels under their awnings.*
	Lack of Pumps:	*Maine is one of only ten or so states in the country without E85 pumps (National Ethanol Vehicle Coalition [NEVC], 2007). This is a major barrier to ethanol consumption in Maine. There are also relatively few biodiesel pumps available to the public. This barrier cannot be addressed in isolation because it is caused by other barriers, including capital, cost, exclusivity contracts, uncertain demand, and lack of FFVs.*
	Cost:	*Feedstocks can be expensive, and sometimes biofuels are more expensive than their petroleum equivalents. The cost barrier for feedstocks and biofuels are grouped together because they are interconnected, and measures that affect one tend to affect the other.*
Consumption	**Uncertain Demand:**	*A potential supplier has to gamble on investing in biofuel pumps. This is a more significant problem with ethanol than biodiesel and is tied to the number of flex-fuel vehicles, discussed below. This is no longer a major barrier for biodiesel producers, though it may still be a barrier for distribution.*
	Lack of Flex-Fuel Vehicles:[12]	*While there are a number of flex-fuel vehicles in the state (likely more than 125,000), they are spread throughout the state. This can inhibit investment in pumps. When E85 becomes available, lack of FFVs can inhibit use.*
	Public Awareness:	*While knowledge about biofuels is increasing, lack of understanding can still pose a barrier. Many consumers do not know, for example, that they can use bioheat in their furnace. There is also a persistent misunderstanding that diesel cars need to be "converted" to run on biodiesel blends. Other consumers may not know that they own FFVs.*

12 There are no diesel passenger vehicles available for sale in the country because these vehicles do not meet new federal Low Emission Vehicle standards for nitrogen oxides (ME DEP, 2007a). This does not currently appear to be a major barrier to the biofuels market in Maine, but it could become one in the future.

The State has already taken steps to address many of these barriers, including technology, capital, cost, uncertain demand and public awareness. The State's current and recent policies on biofuels are discussed and evaluated in the next chapter.

III. MAINE'S CURRENT BIOFUELS POLICIES & PROGRAMS

The following programs are divided by the barrier they attempt to address: technology, capital investment, cost, uncertain demand, public awareness and lack of flex-fuel vehicles. These are not the only barriers in the Maine biofuels market; rather, they are immediate problems on which the State Government has acted. Programs are evaluated based on interviews, the author's experience and research, and, when available, formal third party evaluations.

There are countless federal biofuels programs that affect or are active in Maine, including the federal blenders' credit, tax credits for alternative fuel vehicles and alternative fuel refueling stations, the U.S. Department of Energy (DOE) Clean Cities program and the federal renewable fuels standard (RFS). These programs are not addressed here. Only federal programs that the State has some role in implementing are included.[13]

1. TECHNOLOGY

The Maine State Government has invested in three institutions involved in biofuels research and development – the Maine Technology Institute, the University of Maine at Orono and the Fractionation Development Center. In 2003, the State supported all three of these institutions through a $1 million congressional earmark (Brooks, 2007). There is also a Renewable Resource Fund, which has funded some biofuels R&D.

(a) Maine Technology Institute

The legislature started the Maine Technology Institute in 1999 in order to "encourage, promote, stimulate and support research and development activity leading to the commercialization of new products and services in the state's technology-intensive industrial sectors to enhance the competitive position of those sectors and increase the likelihood that one or more of the sectors will support clusters of industrial activity and to create jobs for Maine people." (Maine Office of Revised Statutes, Title 5, §15302)

MTI has funded a number of biofuels research projects through both seed grants and a dedicated grant program called the Forest Bio-Products Fund. The Forest Bio-Products Fund, funded through a $1 million grant from the DOE, supported biofuels projects at Tethys Research, LLC (Bangor), Maine Biodiesel LP (Rumford), Maine Bioproducts LP (Rumford), and Safe Handling, Inc. (Auburn). This fund is now closed (MTI, 2007a).

MTI seed grants have also funded a number of biofuel-related projects, including Maine Biofuels (Cumberland County), Farmers Group Bio-Energy (Frenchville), and the River Valley Biorefinery. MTI also gave a Cluster Enhancement Award to the River Valley Technology Council to work with the Fractionation Development Center, discussed below (Colgan & Andrews, 2007; MTI, 2006).

Evaluation: A 2007 evaluation of the program concluded that MTI has largely succeeded in fulfilling its mission, with "60% of research projects resulting in marketable products" and helping to create 664 new jobs between 2002 and 2006 (Colgan & Andrews, 2007, p. 4). None of MTI's research projects

13 Due to the scale of information and time constraints, this material deals exclusively with information critical to State involvement. There are other barriers and other programs not included or addressed in this material.

have led to any large scale biofuels production in Maine yet, but this does not negate the organization's role in biofuels research and development. Interviews revealed that MTI's critical role is much appreciated among stakeholders in Maine's biofuel industry. It is possible that its role could be strengthened, however, by reinvesting in the Forest Bio-Products Fund or creating a similar fund for alternative fuels R&D and giving more dedicated, long-term support to biofuels projects.

(b) Renewable Resource Fund

In 1999, the state legislature established a Renewable Resource Fund. The Fund, collected from voluntary contributions through electric utility bills, is intended to fund renewable resource R&D (by state universities) as well as community demonstration projects. The legislation (Maine Office of Revised Statutes, Title 35-A §3210) defines "renewable resource," as "a source of electrical generation." Despite this narrow definition, MTI allocated $10,000 from this fund to match a cluster enhancement award to the Northern Maine Development Commission for a feasibility study, "determining the economic viability of processing vegetable oil feed-stocks (principally from rapeseed [also known as canola], which is inter cropped with potatoes) and available animal fat into biodiesel fuel in the northern Maine/New Brunswick region" (MTI, 2006, p. 9). As of July, 2007, this fund had over $350,000 available (NC State University, 2007).

Evaluation: The narrow definition of "renewable resource" may constrain the Renewable Resource Fund's support of biofuels. Eligible applicants are also narrowly defined to include only Maine universities, non-profits and community organizations. This program could be broadened to make it more accessible.

(c) University of Maine

As early as 2000, the Maine State Government began working with the University of Maine at Orono to enhance its biofuels research capacity. A 2002 Maine Department of Environmental Protection and State Planning Office (SPO) Report to Natural Resources Sub-Cabinet details these early activities, opportunities and recommendations (SPO & DEP, 2002). In 2005, the U.S. Department of Energy gave the University a three-year $1 million grant to research making biofuels from the paper-making process. In the spring of 2006, UMO received an additional $6.9 million from the National Science Foundation (NSF) for its "Forest Bioproducts Research Initiative." The State Government matched NSF's grant with a $3.45 million appropriation through its Maine Economic Improvement Fund (MEIF). The program has since secured additional funding from the U.S. Department of Energy (University of Maine, 2007).

The most visible component of this project is the redevelopment of a decommissioned paper mill in Old Town, with Red Shield Environmental LLC, to produce ethanol from waste hemicellulose in the paper-making process (Bilodeau, 2007) – a promising beginning.

Evaluation: The American Association for the Advancement of Science program Research Competitiveness Service released a favorable six-month evaluation of this project (Shaler, 2007).

(d) Fractionation Development Center

In 2004, the State Government allocated $500,000 federal money to the River Valley Technology

Center in Rumford to help it create a Fractionation Development Center (FDC) (Maine House Democrats, 2004). Shortly thereafter, the Maine Technology Institute awarded the Center an $80,000 cluster enhancement award for the same purpose (Sun Journal, 2004). The mission of the Fractionation Development Center, a 501(c)3 non-profit, is "to identify, attract to Maine, and commercialize viable biomass-conversion technologies for the purpose of advancing energy security, economic activity, and sustainable resource use" (FDC, 2007). FDC staff further identified job creation as a principal goal (Christiansen, 2007).

In 2006, FDC produced a Maine Biorefinery Feasibility Study, which estimated that Maine forests could meet 50% of the state's fuel needs in 20 years, laying out a plan and identifying the technology to meet that goal (Evans & McCormick, 2006). Shortly after the release of this report, the Center began looking for mill sites to implement this plan. It began negotiating with the NewPage Mill in Rumford, but the Mill refused to move as rapidly as the FDC wished (FDC wanted an agreement by early summer, 2007). The NewPage Mill had concerns about discharge permits and worried that the fractionation process might compete with it for raw materials (Sun Journal, 2007). FDC subsequently approached Millinocket for a biorefinery site (Sambides, 2007), to no avail.

In July 2007, Senator Bryant of Dixfield submitted a bill to appropriate $700,000 from the general fund to the FDC over two years. The bill failed, however, and the FDC lost state funding (Office of Legislative Information, 2007a). Despite this setback, as of July 2007, the organization was hopeful that it could find other sources of support (Christiansen, 2007).

Evaluation: The Legislature made a *de facto* evaluation of the FDC when it refused to extend its funding. This is not to say the project has been unsuccessful, however, just that it has not become a major legislative priority.

The FDC faces two critical challenges. Firstly, it has attempted to achieve technology deployment on a political time-line. Technology deployment, even more than technology development, can be a time-consuming process. The second major challenge is the diversity of the Center's goals. It is playing both the role of venture capitalist and the role of state development agency – trying to jump-start new businesses while maximizing the benefits to Maine's economy and job market, goals which sometimes conflict.

2. CAPITAL

The capital investment required to produce and distribute biofuels can be prohibitive. Maine has several programs aimed at reducing the capital barriers to production and supply. These include the Agriculturally Derived Fuels Fund, a clean fuel infrastructure tax credit, the Clean Fuel Vehicle Fund and federal grants administered through state agencies. A problem common to most of these programs is the size of grants necessary to be effective – Maine's grants are often too small (Inches, 2007).

(a) Clean Fuel Vehicle Fund

In 1997, the legislature established the "Clean Fuel Vehicle Fund" (CFVF) (Maine Office of Revised Statutes, Title 10, §1023-K), intended as a revolving fund to provide "direct loans to finance all or part of any clean fuel vehicle project." The Finance Authority of Maine, the implementing authority, defines "clean fuel vehicle projects" as "the acquisition or lease of clean fuel vehicles, the acquisition of

clean fuel vehicle delivery systems and other clean fuel vehicle components, the conversion of vehicle fuel systems to the use of clean fuels and the acquisition of capital equipment necessary to establish clean fuel vehicle support and maintenance facilities" (FAME, 1998). It appears that this definition could include installation of biofuel refueling infrastructure.

The legislature originally funded the CFVF through an appropriation. In 2001, however, the legislature added section 3-A, the High-pollution Vehicle Retirement Pilot Program, also known as "scrap and buy," to the statute, which split the fund, dispersing half the fund through one-time payments for vehicle retirement (Brooks, 2007; Linnell, 2007; Morrill, 2007). The legislature repealed this program in 2003. The other portion of the fund remained unused, and so the legislature re-appropriated most of the remaining money for other purposes.

Evaluation: This fund has not accomplished its intended purpose. It may have been before its time (before there was sufficient interest in clean fuels), and it may be too restrictive to attract many applicants. These two problems resulted in dormant funds, vulnerable to re-appropriation. Now that the timing is right, it is of little use because it lacks sufficient funds. It is possible that this fund could be revived or altered, however – this is discussed in chapters V and VI.

(b) Agriculturally Derived Fuels Fund

In 1999, the State created an Agriculturally Derived Fuels Fund (Maine Office of Revised Statutes, Title 10, §997-A) "to provide assistance to promote the production and use of agriculturally derived fuels." The bill defined "agriculturally derived fuel" as "methanol or ethanol produced from organic matter that is available on a renewable basis, including agricultural crops and agricultural wastes and residues." It aimed to support agriculturally derived fuels through "direct loans, secured loans and investments." Originally, the Finance Authority of Maine and the Agricultural Products Utilization Commission were to oversee the fund. In May 2007, however, the legislature abolished the Agricultural Products Utilization Commission along with other inactive committees (Office of Legislative Information, 2007b). A grant from the National Renewable Energy Laboratory initially contributed to this fund, but it has not been funded since (Brooks, 2007). The legislation authorized FAME to "apply for and accept any appropriation, grant, gift or service made available from public or private sources."

In 2002, FAME commissioned BBI International to study the feasibility of ethanol production in Maine. The study concluded that, while possible, there would be problems securing sufficient locally-grown grain feedstocks, transportation of feedstocks from elsewhere would be prohibitively expensive, and the technology was not yet ready for cost-effective use of cellulosic feedstocks (BBI, 2002). It is possible that this feasibility study discouraged FAME from seeking additional funds.

Evaluation: This fund has not successfully provided capital for biofuels projects in Maine. It is unfunded and defines biofuels too narrowly. Perhaps it, like the CVFV, was before its time.

(c) Clean fuel infrastructure tax credit

In 1999, the state legislature passed an income tax credit worth 25% of the capital costs of "construction or installation of or improvements to any filling or charging station in this State for the purposes of providing clean fuels to the general public for use in motor vehicles" (Maine Office of

Revised Statutes, Title 36 §5219-P). This credit was extended through 2008.

Evaluation: For better or for worse, the stipulation "to the general public" has narrowed the applicability of this incentive. Safe Handling, for example, considered utilizing this incentive for a biodiesel pump, but it would have built the pump for its vehicles on its property, which the company deems unsafe for the general public (Meyer, 2007). Further, some Maine biofuel suppliers have opted to install key-card operated pumps because of the reduced insurance rates (customers sign waivers to get a key-card, which lowers the insurance) (Bean, 2007). These pumps might not be considered "public." Though it may be slightly restrictive, it is a good incentive to have in place, particularly as interest in biofuels grows. The legislature should consider extending it.

(d) Federal grant programs

Finally, there are several federal grant programs, administered through state agencies, that can provide capital and low interest loans for biofuels projects. These include the U.S. DOE State Energy Program administered by the Public Utilities Commission (PUC), U.S. Department of Agriculture (USDA) Renewable Energy Systems and Energy Efficiency Improvement Grants administered by the state USDA offices and U.S. EPA grants administered by the Department of Environmental Protection.

Evaluation: Some of these grants have been helpful in promoting public education and conducting feasibility studies, but they have rarely, if ever, successfully provided capital for infrastructure or production. There are several reasons for this.

Firstly, the grant applications are complex and have many stipulations. Maine's first official biodiesel producer has tried for three years to get a USDA grant, which would have paid 25% of capital investment as well as supplied a guaranteed low interest loan. The paperwork is complicated, however, and the technical stipulations difficult to meet. In 2005, he applied for the grant, but did not realize until too late that he also had to submit a business plan. In 2006, he applied for a grant and loan to cover his investment in a new building, but he had already built part of the building and was therefore ineligible (Bean, 2007). Similarly tight stipulations stymied a State Energy Program grant awarded to the Maine DEP to promote biodiesel. The DEP developed a $10,000 grant to put biodiesel pumps in the greater Portland area, specifically on the Portland Peninsula. The grant specified that customers had to be able to swipe credit cards at the pump, which increases the capital cost of pumps. The DEP received only one application for this grant, which it rejected because the location could not accommodate large enough vehicles (Glatz, 2007).

Secondly, the time it takes to write and award grants can be problematic. In at least one case, by the time the grant process was completed and the grant awarded, the window of opportunity for the project had passed, and the grant fell through.

Finally, as discussed at the beginning of this section, some of these grants may be too small to effectively provide capital for distribution and production infrastructure (Inches, 2007).

3. COST

The cost of feedstocks and fuel is a major barrier to biofuel production, distribution and consumption. There are several programs aimed at reducing the cost. These include a statute which equalizes excise

taxes based on energy content, a production credit and an excise tax cut for biodiesel blends, which recently sunset.

(a) Special Fuel Tax Act

In 2001, the legislature passed the "Special Fuel Tax Act" (Maine Office of Revised Statutes, Title 36 §3203), which equalized the state excise tax on fuels based on energy content. This act benefits ethanol, because the energy content per gallon is about two thirds that of gasoline (Worldwatch Institute, 2007). It reduced the excise tax from 22 cents per gallon to 15.6 cents per gallon. It also benefited other alternative fuels, such as propane. There is currently an effort underway to update and revise this, so that it would apply to more fuels and more accurately reflect their energy content (Linnell, 2007; Bliss, 2007). This amendment would not change the tax rate for ethanol, but it would reduce the excise tax on pure biodiesel by 2.3 cents. It does not appear that it would affect blended biodiesel, however, which is more common in Maine due in part to cold weather gelling problems.

Evaluation: While the Special Fuel Tax Act benefits alternative fuels as compared to the previous per gallon tax, it cannot legitimately be considered an incentive; it only levels the playing field. Because one must purchase a greater quantity of a lower-energy fuel to travel the same distance, one pays exactly the same amount in excise taxes under this system, whether using gasoline or ethanol as a fuel. This is nevertheless an important piece of legislation that should not be undermined.

(b) Production credit

Effective January 2004, the legislature passed a 5 cent income tax credit for every gallon of commercial biofuel (defined broadly) produced (Maine Office or Revised Statutes, Title 36 §5219-X).

Evaluation: A production credit could potentially be effective – such incentives are effective in other states. The paperwork involved (production must be certified by the Commissioner of Environmental Protection) delayed Maine's only ASTM-certified producer in receiving the credit but should not be a major barrier. The incentive is less than that offered in other states (the average producer credit, among states that have them, is 15 cents [Coleman, 2007a]), however, and, according to one potential producer, is insufficient to overcome cost barriers.

(c) Biodiesel excise tax cut

In 2005, the legislature amended the Special Fuel Tax Act above to reduce the excise tax on biodiesel blends of 2% or more to 20 cents per gallon – nearly 8 cents less than the tax on diesel. The fiscal note for this incentive was $20,000 per year (Maine Office of Revised Statutes, Title 36 §3203).

Evaluation: Some consider this incentive, which ended fall 2007, a disaster. Instead of costing $20,000 a year, the incentive cost the state at least $125,000 (Lewis, 2007), and possibly much more.[14] Further, fuel dealers blended 2% biodiesel into their diesel, capturing the benefits of the tax cut without passing on savings or letting their customers know they were using biodiesel. This was not the intended

14 Maine used more than 600,000 gallons of pure biodiesel this year. Not all of that was blended into on-road B2, but if it were, it would make 30 million gallons of B2. If the State gave an 8 cent credit for 30 million gallons of B2, it would cost $2.4 million. This represents an upper limit on what the excise tax cut may have cost Maine. Exact numbers are not yet forthcoming.

purpose of the incentive (Vanags, 2007). Others criticized this policy for favoring biodiesel over other alternative fuels and "picking winners."

In spite of the problems discussed above, this incentive was highly effective. It approximately doubled (maybe even tripled) the amount of biodiesel use in the state (Meyer, 2007; Glatz, 2007). Furthermore, some oil dealers used the profits from the excise tax cut to cover the costs of installing blending capacity in their terminals, so it also helped pay for distribution infrastructure. Additionally, Sprague Oil claims this incentive was the reason it opened a biodiesel blending terminal in Maine – the company believed the incentive would last longer than a year.

The final word on this incentive depends on the cost to the State. Doubling state biofuel use and stimulating blending capacity at four Maine terminals is not an insignificant rate of return on approximately $125,000. It may seem a measly return, however, if it cost the State more than a million.

Regardless of the cost, it was a missed opportunity not to require fuel dealers to let their customers know they were using biodiesel blends. Now that the bill has sunset, the increased biodiesel use has evaporated, and no one realizes anything has changed. There is no increased public awareness or demand.

There are several ways in which this incentive could have been improved or could be re-written for the future. A lower excise tax cut (a 5 cent tax cut is more common in other states [U.S. DOE – Alternative Fuels Data Center, 2007]) on higher blends (for example, B20 and above), or a graduated tax cut based on blends (for example, ½ cent per percent) and biodiesel signs at pumps could reduce costs to the State, help promote public awareness and ensure a more permanent impact on Maine's markets.

4. UNCERTAIN DEMAND

Demand is no longer the major barrier it once was, at least for biodiesel. Most of Maine's biodiesel suppliers report steady growth, and the number of biodiesel suppliers has increased rapidly over the last year. The growth in demand may be attributed to a multiplicity of factors, including rising fuel prices, federal and state programs which decreased the price of biofuels, increased environmental awareness, and successful state programs that aim to increase biofuel use and promote public awareness.

In spite of recent successes, uncertain demand remains a barrier, particularly for the installation of public pumps. There are no E85 pumps in the state. Biodiesel use has increased dramatically among large users (such as municipalities, universities and private companies), but there are still relatively few pumps available to the public, partly due to the risky capital investment and uncertain demand.

(a) Leading by example

The State Government has made an effort to lead by example in biofuel use. In 2003, the State used biodiesel on a trial basis in Department of Transportation vehicles, as well as for heat in several of its buildings (Energy Advisors, LLC, 2005). Though it never utilized biodiesel in its vehicles on any large scale, it has used bioheat ever since. There have been recent efforts to expand use. In fall 2007, the Department of Transportation (DOT) put out a competitive bid request for approximately 21% of its diesel use (425,000 gallons) that included B20 and regular diesel as options (Peabody, 2007).

Unfortunately, only one company bid to supply B20, and the cost was 50 cents higher. DOT put out a second bid, and no companies bid to supply B20. DOT will request bids again June 30, 2008 (Peabody, 2007).

Evaluation: While the State should be commended for its use of bioheat, some regret that state use has not been more visible, and is not well-known. Broader scale DOT use would be more publicly visible and set an example for municipalities considering biofuel use in their fleets. It could also help increase biofuel pumps and production by ensuring demand (this is discussed in greater detail in section VI.2.d.iv). The lack of competitive B20 bids is somewhat surprising, suggesting that there may be other barriers within the biodiesel market. The DOT will only accept the least cost bid, however, (Nadeau, 2007), so it is possible that, since B20 tends to cost 5-10 cents more than diesel, biodiesel suppliers are not submitting bids because they fear they cannot compete. Guaranteed preferential treatment for B20 might increase B20 bids and lead to greater success.

(b) Biodiesel for Maine[15]

Several years ago, the major barrier facing potential producers was uncertain demand. To address this barrier, the Chewonki Foundation, in collaboration with Maine Energy Investment Corporation, Frontier Energy, the Biodiesel Development Project, and the Environmental/Energy Technology Council, received a grant from the Maine State Energy Program of the Maine Public Utilities Commission and the U. S. Department of Energy for the Biodiesel for Maine project.

BFM aimed to build market demand for biodiesel to at least 250,000 – 500,000 gallons per year. To achieve this target, BFM presented to large diesel-users to educate them about biodiesel and asked them to sign non-binding letters of interest to document and aggregate demand. Biodiesel for Maine documented demand for over 700,000 gallons of pure biodiesel per year (3.2 million gallons of demand for B20 and 1.1 million gallons of B5) plus an additional 2.58 million gallons of demand for pure biodiesel for Loring Bioenergy LLC, which was under construction. BFM acquired letters of interest from 45 separate organizations (Rockefeller & Morgan, 2006a).

BFM also wrote and distributed quarterly E-newsletters, maintained a website on biodiesel in Maine, and produced and disseminated public education handouts. It received an additional grant from the Gulf of Maine Council for the Marine Environment to extend its outreach to marine users.

The grant for BFM ended in the fall of 2006, though MEIC hopes to secure funding to resume quarterly newsletters and revamp the website. Meanwhile, the Chewonki Foundation is embarking on a new public education project to encourage 5% bioheat in all heating oil in five years (Arnold, 2007).

Evaluation: There is no question that BFM was successful in accomplishing its immediate goals. How much of this was due to external circumstances (such as the federal blenders credit, which reduced the price of biofuels, and the rising price of diesel) is unclear. Furthermore, documenting demand for biodiesel has not immediately spurred the increase in instate production that the project had originally hoped for, perhaps because other barriers, such as uncertain feedstock supply, have since arrisen. Finally, the project had implicitly assumed that if large diesel users began using biodiesel, public access

15 In the interest of full disclosure, the author worked for Maine Energy Investment Corporation on the Biodiesel for Maine project from early 2005 through summer of 2006. She will again work for BFM as a part-time contractor, beginning January 2008.

and consumption would follow. Experience has shown that while fleet use has climbed substantially, many large users have their own pumps and tanks, and there are still relatively few biofuel pumps accessible to the public. This type of public education has an important role to play, however, and BFM filled an important niche.

(c) DOT directive

In 2006, the Department of Transportation issued a directive to encourage biodiesel use among Maine public transportation providers. The DOT will pay either the incremental cost of biodiesel or cut the local share of new vehicles in half (from 10% to 5%) for documented biodiesel use (Cole, 2006). This is an extension of a previous directive that applied to all alternative fuels (Linnell, 2007).

Evaluation: It may be premature to evaluate this incentive, but it already appears that fleets are taking advantage of it, and it is having a positive effect (Linnell, 2007).

5. LACK OF VEHICLES

(a) Clean fuel vehicle insurance

In 1997, the legislature enacted a clean fuel vehicle incentive (Maine Office of Revised Statutes, Title 24-A, §2303-B), which allows insurers to give special rates to clean fuel vehicles: "an insurer may credit or refund any portion of the premium charges for an insurance policy for a clean fuel vehicle in order to encourage its policyholders to use clean fuel vehicles if insurance premiums on other vehicles are not increased to fund these credits or refunds."

Evaluation: This incentive is voluntary for insurance companies, and it is unclear how often it is used. Nevertheless, it does not cost the State anything, and it could help provide an extra incentive for purchasing flex-fuel vehicles.

(b) Exemption from the sale or lease tax on the incremental cost of a clean fuel vehicle

From 1999 to January 2006, the State offered an exemption from the sale or lease tax on the incremental cost of clean fuel vehicles. For vehicles with no gasoline-powered equivalent, the sales tax was reduced 30% for internal combustion vehicles and 50% for fuel-cell and electric vehicles. This incentive expired in 2006, and various attempts to extend it have died in appropriations (Linnell, 2007).

Evaluation: Theoretically, this incentive could apply to flex-fuel vehicles, though they may not incur an incremental cost. That could change, however. Moreover, this incentive benefits fuel-efficient vehicles, such as hybrids, and encouraging fuel-efficiency is central to the success of biofuels in Maine, as biofuels have limited potential to displace petroleum at current consumption rates.

(c) Alternative fuel vehicles in state fleets – executive orders

On January 7, 2003, Governor Angus King issued an executive order called "Procurement of Fuel Efficient, Less Polluting Vehicles," which asked state agencies to, among other things, "promote the procurement of dedicated alternative fuel vehicles and dual-fuel vehicles and fueling infrastructures to

support such vehicles" (King, 2003). The following year, Governor John E. Baldacci issued an "Order Concerning Increasing The Efficiency Of State Government's Transportation Sector," which asked the Departments of Environmental Protection and Transportation and the Chair of the Energy Resources Council to "study the use of cleaner alternative and renewable fuels in state vehicles pursuant to Resolve 2003, Chapter 50 (L.D. 1184) to determine their relative availability, cost, efficiency, environmental impact and economic development potential. The Departments of Administrative and Financial Services, Transportation, Public Safety, and other agencies shall evaluate the study recommendations for implementation based on their cost-effectiveness, considering full life cycle costs, environmental impacts, and the available resources of state agencies" (Baldacci, 2004)

Evaluation: The report Baldacci ordered was never completed as, according to agency staff, "the State did not provide the resources to undertake such a study." Thus, state agencies were unable to incorporate the recommendations into the design of their fleets.

In sum, Maine has a number of promising policies on the books. Unfortunately, insufficient funding, tight stipulations, complicated paperwork, contradictory goals, and conflicting time-lines have impeded implementation and diminished the impact of some of these policies and programs.

While Maine has made progress addressing the barriers in the biofuels markets and has diminished some barriers (such as uncertain demand for biodiesel), all of the major barriers remain. In some cases, better implementation of current programs could help remove barriers. For example, grants and tax incentives could be made more accessible to reduce the cost and capital barriers. In other cases, new or additional programs are needed. Moreover, Maine has not yet attempted to address feedstock competition, permitting and paperwork, exclusivity contracts or sustainability concerns. Some of the policy options discussed in chapter V attempt to address these barriers. While work remains, Maine's current policies offer a promising starting place for diversifying the liquid fuel market.

The following chapter illustrates other states' strategies, offering examples to inform Maine's future policy choices.

IV. COMMON POLICIES TO PROMOTE BIOFUELS

1. FEDERAL POLICIES

The federal government promotes biofuels using an array of policy tools: mandates, inducements and capacity-building instruments (McDonnell and Elmore,1987). The major federal mandate is the renewable fuels standard (RFS). There are two types of renewable fuels standards – prescriptive and performance-based (Coleman, 2007a). The federal RFS is a performance standard, setting annual volume goals for renewable fuels sold (Coleman, 2007a). Refiners, blenders and importers can trade or purchase renewable identification numbers, a form of credit, to meet the overall volume (U.S. EPA, 2007b). The Energy Independence and Security Act of 2007, passed in December, amended the 2005 Energy Act to increase the RFS to 9 billion gallons in 2008, rising to 36 billion gallons by 2022 (Renewable Fuels Association, 2007). The major federal inducement is a 51 cent per gallon (cpg) tax credit on ethanol and a dollar per gallon tax credit on biodiesel (U.S. DOE – Alternative Fuels Data Center [AFDC], 2007). There is also a significant amount of federal money invested in building capacity for biofuels production by promoting R&D. In February 2007, the DOE announced it would allocate $385 million to six cellulosic ethanol plants (Andersen, 2007a). The 2007 Farm Bill (which has passed the House but not yet the Senate) would allocate $500 million over five years for development of cellulosic technology (Andersen, 2007a).

2. COMMON STATE POLICIES

Beyond the federal government, there is a patchwork of state policies which utilize inducements, mandates and capacity building instruments. Many states have renewable fuel standards, which tend to be prescriptive rather than performance-based, requiring a certain percentage of a specified biofuel in all fuel (Coleman, 2007a). Common policies can be further divided by sector – production, distribution, and consumption. The following chart shows the most common types of policies, with a few illustrative examples for each. It also shows the date instituted and the mechanisms used.[16]

16 To see all state biofuels policies, visit the U.S. DOE's Alternative Fuels Vehicles Data Center: http://www.eere.energy.gov/afdc/incentives_laws.html

Production:	***Policies***	***State***	***Date***	***Mechanism***	***Program***
Inducements	Financial incentives per gallon produced	MN	2000	Cash payment	MN's commissioner of agriculture makes cash payments of 20 cents (temporarily reduced to 13 cents) per gallon of ethanol produced, up to a total of $3 million per producer.
		AR	2003	Grants	AR's Alternative Fuel Commission provides grants of 10 cents per gallon of biodiesel produced, up to a total of 5 million gallons.
		IN	2003	Tax credit	Biodiesel producers may receive a tax credit of $1.00 per gallon up to $3 million total.
	Incentives for capital investment in production	WA	2003	Tax credit	WA gives a tax break on investments in buildings, equipment, land and labor for the purposes of producing biodiesel.
		IA	1998, 2001	Loans	IA has two favorable loan programs that provide capital for biodiesel production.
		CT	2007	Grants	The Connecticut Qualified Biodiesel Producer Incentive Account provides grants for production equipment or retrofit of production facilities up to 25% of the cost or $3 million.
Capacity Building	Incentives for R&D	IA	2007	Grants	Iowa's "$100 Million Power Fund," will allocate $100 million over four years to biofuels R&D, as well as other renewable energy and efficiency programs.
		FL	2006	Tax credit	FL provides a credit against the sales and use tax of 75% of the cost of R&D, up to $6.5 million.
Distribution:	***Policies***	***State***	***Date***	***Mechanism***	***Program***
Inducements	Incentives for capital investment in distribution infrastructure and equipment	AR	2003	Tax credit	AR provides an income tax credit of 5% of the cost of equipment for biodiesel suppliers
		WA	2003	Tax cut	Equipment used for biofuel supply is exempt from sales and use tax
		OK	1990	Loans	OK's Alternative Fuel Vehicle and Refueling Infrastructure Loans provides up to $150,000 zero interest loans to government entities for refueling infrastructure.
		NY	2006	Grants	The New York State Energy Research and Development Authority (NYSERDA) has a $10 million competitive grant program for installation of alternative fuel pumps.
Consumption:	***Policies***	***State***	***Date***	***Mechanism***	***Program***
Mandates	Renewable fuels standard	MN	1991, 2002	Leg. mandate	In 1991, MN passed a law requiring that all gasoline, with a few exceptions, contain 10% ethanol, by volume. The legislature recently increased the required blend to 20%, to go into effect in 2013. In 2002, MN passed a law requiring 2% biodiesel in all diesel. This went into effect in 2005.
		LA	2006		LA has a "triggered" RFS - it will go into effect six months after instate production reaches a given level.
	State use – leading by example	OH	2005	Executive order	Ohio's Department of Transportation is required to use at least 1 million gallons of biodiesel a year.
		IA	2005	Executive order	All State vehicles procured before 2010 must be hybrid electric or alternative fuel vehicles. FFVs must use E85 when available.
Inducements	Renewable fuels standard	IA	2006	Tax credit	Beginning in 2009, fuel retailers must sell 5% biofuel, increasing annually, as a total percentage of fuel sales. They receive a tax credit, the size of which depends on how close they come to meeting the prescribed percentage biofuel.
	Financial incentives for biofuel consumption for specific users	NJ	2003	Rebate	The Local Government Biodiesel Rebate Program will reimburse eligible local governments, schools and universities for the incremental cost of biodiesel. It will also reimburse farmers for bioheat.
		NV	2007	Grants	A portion of air pollution penalties must go to the school district in the area where the pollution occurred to fund 1) education or 2) clean fuel use.
	Per-gallon financial incentives for consumption and distribution	IL	2003	Tax cut	E85 ethanol incurs no sales or excise tax cuts. Blends of biodiesel of 10% or less incur 80% of sales and use taxes. Blends of more than 10% incur no tax.
		USA	2005	Tax credit	The Energy Policy Act of 2005 provides a tax credit to blenders/retailers of 1 cent per percent biodiesel from agriculture, and a half cent per percent biodiesel from waste grease in the blend. It provides $.0051 per percent ethanol in a blend.

FIGURE 10: COMMON STATE POLICIES TO PROMOTE BIOFUELS. *All information in the above table is from the U.S. DOE's Alternative Fuel Data Center (www.eere.energy.gov/afdc/), as well as, in some cases, from state statutes and codes.*

Evaluation of state policies depends on the goals and evaluation criteria. If instate production and consumption are the primary goal, then the renewable fuels standard is likely the most effective (Andersen, 2007b; Rockefeller & Morgan, 2006b). State leadership is also considered a best management practice for encouraging production and supply (Andersen, 2007b). As illustrated below, many leading states invest in government implementation capacity and oversight. Per-gallon tax incentives are also highly effective (Rockefeller & Morgan, 2006b), but if the goal is instate production, these should be aimed at producers rather than retailers (Werner, 2007).

Policies aimed at production and consumption tend to be more effective than policies aimed at distribution (Rockefeller & Morgan, 2006b), perhaps because improving distribution infrastructure without ensuring demand or production can be a risky venture. Leading biofuel states combine a variety of these policies to complete a package. The following examples are relevant due to their proximity and/or similarity to Maine.

3. STATE EXAMPLES

(a) New York

Though its population size and government budget are significantly larger than Maine's, NY is a large northeastern state with much forested land and thus shares much in common with Maine. New York's policy mix is instructive. It has a variety of inducements intended to encourage everything from investment in refueling infrastructure, the purchase of alternative fuel vehicles and research and development. E85 is exempt from sales and use taxes. The State also makes an effort to lead by example, requiring state fleets to include alternative fuel vehicles (FFVs must use E85) and to use an inclining percentage of biodiesel (U.S. DOE – AFDC, 2007). New York's most innovative policy is an income tax credit of 1 cent per percent biodiesel blended in home heating oil (bioheat) (New York State Department of Taxation, 2006). Governor Spitzer vetoed an extension of this tax credit in 2006, however (due to process rather than content concerns) (Christian Science Monitor, 2007). In general, Maine has pursued similar policy strategies.

Where the two states differ is in technical assistance and implementation capacity. In addition to its five Clean Cities Coordinators (U.S. DOE – AFDC, 2007), New York has the New York State Energy Research Authority, with four offices and roughly 100 employees. NYSERDA addresses all renewable energy and energy efficiency, including biofuels (NYSERDA, 2007).

In 2006, NYSERDA and the New York State Department of Agriculture and Markets awarded Mascoma Corporation $14.8 million to build a demonstration cellulosic ethanol plant (RenewableEnergyAccess.com, 2006). New York currently has two other ethanol plants under construction: Western New York Energy LLC plans to produce 50 mgy beginning in the spring of 2008; and Northeast Biofuels LLC plans to produce 100 mgy beginning in the winter of 2007 (American Coalition for Ethanol, 2007b). The state consumes 328 million gallons of ethanol a year (EIA, 2007b), the third most in the country. New York's North American Biofuels Company currently produces 2.5 mgy biodiesel from waste grease, and the state has approximately ten biodiesel pumps (National Biodiesel Board [NBB], 2007).

(b) Massachusetts

With little support from state government (U.S. DOE – AFDC, 2007), Massachusetts has not traditionally been a leader in biofuels. This may change soon, however. With the phase-out and replacement of the gasoline additive Methyl Tertiary Butyl Ether (MTBE) with 10% ethanol,[17] Massachusetts now uses an estimated 282 million gallons of ethanol a year (Coleman, 2007a), only a little less than New York. Though this cannot genuinely be considered a renewable fuels standard, it produces a similar effect.

Furthermore, Massachusetts policymakers are increasingly proactive. The Governor, Senate President and Speaker filed a joint bill that would require biofuels in all transportation and heating fuels, starting at 2% biodiesel in 2010 and increasing to 5% in 2013 (Coleman, 2007b; Schuyler, 2007). It would also exempt cellulosic ethanol from the state's gasoline excise tax. Massachusetts also established a Biofuels Task Force that will work with stakeholders to identify opportunities for cellulosic and other alternative fuels.

With ethanol blended at 10% in all gasoline and the proposal to blend biodiesel into all diesel and heating fuel, Massachusetts is poised to become a regional leader in biofuel consumption. It already has nearly thirty pumps offering biodiesel (NBB, 2007). This may increase instate production, as well. Massachusetts currently has one instate biofuel producer, producing 500,000 gy from waste grease (NBB, 2007), and Berkshire Biodiesel plans to begin producing 50 mgy biodiesel in 2008 (Schuyler, 2007).

(c) Pennsylvania

Pennsylvania is actively promoting energy independence. It taxes ethanol favorably compared to gasoline and has a number of grant programs promoting alternative fuels (Coleman, 2007a). Grant programs include: the Alternative Fuels Incentives Grant (AFIG) program, which provides a 5 cpg credit to producers and pays the incremental cost of biofuel use for public agencies; the Pennsylvania Energy Development Authority grant program, which recently awarded $1 million to BioEnergy International Inc. to build rail infrastructure at an ethanol plant; and the Pennsylvania E85 Corridor Project, which is distributing nearly $300,000 from the Department of Energy to install 14 ethanol pumps (Coleman, 2007b).

In addition to significant financial investment in alternative fuels, the state government is pursuing an energy independence plan which would replace 900 million gallons of transportation fuels over the next decade with alternative fuels and require a percentage biofuels in all transportation fuel. This plan would also increase funding for AFIG and provide incentives for growing feedstocks (Pennsylvania State Government, 2006). Parts of this plan are now in the legislative process, including a bill to introduce a triggered RFS, requiring 2% biodiesel in all diesel once instate production reaches 30 mgy, 5% when instate production reaches 75 mgy, 10% at 150 mgy and 20% at 300 mgy (HB 1202, 2007-2008).

Pennsylvania has taken steps to improve its capacity and oversight of alternative fuels programs. It has an Alternative Fuels Program Manager within the State Department of Environmental Protection

17 The Federal Clean Air Act requires blending additives called oxygenates into gasoline to help gasoline burn more completely and reduce emissions of benzene and sulfur. Due to concerns about polluted drinking water, many states have switched from MTBE to ethanol (U.S. EPA, 2007c). Maine does not use either, however. When Maine decided to ban MTBE in 2001, it petitioned the U.S. EPA to use lower "Reid Vapor Pressure" gasoline instead (ME DEP, 2007b).

Office of Energy and Technology Deployment and recently created a committee called the Renewable Agricultural Energy Council to advise the governor on biofuels policy (U.S. DOE – AFDC, 2007).

Pennsylvania currently has six biodiesel plants producing over 10 million gallons a year. According to the National Biodiesel Board (2007), Pennsylvania has over 20 biodiesel pumps available to the public. At least one ethanol plant is planned, which would produce over 100 mgy (Coleman, 2007a). Pennsylvania has 13 E85 pumps (NEVC, 2007), and, as of 2005, was using over 100 million gallons of ethanol per year (EIA, 2007b).

(d) Washington

Washington State provides a relevant model for Maine. Despite its geographic distance, it has a similar climate and a similar natural resource base. It also has a number of progressive policies to promote biofuels. Washington promotes biofuels through a mix of inducements and mandates, as well as state leadership. Inducements include a tax cut on E85 ethanol, a sales tax exemption on equipment used for the distribution or production of biofuels and several grant programs. Grant programs include the Energy Freedom Program, which supports biofuels R&D, production and public distribution infrastructure, and a Clean School Bus Program (U.S. DOE – AFDC, 2007).

The major state mandate is a renewable fuels standard, requiring 2% biodiesel in all diesel by 2008, and increasing to 5% once instate feedstocks and crushing capacity can provide 3%. Washington is interested in canola, mustard seed (used as a rotation crop with potatoes) and waste feedstocks (Stearns, 2007b) – all feedsocks appropriate to Maine. By 2009, at least 20% of all diesel used by state agencies must be biodiesel, and, by 2015, all state and local governments must use 100% alternative fuels or electricity (U.S. DOE – AFDC, 2007).

Washington currently has six biodiesel production plants, which produce over 125 mgy year. Two more plants are planned, which would produce an additional 18.5 mgy (NBB, 2007). A third, under construction, would produce an additional 100 mgy (NWBiodiesel Network, 2007). Over 50 stations offer biodiesel at their pumps (NBB, 2007). Washington has one ethanol plant under construction, which would produce 55 mgy from corn. The state has nine pumps dispensing E85 (NEVC, 2007), and, as of 2005, used a little more than 25 million gallons of ethanol a year (EIA, 2007b).

(e) Oregon

Oregon is fast following Washington's lead. The biofuels subcommittee of the Governor's Renewable Energy Work Group developed a bill, recently passed in the summer of 2007, that would both induce and require the use biofuels in the state. The bill contains a triggered RFS that would require 10% ethanol in all gasoline once instate ethanol production meets 40 mgy, require 2% biodiesel in all diesel once instate biodiesel production reaches 5 mgy and 5% biodiesel once production reaches 15 mgy. The bill also contains several incentives. Producers or collectors of biofuels feedstocks, including forest crops, oil seed and grain crops (excluding corn), grass or wheat straw and waste products may receive a tax credit. Producers can receive a business energy tax credit, as can consumers of E85 ethanol or B99 biodiesel (HB 2210, 2007; All American Patriots, 2007).

The state is also making an effort to lead by example. The Department of Transportation uses B10, and the state has nearly 600 FFVs running on E85 (All American Patriots, 2007).

Three producers make biodiesel in Oregon – two from canola and one from waste restaurant grease (NWBiodiesel Network, 2007). There are approximately 40 pumps offering biodiesel in the state (NBB, 2007). Oregon currently has one ethanol plant, with a capacity of about 40 mgy (Pacific Ethanol Inc., 2007), and another under construction, which would produce over 100 mgy ethanol from corn. The state has seven E85 pumps (NEVC, 2007), and, as of 2005, used a little over 30 mgy (EIA, 2007b).

Lessons drawn from these state examples are incorporated into the policy options and analysis below.

V. POLICY OPTIONS AND ANALYSIS

As discussed in the previous chapter, there are countless biofuels policies. The following 16 policy options were selected for analysis and evaluation based on interviews (see the list of interviews appendix IV.4), past research on biofuels policies in Maine and other white papers (see appendix VI), the specific requests of LD 1347 and LD 1159 (appendices I and II), and research on other states' policies, discussed in the previous chapter. Given that Maine is not a blank slate and currently has a number of policies in place (discussed in chapter III), policy options are further refined based on Maine's existing policies. A brief description and examples from other states are provided, as well as potential benefits and drawbacks. Charts in the following sections estimate impact and feasibility.

A biofuels stakeholder workshop, held on October 29, 2007, helped to refine and narrow down the policy options based on the analysis below. Recommendations gathered from the workshop and policy analysis are presented in the following chapter, chapter VI.

For the evaluation criteria used in this chapter, please refer to chapter I.4. It should be noted that biofuels are not the only means of achieving the goals discussed in this report. Other means, such as efficiency, would also help achieve some of the goals (environmental health and energy independence), but the purpose of this report is to discuss biofuels. Biofuels policies are compared against each other, not against these other means.

1. POLICY DESCRIPTIONS

(a) Policy options aimed at the biofuels industry in general

i. Do nothing

- ***Estimated cost: n/a***
- ***Barrier addressed: n/a***

Maine already has a number of biofuels policies in place, and, though biodiesel use collapsed after the excise tax cut ended (see section III.3.c above), it is likely that it will begin to grow again, as long as federal incentives and high fuel prices remain. It is also likely that production will grow on its own at a modest rate. Given the recent opening of Safe Handling's ethanol terminal, we may soon see increased ethanol supply in Maine, as well.

Further, some believe that, given the controversial nature of biofuels (see appendix V.1), governments should not invest in them. Many in the environmental community would support State promotion of biofuels, so long as it does not come at the expense of other important policies such as efficiency measures.

Given these concerns, it is important to include inaction as one policy option. Potential drawbacks to this option include the fact that some current policies may not be implemented well, and may continue to struggle without state action. Further, some may argue that change is not happening rapidly enough and will not happen rapidly enough without increased state involvement. Others may argue that the long-standing government support of petroleum fuels means that governments must support alternatives in order to level the playing field.

ii. Alternative Fuels Incentive Grant (AFIG) program

- ***Estimated cost: $500,000 annually***[18]
- ***Barrier addressed: this policy could address the cost and capital barriers in all three sectors***

Resolve LD 1347 originally came from a bill that was modeled after Pennsylvania's Alternative Fuels Incentive Grants program, which distributes funds to grantees for purchasing and producing biofuels. Though Pennsylvania's legislation allows for much broader interpretation, the grant program is implemented relatively narrowly; it contributes 5 cents per gallon for production (up to 12.5 mgy), and pays public agencies for the incremental cost of purchasing biofuels (Coleman, 2007a). According to staff at Pennsylvania's Clean Cities, the grant program works relatively well, but is limited by the time-line – applications are due once a year, and once a project has started, it is ineligible for grants.

Potential benefits to this policy include the flexibility entailed, with benefits for all three sectors and for all "three 'E's" (economic development, energy independence and environmental health), and the predictable cost to the State. Potential drawbacks include the difficulty of implementing effective grants (complicated paperwork, cumbersome stipulations and problems with timing), and the fact that Maine already has policies in place that attempt to accomplish aspects of Pennsylvania's program.

iii. Hire alternative fuels point person

- ***Estimated cost: $50-90,000 annually***[19]
- ***Barrier addressed: implementation (esp. capital & cost), permitting, paperwork***

Many biofuels experts, suppliers and potential producers interviewed suggested that it would be a good use of state funds to hire an alternative fuels point person. An alternative fuels point person could serve two purposes – he or she could improve implementation of current policies and also provide other non-legislative services to aid the biofuels industry in Maine (such as applying for federal grants, streamlining permitting, matching producers with investors, identifying potential locations for production, and helping support restaurants who contribute waste grease for biodiesel production[20]). As discussed above, Pennsylvania has an Alternative Fuels Program Manager in the Department of Environmental Protection, Office of Energy and Technology Deployment (U.S. DOE – AFDC, 2007). New York also has more implementing capacity than Maine, even accounting for the difference in population size.

Potential benefits of this include the low cost for a potentially high return on effective implementation, as well as possibly avoiding expensive errors such as the underestimated cost of the biodiesel excise tax cut. Potential drawbacks include the possibility of creating "more dead wood" in State Government.

iv. Sustainability certification

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18 Pennsylvania's AFIG costs $3.5-4 million annually, but PA has a much larger population – roughly 12 million

19 A similar job for a Senior Planner Energy Policy Analyst recently posted at the Bureau of Human Resources offers between roughly $50- and $70,000 with benefits. According to Nancy Goodwin who handles personnel for the Public Utilities Commission, however, an alternative fuels point person might be considered a utility analyst, receiving $80-90,000, including benefits.

20 Some potential producers suggested that writing a letter on state stationary endorsing biodiesel could help potential producers secure restaurant grease for production.

- ***Estimated cost: uncertain – unlikely to cost the State, though it may cost the private sector***
- ***Barrier addressed: sustainability concerns***

Several environmental non-profits recommend the development of a certification for sustainable biofuels (Worldwatch Institute, 2007; United Nations [UN]-Energy, 2007; Food and Water Watch & New Energy Choices, 2007; World Wildlife Fund, 2007). Some in Maine's environmental and forestry communities recommend that the State support third-party certification of wood as a feedstock for biofuels to ensure sustainable practices.

In the fall of 2007, the European Parliament announced plans to restrict government support from all biofuels to sustainability-certified biofuels and called for the development of a biofuels certification program (European Parliament, 2007a; European Parliament, 2007b; Navarro, 2007). The World Wildlife Fund commissioned a study on certification, which identified five areas to be included: conservation of carbon stocks, conservation of biodiversity, conservation of soil quality/productivity, efficient water use and prevention of water pollution, and prevention of air pollution (Dehue et al, 2007). A number of other entities and organizations, including the United Kingdom, the Netherlands, Switzerland and the UN Conference on Trade and Development, are also exploring various mechanisms to increase the sustainability of biofuels (Gnansounou et al, 2007). Maine may not have the capacity to create such a system, but it could utilize one once it is developed. Alternatively, it could take advantage of existing certifications, such as the Forest Stewardship Council certification,[21] incorporating them into current and future policies.

Maine could also borrow from California's low carbon fuel standard (discussed below), which would require producers to report on the sustainability impacts of their feedstock and prohibit feedstocks grown on protected lands. An early policy report on the LCSF recommends against other initial sustainability measures (though it recommends continuous study and mid-term review). The LCFS is based on GHG emissions, however, which can serve as a proxy for some sustainability concerns (because, for example, burning rain forest to grow biofuels feedstocks is both unsustainable and releases GHGs).

Potential benefits of restricting state support to sustainability-certified biofuels include putting Maine in good standing to export to Europe (if Maine begins to produce biofuels on a larger scale) and maximizing the environmental benefits of state investment in biofuels. Possible drawbacks include potentially stifling the nascent biofuels industry (Worldwatch Institute, 2006).

(b) Policies aimed at biofuels production

i. MTI alternative fuels fund

- ***Estimated cost: $1,000,000***[22]
- ***Barriers addressed: feedstocks and technology***

During interviews, instate production was frequently cited as a priority, and state investment in R&D was one of the more common policy recommendations. Innovative Natural Resources LLC's study

21 The Sustainable Forestry Initiative, and the American Tree Farm are also active in Maine (Maine Forest Certification Advisory Committee, 2005).

22 This was the amount of MTI's previous Forest Bio-Products Fund.

"Wood-Based Bio-Fuels and Bio-Products" also recommends investment in research and development. The Maine Technology Institute came up in a number of interviews as an example of a good mechanism for distributing R&D funds.

MTI continues to invest in biofuels through seed grants, but it no longer has the Forest Bio-Products Fund, which supplied most of the money for past projects (discussed in section III.1.a). With state help, MTI could re-open this fund or start a new, dedicated alternative fuels fund.

The biggest benefit of this is the potential to overcome the technological barriers to utilizing Maine's largest feedstock – forest resources. It also has the potential to create jobs and stimulate Maine's economy. The potential drawbacks include the time-line for success, which may be long, the risk involved in investing in new technology and the cost.

ii. Increase production credit to $0.15

- ***Estimated cost: 2008: $120,000; 2009: $370,000 (not including current 5 cent credit)***[23]
- ***Barrier addressed: cost***

Several policy organizations recommend per-gallon producer credits (Coleman, 2007a, Werner, 2007). While Maine has a 5 cent per gallon production credit, the average biofuels credit, among states that have them, is 15 cents (Coleman, 2007a). An additional 10 cent production credit could be tailored to meet Maine's needs – for example, it could be limited to locally-owned plants, local feedstocks, or sustainability-certified feedstocks.

Effective 2000, Minnesota, one of the country's leading biofuels producing states, enacted a 20 cpg cash producer payment, up to $3 million per producer. It amended this payment in 2003 to apply to farmer-owned plants only. In 2003, it also adjusted the producer payment down to 13 cents due to a budget shortfall (U.S. DOE – AFDC, 2007).

Potential advantages of a production credit include the fact that it only costs the State money when production is underway, which implies that new jobs and other economic benefits have materialized (Coleman, 2007a), and the fact that production incentives are more effective at stimulating instate production than are per-gallon retail or blending incentives (Werner, 2007). Potential drawbacks include the cost to the State and the fact that increasing this incentive may enter Maine in a race to the highest incentive, which it may not win (Handley, 2007). Further, it may promote high-cost production far from feedstocks, as investors shop around for the highest incentives.

(c) Policies aimed at biofuels distribution

i. Pump pilot program

- ***Estimated cost: $10,000-25,000 per pump; $200,000-$500,000 for 20 pumps***[24]

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23 This assumes production levels of 1.2 mgy in 2008 and 3.7 mgy in 2009. These are very rough estimates based on conjecture and imperfect information, intended to give only a rough idea of cost. Please see appendix IV.3, limitations of data, for the projection underlying this estimate.

24 Cost estimates are extrapolated from the pump pilot programs in NY and PA. These programs are installing new pumps, rather than converting old pumps. This program could potentially be less expensive if it focused on converting

- ***Barrier addressed: lack of pumps***

LD 1159 asks the Office of Energy Independence and Security to "develop a plan for a pilot program to establish refueling stations for biofuel that is at least 85% ethanol...The goal of the program is to convert up to 20 pump and tank systems to dispense biofuel that is at least 85% ethanol" (for the full text, see appendix II).

Both New York and Pennsylvania have similar programs. The New York State Energy Research and Development Authority has a $10 million competitive grant program for installation of E85, biodiesel, natural gas or other renewable fuel pumps. NYSERDA hopes to support the installation and operation of between 400 and 600 renewable fuel pumps at private stations across the state. (Chittenden, 2006). Pennsylvania has a similar project called the E85 Corridor project. The Greater Philadelphia Clean Cities Coalition will receive $283,380 from the DOE to install 14 E85 pumps between Philadelphia and Central Pennsylvania and perform outreach regarding E85 (Coleman, 2007a).

Potential benefits of a pump pilot program include giving flex-fuel vehicles in Maine the opportunity to use E85 (reducing GHGs and increasing energy independence), creating the distribution infrastructure to prepare Maine for instate production and the possibility of securing federal funding as Pennsylvania has done. The potential drawbacks and challenges include the difficulty of implementation (Maine failed once before to implement a similar program), lack of political support for corn ethanol, and the fact that other barriers, such as exclusivity contracts, cost, dispersed FFVs and uncertain demand may pose more fundamental barriers that could hinder distribution infrastructure development even with state support.

ii. Pump lease program

- ***Estimated cost: $10-$25,000 per pump (plus staff time); $200,000-$500,000 for 20 pumps***[25]
- ***Barriers addressed: capital, lack of pumps, uncertain demand***

Peter Arnold of the Chewonki Foundation suggested an innovative idea for overcoming Maine's lack of pumps. The State could buy modular pumps and tanks and lease them to potential suppliers worried about making a capital investment while uncertain of demand. The pumps could be leased or leased to own. This would be a novel approach.

The potential benefits of this policy include the relatively low risk and low cost to the State (the program could start small and grow depending on its success rate), as well as potential visibility. The potential drawbacks include the lack of discretion available for retailers (who would not get to choose the type of pump or tank), implementation capacity, and some drawbacks to small, above-ground tanks.

iii. Revive Clean Fuel Vehicle Fund

- ***Estimated cost: $500,000***[26] ***or whatever is available from air pollution penalties***
- ***Barriers addressed: capital, lack of pumps***

existing pumps and tanks to E85. 20 pumps was the amount suggested in LD 1159.

25 See footnote 24.

26 This is proportional to Pennsylvania's Alternative Fuel Incentive Grant program – see footnote 18, above.

When discussing the best method to encourage biofuels pumps, several people suggested that, instead of a pump lease program, the State should have a revolving fund to allow for more flexibility and discretion on the part of the supplier. Washington State has a low interest loan program, called the Energy Freedom Program, which can offer funding for refueling infrastructure, though it appears it is utilized mostly for production (Canaan, 2007).[27]

As discussed in Section V.2.c, Maine has a revolving loan program in place, called the Clean Fuel Vehicle Fund. The legislation allows for funding through air pollution penalties, and it may be possible to work with DEP to add this fund to the list of Supplemental Environmental Projects (SEP) (Morrill, 2007) to increase the flow of funds.

The potential benefits of this include increased capital available for pumps from an existing funding source. Potential challenges include problems with implementation and lack of funding. The legislature has re-appropriated money from this fund when it had a budget short-fall in the past – this makes such funds vulnerable.

iv. Exempt alternative fuels from exclusivity contracts

- ***Estimated cost: $0***[28]
- ***Barriers addressed: exclusivity contracts, lack of pumps***

Exclusivity contracts (franchise contracts which require retailers to only sell a particular brand of fuel) can pose a barrier to refueling stations interested in supplying alternative fuels. The Northeast Biofuels Collaborative, as well as several stakeholders interviewed, recommend exempting alternative fuels from exclusivity contracts. New York State did this in 2006 (Coleman, 2007a).

According to the Northeast Biofuels Collaborative, alternative fuels can be exempted from these contracts either legislatively or through administrative rule-making by the Attorney General (AG) under the "Unfair or Deceptive Acts and Practices" statutes (Coleman, 2007a).

The potential benefits of this policy option include the provision of a relatively low risk and cheap mechanism for removing barriers and encouraging biofuels distribution. Potential drawbacks include possible resistance from oil companies, though it does not appear that this was a major issue in New York.

(d) Policies aimed at biofuel consumption

i. Rewrite/reinstate excise tax cut

- ***Estimated cost: 2008: $500,000 (¼ cent/percent) - $1 million (½ cent/percent); 2009: $1.2 million (¼ cent/percent) – $2.4 million (½***

27 Some people suggested a revolving loan program for production. This option is not included here because, though capital is a barrier for some potential producers in Maine, it is not such a barrier for those who have secured their feedstocks. This suggests that feedstocks may be a more fundamental barrier. Furthermore, even those working to secure capital were not interested in state loans. Others worried about the State's investment savvy. Nevertheless, Maine has a revolving loan in place for biofuels production – the Agriculturally Derived Fuels Fund. It is up for debate whether Maine should revive and expand it. Though Washington appears to have a successful loan program, Maine is not the only state with a defunct revolving fund program. Utah also put its fund on hold (U.S. DOE – AFCD, 2007). This suggests that perhaps this is a risky policy.

28 According to the Northeast Biofuels Collaborative.

cent/percent)[29]

- ***Barriers addressed: cost***

As discussed in section III.3.c, Maine's biodiesel excise tax cut was controversial because it cost the State much more than anticipated.[30] There is no question, however, that reducing the cost of biofuels is an effective way to increase supply and production (though effects on production are not as direct [Werner, 2007]). For example, in 2005, the federal government introduced a blenders credit of 1 cent per percent biodiesel in the blend. Biodiesel production tripled that year (NBB, 2006). In Maine, the tax cut more than doubled biodiesel consumption and paid for some blending infrastructure as well. Some of those who benefited from the credit and others who witnessed its effectiveness recommend reinstating it or a variation thereof.

In addition to being more costly than anticipated, however, Maine's excise tax cut was also overly generous. The tax cut could be rewritten as a lower cut on higher blends (5 cents for B20 and above) or it could be graduated and give, for example, ½ cent per percent of biodiesel. This would reward higher blends proportionately. It also could be expanded to cover other alternative fuels. Additionally, signage could be required in order to increase public awareness.

Potential benefits of this policy include its direct, relatively predictable effect (especially given past experience) on supply, and ease of implementation. Potential drawbacks include the cost, which is difficult to estimate and could climb untenably high.

ii. Renewable fuels standard

- ***Estimated cost: $0 to State – may cost private sector and public***[31]
- ***Barriers addressed: uncertain demand, lack of pumps***

A number of biofuel policy studies conclude that renewable fuels standards are one of the most effective policies at increasing biofuels consumption, distribution and production (Worldwatch Institute, 2007; Andersen, 2007b; Coleman, 2007a; and Rockefeller & Morgan, 2006b). The Maine Climate Action Plan explored this possibility as well, but stakeholders could not come to a consensus on it at the state level – many environmental groups favored this option, while the oil industry opposed it (Transportation and Land Use Working Group, 2004), as Maine's market is small, and some believe it is burdensome to require separate blends from the rest of the region (Vanags, 2007). There was consensus, however, favoring a regional RFS.

A renewable fuels standard can work two ways – it can require a certain amount of biofuel consumption total (as in the federal RFS) or it can require a certain percent biofuel blend in all petroleum fuels (Coleman, 2007a). Most states have opted for the latter, which is easier to implement.

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29 This assumes a tax cut on both ethanol and biodiesel. It estimates total consumption levels at 2 mgy in 2008 and 4.65 mgy in 2009. These are very rough estimates based on conjecture and imperfect information, intended to give only a rough idea of cost. Please see appendix IV.3, limitations of data, for the projection underlying this estimate. Since it is likely that such an incentive would increase production and supply beyond baseline scenarios, the cost could be much higher.

30 The cost has not yet been verified. The Maine Revenue Service recently estimated that it cost the state at least $125,000 (Lewis, 2007). It may have cost much more.

31 Missouri's fiscal note for its RFS estimated zero cost to the State (HB 1270 & 1027, 2006). The Climate Action Plan anticipated a cost to the public due to the incremental cost of biofuels blends (Transportation and Land Use Working Group, 2004).

Many of the largest biofuel-producing and consuming states, including Minnesota and Iowa, have some version of the RFS. Iowa's RFS is unique in that it is not a mandate, but rather based on incentives – fuel dealers receive incentives based on how close they come to meeting a percentage blend. Iowa's RFS will go into effect in 2009 (Shaw, 2007). Minnesota's RFS is a straight mandate, requiring 2% biodiesel in all diesel and 10% ethanol in all gasoline (U.S. DOE - AFDC, 2007).

An RFS can also be triggered – it can be designed to come into effect when instate production reaches a predetermined level. Oregon and Louisiana both have a triggered RFS (Coleman, 2007a). This has a more direct effect on production and ensures economic benefits. It could also be triggered on a regional basis – designed to go into effect when another state passes the RFS (Vanags, 2007). This might allay some concerns about the size of Maine's market.

Potential benefits of the RFS include the low cost to the State and the virtually assured increase in consumption, distribution and production. Potential drawbacks include political resistance.

iii. Low carbon fuel standard (LCFS)

- ***Cost estimate: uncertain***[32]
- ***Barriers addressed: uncertain demand, lack of pumps***

California's new low carbon fuel standard has potential. It calls for a "reduction of at least 10 percent in the carbon intensity of California's transportation fuels by 2020" (Farrell & Sterling, 2007) Environment Northeast supports development of a policy like this in their "Climate Change Road Map" (Stoddard & Murrow, 2006). The Maine Climate Action Plan also addresses a low carbon fuel standard, though its version is more like a renewable fuels standard, discussed above (Transportation and Land Use Working Group, 2004). Additionally, this option emerged as the top action item under transportation at the New England Governors and Eastern Canadian Premiers' (NEG/ECP) most recent meeting (NEG/ECP, 2007). Maine could use the model currently being implemented for the Regional Greenhouse Gas Initiative to institute the LCFS on a regional basis. RGGI and the LCFS would complement each other, as RGGI deals with stationary sources and the LCFS deals with transportation fuels.

Potential benefits of the LCFS include definitive climate benefits and the fact that it is technology neutral, performance-based (and therefore more cost-effective) and addresses some sustainability concerns (because intensive agriculture and land clearing both contribute to GHG emissions). Potential drawbacks include the technicality of design and implementation.[33]

iv. Department of Transportation biodiesel purchasing requirement

- ***Cost estimate: $90,000-$180,000***[34] ***annually***
- ***Barrier addressed: uncertain demand***

Several policy organizations recommend capitalizing on state purchasing power to promote biofuels (Coleman 2007; Worldwatch Institute, 2007; Andersen, 2007a), and this appears to be effective in other

32 The California Air Resources Board will study costs and cost-effectiveness (Farrell & Sterling, 2007).

33 Maine could follow California's design and implementation strategy, but it is not yet fully developed. This may be something to consider as a long-term, regional strategy.

34 DOT uses 1.8 mgy diesel (Allen 2007). The cost of B20 usually falls between 5 and 10 cents more than diesel (Rockefeller & Morgan, 2006a).

states. Furthermore, the recent New England Governors and Eastern Canadian Premiers Ministerial Forum on Energy and the Environment (2007) recommended that governments lead by example in renewable energy and efficiency. Some in Maine's biofuel industry also advocate state use, noting that, although the State currently heats some of its buildings with bioheat, if the DOT preferentially purchased B20, it would be more visible and set an example for towns and other large fleets. To encourage production, DOT could preferentially purchase from instate producers.

As discussed in section III.4.a, in 2003 the DOT piloted biodiesel in five of its heavy duty vehicles. The project was a success in that no problems occurred, but the Department found the price of biodiesel, which at the time was 40 – 50 cents more per gallon, prohibitive (Maine DOT Transportation Research Division, 2004). The DOT recently put out a competitive bid request both diesel and B20, but the only B20 bid was too expensive (Peabody, 2007). It is possible that, because DOT will select the least-cost bid (and B20 tends to be slightly more expensive), biodiesel retailers are not submitting bids because they fear they cannot compete. Preferential purchasing or purchasing requirements could potentially overcome this problem.

In 1999, the Ohio governor asked the Ohio DOT to pilot alternative fuels, and, in 2005, announced an executive order requiring the DOT to use at least 1 million gallons of pure biodiesel annually. This amounts to about a quarter of its diesel use. This is Ohio's only substantive policy, and it appears to be effective. At the time of the executive order, Ohio had two biodiesel production plants (Rockefeller & Morgan, 2006b). It now has six (NBB, 2007). Maine could adopt similar legislation.

Potential benefits of a DOT purchasing requirement include guaranteed demand for potential producers or suppliers, possibly encouraging new pumps and production and setting an example for others. Potential drawbacks include the cost to the State.

v. School bus program

- ***Cost: $200,000 - $400,000 annually for the incremental cost or $400,000-$800,000 one-time payment for infrastructure.***[35]
- ***Barriers it addresses: uncertain demand***

Joel Glatz, Maine's first biodiesel supplier, recommends that Maine promote biodiesel use in school buses as a way to maximize health benefits and increase biodiesel distribution. A number of other states have programs aimed at school buses (including Washington, New York and California), but few, if any, of these programs are aimed specifically at biodiesel (U.S. DOE – AFDC, 2007). The federal government also has a grant program called Clean School Bus USA, aimed at improving school bus emissions. These grants have not gone to biodiesel projects in Maine, however, presumably because of NOx concerns (as discussed in section I.3.c, some recent studies may ameliorate these concerns). An incentive program could be designed to switch more schools to biodiesel (and/or other alternative fuels) by paying for the incremental cost of the fuel or paying for pumps and tanks.

35 There are about 130 public school districts in Maine (Maine Department of Education, 2007). It is unlikely that every school district would switch to biodiesel, however. This cost estimate assumes that approximately 30% or 40 of them would switch. A rough estimate that each school district uses approximately 100,000 gallons of diesel a year, on average, is extrapolated from a small sample obtained from BFM's letters of interest. That amounts to about 4 million gallons of B20. At 5-10 cents more, this would cost the State roughly $200,000-$400,000 a year. It should be noted, however, that as more biodiesel is produced in state, the price will drop. This incentive could be modified to pay for infrastructure instead. For 40 schools, at $10,000 - $20,000 a tank and pump system, this would cost the State a one time price of $400,000-$800,000.

Potential benefits of this policy include increased distribution and maximized health benefits (diesel emissions, which can cause asthma and are carcinogenic, tend to concentrate inside school buses posing health hazards for school children [Natural Resources Defense Council, 2001]). Potential drawbacks include the cost to the State.

vi. Flex-fuel vehicles in state fleets

- ***Estimated cost: $500-$1,000 annually per car,[36] $300,000 - $600,000 a year for 600 cars[37]***
- ***Barriers it addresses: lack of flex-fuel vehicles, uncertain demand***

Several policy organizations have suggested that state purchasing power is an important tool for moving the market (Worldwatch Institute, 2007; Coleman, 2007a; Andersen, 2007b). As discussed above (in section III.5.c), Baldacci's executive order asked the Office of Energy Independence and Security, among others, to study the prospect of incorporating flex-fuel vehicles into the state fleet. Though the study was never completed, this indicates that there is interest in this policy. The Transportation and Land Use Working Group also discussed this possibility during the Maine Climate Action Plan process, but was unable to come to a complete consensus, though most parties supported the measure, particularly if it were enacted regionally (Transportation and Land Use Working Group, 2004).

Many states have fleet purchasing requirements, though few are geared specifically towards flex-fuel vehicles. Iowa's state purchasing requirement, an executive order passed in 2005, requires that all non-emergency, light duty vehicles purchased before 2010 be hybrid-electric or alternative-fuel vehicles. It further requires that all state flex-fuel vehicles run on E85 when available (U.S. DOE – AFDC, 2007).

Potential benefits of this policy include encouraging E85 pumps by guaranteeing at least some demand. Potential risks include decreasing the state fleet's fuel economy by promoting FFVs at the expense of other more efficient vehicles (FFVs tend to be larger and less efficient, although this is changing), particularly if E85 did not become available.

36 Flex-fuel vehicles generally do not have a higher purchase price than their gasoline-powered counterparts. Because ethanol contains less energy, however, the State would have to buy more fuel. According the the U.S. Department of Energy website FuelEconomy.gov (2007) the annual difference in fuel cost is about $500-$1,000.

37 600 is approximately the number of FFVs in Oregon's fleet (All American Patriots, 2007). During the creation of the Maine Climate Action Plan, the Transportation and Land Use Working Group (2004) discussed having 50,000 FFVs by 2020, but 600 seems like a reasonable place to start.

2. POLICY IMPACTS

The following chart estimates the cost of each policy as well as the benefits – the impact each option would have on Maine's various goals – economic development, energy independence (amount of fossil fuel displaced), energy security (distribution infrastructure for alternative fuels), health (specifically air quality), reduction of greenhouse gases, and other environmental concerns, grouped under "sustainability." These are rough estimates – pluses indicate benefits (more pluses, the higher the expected benefits), '0' indicates a lack of impact, '?' indicates an uncertain impact and minuses indicate a negative impact.

Quantitative impact is estimated where possible – in fuel use and GHG mitigation, for example. Numbers in the energy independence column indicate the total amount of petroleum displaced, as well as the percent of either the gasoline or diesel transportation market displaced. Numbers in the GHG reduction column indicate the annual metric tons of CO2 equivalent (tCO2e) displaced. For comparison, please note that over 20 policy options considered in the Maine climate action plan would reduce emissions by over 100,000 tCO2e in the year 2010 (Maine Climate Action Plan, 2004). A link to the Climate Action Plan is provided in appendix VI below.

This chart also estimates the time-line for benefits to materialize – 'immediate' indicates beginning within the next year, 'medium' indicates two to four years and 'long term' indicates 5-15 years. Again, estimates are subjective and involve imperfect information and guesswork. The final column, "other costs and benefits," is self explanatory.

	Policy	Estimated Costs[38]	Econ-omic Benefit	Energy Indep-endence	Energy Security	GHG reduction	Sustain-ability	Time-line	Other costs or benefits
All sectors	Do Nothing:	n/a	0	0	0	0	0	n/a	
	AFIG	$500k/yr	++	+	+	+	?	Medium	
	Alternative fuels point person to implement policies	$50-90k/yr	++	++	++	++	0/+	Immediate	Remove other barriers, improve future policies
	Sustainability Certification	?	?	+	?	++	+++	Medium/ Long term	Encourage export market to EU?
Production	MTI alternative fuels fund	$1m	+++	+ (long term +++)	+	+ (long term +++)	?/+	Long term	
	Increase producers' credit to 15 cents	'08: $120k '09: $370k	++	++	++	++	+/?	Medium	
Distribution	Pump pilot program	$10-25k/ pump, $200-500k/20 pumps	+	20 mgy[39] (2.34%) gas displaced	++	40,000 tCO2e[40]/yr	?	Medium	
	Pump & Tank Lease	Same as above	+	Same as above	++	Same as above	?	Medium	
	Revive Clean Fuel Vehicle Fund	$500k/yr or what is available from SEP	+	++	++	++	?	Medium	
	Exclusivity Contracts	$0	0/+	++	++	++	?	Medium	

38 Cost estimates are explained in footnotes in the previous section.

39 According to EPA, the average vehicle travels 12,000 miles a year, with a fuel economy of roughly 20 mpg, burning 600 gallons of gasoline (U.S. EPA, 2007d). If 85% of that were replaced with ethanol, that would displace 510 gallons of gasoline. There are over 125,000 FFVs in Maine. Optimistically assuming that a pump pilot program resulted in a market penetration of 30%, 40,000 FFVs would run on E85, times 510, equals 20 mgy.

40 E85 reduces each of the 40,000 cars' greenhouse gas emissions by roughly one ton per year, roughly 40,000 tons (U.S. DOE – FuelEconomy.Gov, 2007). Alternatively, assuming that the average vehicle burns 600 gallons of gasoline a year (see footnote above), if 85% of that gasoline were replaced with ethanol, which reduces GHG emissions by 21.8% compared to the 19.4 lbs CO2e emitted from gasoline, it would reduce emissions by 0.97 tCO2e per car, or nearly 40,000 tCO2e.

	Policy	Estimated Costs	Econ-omic Benefit	Energy Indep-endence	Energy Security	GHG reduction	Sustain-ability	Time-line	Other costs or benefits
Consumption	Rewrite/re-instate excise tax cut	'08 $500k – 1 m '09 $1.2 m – 2.4 m	+	++	++	++	?	Immediate	New pumps, public awareness
	RFS	$0 to State, may cost private sector	+? (results in increased produc-tion)	B2 = 4 mgy (2%) diesel displaced, E10 = 72 mgy (10%) gas displaced	++	27,000/yr for B2 & 140,000 tCO2e/yr for E10[41]	?	Medium	
	LCFS	?	+?	++	++	Reduce GHG 10% by 2020	+	Longterm	
	DOT B20 purchasing requirement	$90-180k/yr	0/+	360kgy (0.19 %) diesel displaced[42]	++	2,500 tCO2e[43]/ yr	?	Immediate	New pumps?, public awareness, set example
	School bus program	$250,000-$500,000/yr	+	800kgy (0.42%) diesel displaced[44]	++	5,400 tCO2e[45]/ yr	?	Medium	Encourage pumps
	State fleet FFV req.	$500-1k/ car/yr, $300-600k/ yr for 600 cars	0/+	306kgy (0.04%) gasoline displaced[46]	++	600 tCO2e[47]/ yr	?	Medium	Encourage ethanol pumps

41 Maine uses roughly 200 mgy diesel (EIA, 2007a). If an RFS required 2% biodiesel in all diesel, that would displace 4 million gallons of diesel with biodiesel. Each gallon of diesel emits approximately 22.2 pounds of CO2 (U.S. EPA, 2005). Each gallon of biodiesel used instead of diesel reduces greenhouse gas emissions by 67.7% (U.S. EPA, 2007a), which would reduce emissions by 27,000 tons of CO2 equivalent. If Maine were to institute a 10% ethanol RFS, this could reduce emissions by 140,000 tons of CO2 equivalent (Maine uses 716 million gallons of gasoline for transportation [EIA, 2007b] * 10% = ~ 72 million gallons * 19.4 lbs CO2 per gallon [U.S. EPA, 2005] = ~ 1.42 billion lbs CO2e * .00045 lb per metric ton = 640,000 metric tons * 21.8% emission reduction [U.S. EPA, 2007a] = ~ 140,000 tons).

42 20% of 1.8 million.

43 DOT uses approximately 1.8 million gallons of diesel a year (Allen, 2007). Every 1,000 gallons of B20 reduces CO2e by 1.35 tons (1000*.2 = 200 gallons * 22.2 lbs CO2e per gallon diesel [U.S. EPA, 2005] = 4440 lbs CO2e * .00045 tons per pound = 2 tons CO2e * 67% reduction in GHG [U.S. EPA, 2007a] = 1.35 tons CO2e), so this would eliminate roughly 2500 tCO2e

44 20% of 4 million (see footnote 35 above).

45 Using the conversion above, and estimating that this policy increases biodiesel use to 4 million gallons of B20 a year (see footnote 35), that would eliminate roughly 5,400 tCO2e.

46 600 vehicles use approximately 360,000 gallons of fuel a year (U.S. EPA, 2007d). 85% of 360,000 is 306,000.

47 According the the DOE website FuelEconomy.gov, flex-fuel vehicles running on E85 emit roughly one ton per year fewer greenhouse gases than their gasoline-powered counterparts. If the State were to replace 600 of its vehicles with FFVs and run them on E85 all the time, this would amount to a reduction of roughly 600 tons of CO2 equivalent.

3. POLICY FEASIBILITY

The following chart lays out the potential feasibility of each policy – the various factors that may or may not contribute to legislative approval[48] (political resistance, political support, political appeal) as well as ease of implementation (novelty, level of technicality, degree of paperwork involved and capacity of the implementing institution). Some policies offer more direct means of achieving goals than others. This chart tries to incorporate this variability through the "chance of achieving desired effects."[49] These characterizations are subjective and based on imperfect information, but they provide a platform for analyzing the policies at hand. Information is largely based on interviews, the evaluation of Maine's current policies and past experience, other states' experience, and the stakeholder workshop.

	Policy	**Political Resistance**	**Political Support**	**Political appeal**	**Ease of implementation**	**Chance of achieving desired effects**
Aimed at all biofuels sectors	Do Nothing	Some	Some	Negative?	n/a	n/a
	AFIG	Some, due to cost	Yes – appeals to broad cross-section because it can support all sectors and all "three 'E's"	Positive	Difficult to implement well – grants add paperwork, time	Medium
	Hire alternative fuels point person	Moderate – people are concerned about "dead wood."	A number of people interviewed felt that an alternative fuels point person would be helpful – this was one of the most commonly recommended policies	None, except maybe to those in the industry.	This could greatly increase Maine's capacity to implement its existing programs and new policies	Medium/ high
	Sustainability certification	Perhaps – from biofuels industry	Environmental community, Maine Forest Service, increasingly the public	Positive?	New and technical – could be challenging to implement	Medium/ low
Aimed at production	MTI alternative fuels fund	Some – due to cost	Many people recommended R&D as a good use of state funds	Positive	MTI has proven capacity to administer funds in an effective manner	Medium/ high
	Increase producers' credit to 15c	Some - due to cost	Some – biofuels advocates	Positive	Relatively straight-forward, but a point person might help.	Medium

48 Not all of these policies would have to go through the legislative process (doing nothing, hiring an alternative fuels point person, DOT use, FFVs in state fleets and exempting biofuels from exclusivity contracts could be accomplished administratively or through executive order).

49 Policies tailored towards ethanol (E85 pump pilot programs or policies involving FFVs, for example) entail greater risks because the market in Maine is virtually non-existent; there are problematic chicken and egg dilemmas. Firstly, while all vehicles can run on a 10% blend of ethanol, only flex-fuel vehicles can run on E85. There is a limited number of such vehicles (approximately 125,000), and they are presumably dispersed throughout the state. This makes investment in an E85 risky. Conversely, encouraging more flex-fuel vehicles also has uncertain outcomes because Maine currently has no ethanol pumps. While there are already a number of FFVs in Maine, none of them run on ethanol.

	Policy	Political Resistance	Political Support	Political appeal	Ease of implementation	Chance of achieving desired effects
Aimed at Distribution	Pump pilot program	Some – due to cost	None or small	Positive - visible	Difficult to implement – was not well-implemented previously	Low
	Pump & tank lease	Some – depending on the size of the program	None or small	Positive	Difficult to implement due to technicality and lack of supplier discretion	Medium/ low
	Revive Clean Fuel Vehicle Fund	None	Yes – biofuels advocates	Uncertain – it could either be viewed as a credit to this admin to revive it or an embarrassment that it was neglected.	Uncertain – there are technical difficulties to overcome – must make funding more accessible.	Medium/ low
	Exclusivity contracts	Uncertain – could be done through AG office	Small – alternative fuel advocates	Positive but small?	Straightforward	Medium/ high
Aimed at Consumption	Rewrite/re-instate excise tax cut	Some, possibly due the potentially high cost and to the botched past experience	Yes – Support for this policy is high within the biofuels industry because it was effective and encouraged capital investment	Mixed – due to past experience, but probably generally positive among the public, particularly if the public can see the impact through signage	Relatively straightforward	High
	RFS	Some to state RFS, regional is more palatable	Some – environmentalists?	Mixed?	Straightforward	High
	LCFS	?	Yes - Environmental community	Generally positive? - visible, innovative	New and technical – Maine may not have capacity	Medium/ low
	DOT B20 purchasing requirement	Some – due to cost	Biofuels advocates – broad support, though not the highest priority	Positive – good visibility	Relatively straightforward	Medium/ high
	School bus program	Some – due to cost	Biofuel advocates, health organizations?	Positive – good visibility	Relatively straightforward	Medium
	State FFV requirement	Some, depending on size of program	Mixed - not a lot of support for corn ethanol, no ethanol industry in Maine to support it	Positive?	Straightforward	Medium

VI. RECOMMENDATIONS

The policy options discussed in this chapter derive largely from the policy analysis presented above and a stakeholder workshop intended to evaluate policy options. The recommendations below are divided by sector. Beyond that, however, they are presented in no particular order. For more details on the methodology and the stakeholder workshop please refer to appendix IV. Draft legislation, where appropriate, is included in appendix III.[50]

Before embarking on final recommendations, it is important to reiterate goals. The objective of this report and the policies it recommends is to offer Mainers true diversity in the fuel marketplace – to provide alternatives that do not merely replicate the problems associated with oil, but rather offer economic, energy independence and/or environmental benefits. More diversity in the marketplace will benefit all Mainers, enhancing their freedom to choose. Ideally the policy instruments chosen will achieve this objective in an economically efficient, equitable manner that is straightforward to implement. Policies also, however, must make it through the political process. All of the policies below are strong candidates. Again, this report only discusses policies to promote biofuels – there are other means to achieve similar goals (such as efficiency), which should be considered, as well.

1. POLICIES AIMED AT ALL THREE SECTORS

(a) Combine existing funds into a broader Clean Fuel Fund (CFF)

A stakeholder workshop helped to evaluate and refine the policies discussed and analyzed in the preceding chapter (please see Methodology, appendix IV). The stakeholders present at this workshop suggested and supported combining Maine's existing funds (the Clean Fuel Vehicle Fund and the Agriculturally Derived Fuel Fund) into a single fund similar to Pennsylvania's Alternative Fuel Incentive Grant program. This fund would support all three sectors (production, distribution and consumption), through both loans and grants, but would not support R&D.[51] NYSERDA, discussed in section IV.3.1, could also provide a model for this program. Stakeholders suggested that such a fund be compartmentalized – divided between production, distribution and consumption. It could still support clean fuel vehicles, though that would no longer be the primary purpose. To reflect the broad application of the fund, stakeholders recommended calling it the Clean Fuel Fund, instead of the Clean Fuel Vehicle Fund. They suggested that FAME administer the fund with OEIS oversight.

DEP should add the Clean Fuel Fund to the list of Supplemental Environmental Projects for air pollution penalties. Additionally, adding a check-off box to income tax forms or vehicle registration (similar to the voluntary contributions through utility bills to the Renewable Resource Fund) would increase the flow of funds. Alternatively, unused funds from the Renewable Resource Fund could be transferred to the Clean Fuel Fund. Draft legislation is presented in appendix III.

Impacts & Feasibility: In order to be effective, a Clean Fuel Fund must secure some funding, preferably at least $350,000. In addition to funds, the Clean Fuel Fund would require significant implementation capacity. It would provide flexibility, however, and would be capable of supporting all three sectors (production, distribution and consumption) and all three goals (economic development, energy

50 Draft legislation is included because LD 1347 asks for it; it is not, however, intended to be the final word.

51 Most stakeholders present agreed that R&D was fundamentally different and significantly more expensive, so should not be included in the same fund

independence and environmental health). It also has the potential to incorporate a number of the policy options discussed in the previous chapter under one policy. It could, for example, provide production credits as well as give grants to schools for biofuel use. As such, it has broad political appeal and is unlikely to encounter much political resistance. This policy option was one of the top policy preferences at the stakeholder workshop.

The main drawback of a Clean Fuel Fund is the difficulty of implementing effective grant and loan programs for biofuel production and distribution – such policies are not among the most effective in other states (though they can be beneficial), and they have not had a high success rate, at least in terms of providing capital for biofuels projects, in Maine. Increasing implementation capacity might increase the chance of success, however, and a grant program aimed at supporting all three sectors of the biofuels and clean fuels industry might be more robust than, for example, the Clean Fuel Vehicle Fund, which is aimed mainly at distribution. Additionally, the timing is more appropriate for such a fund in the current market, giving it a better chance of success than it had a few years ago.

(b) Study sustainability measures for biofuels

As discussed in the previous chapter, the European Parliament recently announced plans to restrict government support from all biofuels to sustainability-certified biofuels and called for the development of a biofuels certification program (European Parliament, 2007a; European Parliament, 2007b; Navarro, 2007). Certification is not mandatory, but governments will limit support to sustainable biofuels. A number of other entities and organizations, including the United Kingdom, the Netherlands, Switzerland and the UN Conference on Trade and Development, are also exploring various mechanisms to increase the sustainability of biofuels (Gnansounou et al, 2007). A certification program is not yet developed, however. In interviews, several environmental groups and the Maine Forest Service expressed support for a similar proposition – using existing forest certifications for biofuels feedstocks. Additionally a number of white papers recommend this policy option (Worldwatch Institute, 2007; UN-Energy, 2007; Food and Water Watch & New Energy Choices, 2007; World Wildlife Fund, 2007).

Sustainability certification was among the most popular policies at the stakeholder workshop, though there was much disagreement over how to implement it. Ultimately, most agreed that agencies should be tasked with studying sustainability measures. There was a concern, however, that such a study would not be completed. Natural Resources Council of Maine staff present at the workshop therefore recommended that the legislature impose some precautions to safeguard Maine's resources (both fiscal and environmental) and encourage completion of the study. Not all stakeholders support this, however (Strauch, 2007).

There are two potential ways to encourage completion of the study. The first approach would require state incentives to sunset if a study is not completed within three years (or another given time-frame). A second approach would be to dictate that, if the report is not completed, at the end of three years, existing certifications, such as the Forest Stewardship Council certification,[52] be applied to Maine's feedstocks in order to receive government support. The preferable course of action would be to complete a study, as sunsetting incentives might discourage long-term investment, and certifying some feedstocks and not others might be unfair and would raise contentious issues regarding existing

52 The Sustainable Forestry Initiative and the American Tree Farm are also active in Maine (Maine Forest Certification Advisory Committee, 2005). There is much disagreement over the preferred certification scheme.

certifications, but it might be prescient to safeguard Maine's resources in the event that a study is not completed.

A study of biofuels sustainability certification should address two questions: should Maine impose sustainability measures on biofuels in order for them to receive state support, and, if so, how? To answer the first question, agencies should look at the potential benefits and detriments of certification and/or other programs. To answer the second question, agencies should examine what other states and countries are doing and other related research. In addition to the research on certification specifically related to biofuels, there is research related to biomass and the Regional Greenhouse Gas Initiative and other research on best management practices for forest harvest and forest certification that may be helpful. This study should look closely at land use, particularly forest practices (as this will be the largest feedstock in Maine) and life cycle GHG emissions (as life cycle GHG emissions can provide a proxy for other sustainability concerns). Draft legislation for this study is included in appendix III.

This study should also look at whether following California's low carbon fuel standard (discussed in greater detail below) would adequately allay sustainability concerns, obviating the need for certification. The LCFS will favor low-GHG fuels, which correlates with sustainable land use and farming practices (because these emit fewer GHGs). In addition, under the LCFS, California would prohibit feedstocks grown on protected lands and require producers to report on the sustainability of their feedstocks. A preliminary policy paper on the LCFS recommends against other initial measures, though it recommends aligning policies with Europe's certification as much as possible (Farrell & Sperling, 2007). Because these two recommendations (sustainability certification and pursuing the LCFS at a regional level, discussed below) are related, agencies could undertake them congruently, reducing the work load.

Impacts & Feasibility: A study of sustainability certification would take some administrative time, but would not necessarily be expensive, as there are a number of other governments and organizations examining the issue. The certification itself, however, would be more expensive, though not to the State. Biofuels certification may cost the biofuels industry, may reduce biofuels' capacity to compete in the petroleum market and may disadvantage smaller biofuels producers. More research should reveal such costs.

Certification will help achieve the goal of supporting a *true alternative* to oil, however. Biofuels can improve air quality and reduce GHG emissions as compared to their petroleum equivalents. They are also renewable if harvested at a sustainable rate and in a sustainable manner. It is possible, however, to produce biofuels without such benefits (please see appendix V.1). If this is the case, then they do not necessarily deserve special treatment from the State. Additionally, certification might help Maine build an export market to the EU. Maine is already in a good position, given its vast forest feedstock (which are considered better than crops in terms of land-use and GHG impacts [Righelato & Spracklen, 2007; Delucchi, 2006]) and its progressive approach to forest certification (Maine is the national leader in forest certification, and 37% of its productive forests were certified as of 2005 [Maine Forest Certification Advisory Committee, 2005]).

There are two ways of viewing sustainability certification: if one views biofuels as receiving special state support in the petroleum market, then the State has the right to demand excellence to ensure it is supporting a true alternative to oil. If, on the other hand, one views state support of biofuels as merely leveling the playing field in a market that has traditionally favored petroleum, then certification may

seem cumbersome, setting biofuels at a disadvantage against their petroleum competitors. These two views are not necessarily mutually exclusive, however. It may be possible to level the playing field, giving state support to biofuels, while still maintaining high standards. Furthermore, it may be preferable to put in place best practices now rather than waiting until political will has evaporated, and we are in an emergency situation (with rising fuel prices), which might endanger Maine's resources.

Addressing sustainability concerns will make state support of biofuels more appealing to a broader audience, potentially avoiding a fight up front. There is increasing public awareness of the dark side of biofuels, which may engender a backlash. Furthermore, a study of certification should be relatively straightforward to implement. The certification itself, however, will prove more difficult. Following Europe and limiting incentives to sustainability-certified biofuels may also engender political resistance. A study will shed more light on all these costs and benefits – there should be little resistance to studying the issue further.

(c) Improve implementation of existing policies

As discussed in chapter III, Maine already has a number of progressive policies on the books, some of which are better implemented than others. Maine's current capacity to implement biofuels policies may not suffice for its enterprising agenda. Other states, such as New York and Pennsylvania, have invested more in implementation capacity. Pennsylvania, for example, has a dedicated alternative fuels program manager (U.S. DOE – AFDC, 2007). Stakeholders interviewed suggested that Maine would benefit from something similar. Ideally Maine would create a new position. If that is not possible, Maine could alter an existing position to include more oversight of alternative fuels. If the latter is pursued, it should be done carefully – it would be a mistake, for example, to take staff time away from other critical responsibilities. There is an effort underway to potentially reorganize the energy office. Any such reorganization should increase renewable energy and efficiency implementation capacity.

Impacts & Feasibility: Hiring an additional staff-person would cost at least $50,000 per annum, with benefits and probably more (see footnote 19). Furthermore, there is a risk of creating "more dead wood" in State Government.

Were the right person hired, however, it could yield a high return on investment. A dedicated staff member could help remove multiple barriers, benefit all three sectors (production, consumption, and distribution), and help fulfill all three goals (economic development, energy independence and the environment).

Specifically, increased staff time would improve implementation of existing policies by, for example, helping to educate the public about policies, clarifying stipulations, and streamlining paperwork for grants and incentives, as well as helping to safeguard existing funds. Secondly, it would increase the likelihood of successful future policies by increasing implementation capacity and guarding against errors in policy design. Increased staff time is especially critical if Maine decides to pursue some of the policy options suggested here, such as the Clean Fuel Fund. Thirdly, this could enhance the biofuels industry in general by securing federal grants, aiding with permitting, matching potential investors with producers, coordinating regional efforts, convening workshops and gathering and disseminating information. Finally, it could be combined with other work to yield co-benefits. For example, Bill Bell, who coordinated the Maine Biomass and Biofuels Conference, has suggested that additional staff time could be instrumental in promoting "fuels for schools," helping schools transition to pellets and wood

chips for heat. Perhaps an alternative fuels point person could oversee biofuels for heat as well as for transportation.

This recommendation may struggle through the political process, as it it not particularly glamorous, runs counter to current budget cuts and raises concerns over "dead wood." Nevertheless, it would be straightforward to implement and would provide a high return on investment.

2. POLICIES AIMED AT PRODUCTION

(a) Support biofuels R&D

Instate production is a priority among many stakeholders in Maine's biofuels industry. Maine's potential instate production is limited by the lack of cost-effective technology to convert forest resources to biofuels. As such, research and development is an important priority among stakeholders and was recommended at a stakeholder workshop for legislation this term. Other states, such as New York, Washington and Florida are investing heavily in R&D (U.S. DOE – AFDC, 2007). There are three ways Maine should support R&D:

i. MTI funding

Stakeholders present at a biofuels workshop prior to the November 2007 elections strongly supported legislative action to create an R&D fund for biofuels, which MTI might administer. Given the outcome of the November elections in which the people approved a $50 million bond allocation to MTI, it may not be necessary to pass legislation this term. Though there was a conscious decision to allocate the bond to an open fund rather than designating it to specific areas, MTI should use at least part of its bond money to seek out and support biofuels R&D.

ii. Match federal grants

Secondly, the State should commit to matching federal grant money for R&D when opportunities arise, as it has done for UMO. It should continue to make the Maine Economic Improvement Fund available for this purpose.

iii. Northeast biofuels R&D consortium

Thirdly, Maine can increase its chances of receiving federal grants by collaborating with other research institutions in the region. Both state agencies and universities should look for opportunities to collaborate.

Impacts & Feasibility: Supporting R&D is expensive and can be risky. Furthermore, the benefits may not immediately materialize. The potential benefits are manifold, however – R&D may be high risk, but it is also high return. As discussed in section II.1, the most recent study shows that, if there were economically viable technology, Maine could meet 18% of its gasoline needs with forest residues and an additional 58% from roundwood (though there is competition for roundwood resources). If forest resources were directed instead towards production of renewable diesel, 39% of Maine's diesel consumption could be replaced with forest residues. Roundwood could displace an additional 109% (Dickerson et al, 2007). If Maine were to use sustainably harvested forest residues to replace 18% of its

gasoline use with cellulosic ethanol, that would reduce annual GHG emissions by nearly 1 million tons of CO2 equivalent per year.[53] Developing cost-effective technology to access forest feedstock could greatly increase Maine's energy independence and have significant GHG benefits, as well.

Producing biofuels in state could also yield great economic benefits. The study cited above estimates that the total potential revenue from the sale of ethanol from forest residues and roundwood could be as much as $1.9 billion (Dickerson, 2007). Already state investment in UMO's Forest Bioproducts Research Initiative helped secure roughly $7 million federal dollars (UMO, 2007). It is also helping to start the first ethanol production in Maine, producing two million gallons a year (0.27% of Maine's gasoline market) and increasing revenue at a paper mill. There is concern among the forest products industry, however, that government support for biofuels may have negative impacts on existing industries (Strauch, 2007). This should be taken into account.

Biofuels produced in state from indigenous resources may also be more sustainable than some imported alternatives such as palm oil (which may endanger rain-forests) or corn (discussed in appendix V.1), particularly if Maine is careful to protect its resources through sustainability certification or other measures.

In addition to having a broad positive impact, R&D support is politically viable. There is widespread support for biofuels R&D, little or no resistance, and it is politically appealing. Furthermore, Maine has proven capacity to implement R&D programs. R&D is risky, however, and there is no guarantee that increased state support will lead to material benefits.

3. POLICIES AIMED AT DISTRIBUTION

(a) Exempt alternative fuels from exclusivity contracts

As discussed in the preceding chapter, several stakeholders as well as the Northeast Biofuels Collaborative, recommend exempting alternative fuels from exclusivity contracts (Coleman, 2007a; Linnell, 2007). Alternative fuel supply is constrained by franchise contracts which require retailers to buy and sell fuel solely from their parent company. If a parent company does not supply a particular fuel, a franchise cannot sell it. New York recently exempted alternative fuels from such contracts. Section 241 of the federal Energy Independence and Security Act of 2007 (recently passed in December), goes partway towards exempting alternative fuels from such contracts, but exempts only E85- and B20-blends and above (HR 6, 2007). New York's legislation, which Maine should adopt, is more comprehensive, exempting other blends and other alternative fuels. To see this legislation, please refer to appendix III. Since some retailers are uncomfortable selling B20 in the winter (due to cold weather gelling concerns), it is particularly important to exempt lower biodiesel blends.

Impacts & Feasibility: Exempting alternative fuels from exclusivity contracts does not cost the State anything. It is possible that is could cost the oil industry some market share (which is why they have developed these contracts), but it would not impact Maine businesses, outside of fuel retailers who would have an additional product to market (Schuyler, 2007).

53 Maine uses approximately 730 million gallons of gasoline a year (EIA, 2007a [data from 2005]). 18% of 730 million is 124 million gallons, each of which would release 19.4 pounds, for a total of 1.08 million tons. According to the U.S. EPA (2007a), cellulosic ethanol reduces net emissions by 90.9%. 90.9% of 1.08 million is nearly a million.

Exempting alternative fuels from exclusivity contracts will remove a barrier in the petroleum market, potentially increasing the pumps offering alternative fuels and allowing Mainers a choice. It will likely lead to greater distribution (increasing energy security), increase consumption of alternative fuels (reducing GHG emissions, improving air quality and increasing energy independence) and potentially encourage production by making Maine a more appealing place to do business.

While this was not one of the priority policies selected at the stakeholder workshop, it did not appear to engender much resistance either, and it does not cost the State anything. Furthermore, it would be straightforward to implement.

4. POLICIES AIMED AT CONSUMPTION

(a) Revenue neutral excise tax cut on biofuels

As discussed in the previous chapter, Maine's excise tax cut on biodiesel was extremely effective, if problematic. Reducing the cost per gallon of biofuels has been effective at the federal level as well, spurring consumption, distribution and production. Due to its efficacy, this incentive is popular among Maine's biofuel industry and was a priority for draft legislation among stakeholders attending a biofuels workshop. Though there were problems with the past incentive, including the cost to the State, a similar incentive could be written to reduce taxes on biofuels by ½ to ¼ cent per percentage biofuel in the blend. This smaller incentive rewards higher blends proportionately. A revised excise tax cut should also require signs on biofuel blends to increase public awareness. This incentive could be expanded to all biofuels or to all alternative fuels (though the draft legislation presented in the appendix would apply it to biofuels, only). Such a policy could also potentially have a shut-off, if petroleum prices climb above biofuel prices.

Several stakeholders present at the biofuel workshop strongly supported making an excise tax cut revenue neutral – instituting a tax shift to cover costs to the State. The following chart illustrates what such a tax shift might look like if biodiesel were to receive a tax credit of ½ cent per percent in the blend (or 50 cents per gallon). This example shows biodiesel and diesel only – not gasoline and ethanol. Numbers are approximate and simplified for illustration purposes, based on a theoretical annual doubling of biodiesel consumption, which is based roughly on current trends.[54]

Year	Biodiesel use (gal/yr)	Distillate use (gal/yr)	Diesel use (gal/yr)	% biodiesel in market	Total cost of tax cut	Marginal diesel tax	B20 tax cut:	B5 tax cut:	B2 tax cut:
2007	500,000	200,000,000	199,500,000	0.25%	$250,000	$0.00125	$0.09900	$0.02381	$0.00877
2008	1,000,000	200,000,000	199,000,000	0.50%	$500,000	$0.00251	$0.09799	$0.02261	$0.00754
2009	2,000,000	200,000,000	198,000,000	1.00%	$1,000,000	$0.00505	$0.09596	$0.02020	$0.00505
2010	4,000,000	200,000,000	196,000,000	2.00%	$2,000,000	$0.01020	$0.09184	$0.01531	$0.00000
2011	10,000,000	200,000,000	190,000,000	5.00%	$5,000,000	$0.02632	$0.07895	$0.00000	-$0.01579
2012	20,000,000	200,000,000	180,000,000	10.00%	$10,000,000	$0.05556	$0.05556	-$0.02778	-$0.04444
	40,000,000	200,000,000	160,000,000	20.00%	$20,000,000	$0.12500	$0.00000	-$0.09375	-$0.11250

FIGURE 11: EXAMPLE OF A REVENUE NEUTRAL TAX SHIFT FAVORING BIOFUELS. *The "biodiesel use" column estimates total on-road biodiesel use. Estimates are rough, based loosely on current trends. The "distillate use" column shows the total on-road distillate market in gallons per year, rounded up from EIA's 2005 estimate. The "diesel*

54 This is simplified and only based on biodiesel, which is why it is different from the market projections in appendix IV.3.a

use" column shows the total diesel use – the total distillate use minus the biodiesel use. The "% biodiesel in market" shows the percentage of biodiesel in the distillate market. The "total cost of the biodiesel tax cut" is the biodiesel consumption times 0.5 (50 cents per gallon or ½ cent per percent). The "Marginal diesel tax" per gallon is the "diesel use" divided by the "total cost" - the amount necessary to cover the biodiesel tax cut. The final three columns show how, in each year, different blends of biodiesel would be taxed. The tax cut on B20, for example, results from subtracting the marginal diesel tax on 80% of the fuel from the biodiesel tax cut on 20% of the fuel (.5.2)-(marginal diesel tax*.8). An interesting result of this revenue neutral shift is that, as long as a retailer supplies the average percent biodiesel for the year, there is no tax change. Retailers are rewarded for leading the state with higher than average blends. Those using less than average will incur a small tax. In order to reach a theoretical top-out level of 20% biodiesel (blends higher than this are not as common), nearly every retailer would have to sell B20 as a standard blend, so virtually no one would be taxed (the tax benefit on biodiesel at that level cancels out the marginal tax on diesel).*

Impacts & Feasibility: A revenue neutral tax shift would not cost the State, but it would cost retailers supplying less than the average amount of biofuels in their blends, as discussed under Figure 11, above. If, instead of a tax shift, the State were to shoulder the tax cut, the costs could be great, as this example illustrates in the "total cost of biodiesel tax cut" column above (this only shows biodiesel, not ethanol – for a more detailed projection, see appendix IV.3.a). Furthermore, costs are difficult to estimate, adding a degree of risk to this policy.

This tax shift (as described here and in the draft legislation below) would only benefit biofuels, not all alternative fuels. This is not ideal, but could be considered an incremental approach. Including all alternative fuels in the tax-shift would not be impossible, but would add to the complexity.

Removing the cost barrier to biofuels is highly effective at encouraging consumption, distribution and production. A revenue neutral incentive would also be economically efficient – it uses the power of the market to influence retailer and consumer choice towards an alternative with greater public benefits. It also internalizes some of the externalities associated with transportation fuels, leveling the playing field and helping to create a more equitable market where consumers have a choice among different transportation fuels. Furthermore, market mechanisms may encourage higher blends than mandates because the incentive continues to apply at higher blends (though, as discussed in chapter IV, mandates do appear to be the most directly effective state policy, and these two policy options could complement each other).

The excise tax cut on biofuels is broadly supported among stakeholders – reinstating this policy was the most popular option at a biofuels stakeholder workshop (though the stakeholders present were not necessarily representative – please see section IV.3.d). There may more political resistance to the tax shift component of this policy option, but there may also be more support (some stakeholders only support a tax shift, not a tax cut).

An excise tax cut is relatively straightforward to implement. A tax shift, however, may be more challenging. As shown in the example table above, it would involve estimating annual biofuel consumption in order to determine the tax, which could be precarious. One way to insulate against gross under- or over-estimation would be to allow the Clean Fuel Fund, discussed above, to cover shortfalls or receive surplus funds, when necessary. Furthermore, designing a shut-off, so that the incentive no longer applies if biofuels are less expensive than their petroleum equivalents, would also be complicated and potentially subject to manipulation.[55] These challenges will require intelligent rule-

55 It is possible to manipulate biofuels prices because biofuels are only sold in a few stations in some parts of Maine, and the

making, but they are not insurmountable. Having different tax rates for different blends may also be complicated. If this is deemed too complicated, there could be a single tax rate applied only to higher blends.

(b) DOT biodiesel purchasing requirement

State leadership is an effective way to move markets (Worldwatch Institute, 2007; Coleman, 2007; Andersen, 2007b). Ohio, New York, Missouri, Colorado and a number of other states require state agencies to use biofuels. Though it was not the highest priority, stakeholders who attended the biofuels workshop broadly supported DOT biodiesel use. DOT use could be achieved legislatively, administratively or through executive order. To see draft legislation, taken largely from Missouri's statute, please refer to appendix III.5. The draft legislation would require DOT to run 50% of its vehicles on B20 by 2009 and 75% to use B20 by 2010, but there are many variations on this theme. Ohio requires its DOT to use at least 1 million gallons of biodiesel a year, and New York requires an increasing percentage of biodiesel use in all diesel vehicles. One common element is that requirements are firm. Policies that request biofuel use "whenever possible" or "whenever practical" are not as effective at encouraging biofuels production or consumption (Rockefeller & Morgan, 2006b). DOT's recent attempts to secure B20 through a competitive bid process have not been successful (Peabody, 2007), either, but preferential purchasing or a purchasing requirement (which would increase biodiesel's capacity to compete) would increase the likelihood of success by encouraging more biodiesel bids. To further encourage instate production, a policy requiring DOT biodiesel use could include preferential purchasing from instate producers.

Impacts & Feasibility: At a price differential of 5 to 10 cents (Rockefeller & Morgan, 2006a), it would cost the state $90,000-$180,000 to run the DOT fleet on B20 (DOT uses roughly 1.8 million gallons of diesel a year [Allen, 2007]). This may be an efficient use of funds, however, as implementation is straightforward, and this policy would have a number of benefits. Direct benefits include reducing diesel consumption by 360,000 gal/yr (0.19% of the diesel market) and reducing state GHG emissions by 2,500 tCO2e/yr. A DOT purchasing requirement would also help remove the barrier of uncertain demand, stimulating distribution and production. Finally, it would set an example for others, particularly schools and municipalities, who might follow the State's lead.

DOT biodiesel use is broadly supported and will likely encounter little political resistance. Additionally, it would be visible to the public, and is therefore politically appealing. It should be straightforward to implement, and it is likely to achieve its intended effects and easy to evaluate. Though it may cost the State, it appears an efficient and cost-effective policy option.

(c) Pursue low carbon fuel standard/renewable fuels standard at a regional level

As discussed in the preceding chapter, both the renewable fuels standard and the low carbon fuel standard are promising policies. The renewable fuels standard, which requires that petroleum fuel (diesel or gasoline) contain a certain percentage biofuel, is the most directly effective state-level policy for increasing biofuels consumption, distribution and production (Worldwatch Institute, 2007;

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sample size for obtaining cost estimates is much smaller than for diesel. Additionally, biofuels from different sources sometimes vary dramatically in price. Adding or subtracting one supplier from a small sample may change the average price. Also, because biodiesel suppliers are concentrated in Southern Maine where fuel is less expensive, biofuel blends may appear less expensive than the average state diesel prices even if, at the same station, B20 is 5 cents more than diesel.

Andersen, 2007b; Coleman, 2007a; and Rockefeller & Morgan, 2006b). As discussed in chapter V, there are several different ways to design an RFS. It can be incentive-based, as in Iowa, rather than a mandate, or it can be triggered to go into effect when instate production reaches a predetermined level, as in Oregon (U.S. DOT – AFDC, 2007).

California is developing a technology-neutral variation of the RFS, the low carbon fuel standard,[56] which is intended to yield greater environmental benefits than the RFS. It requires a 10% reduction in the greenhouse gas-intensity of transportation fuels by 2020 (Farrell & Sperling, 2007). Part of the reason California is promoting the LCFS is to counter the current trend of the increasing GHG-intensity of fuel (as oil supplies diminish, it takes more and more energy, and, by extension, GHG emissions, to extract and refine it). The LCFS is not fully developed yet, but it may be possible to design an RFS that leads into a low carbon fuel standard.

These policies would serve Maine well, but the LCFS is novel and not yet developed. There is also a concern that Maine's market is too small to require fuel dealers to make adjustments specific to Maine. Stakeholder present at the biofuels workshop therefore recommended that agencies actively pursue these policies at a regional level. Specifically, DOT should promote them through the New England Governors and Eastern Canadian Premiers (where it is already one of several transportation action items), and DEP should promote them through the Northeast States for Coordinated Air Use Management (NESCAUM). States can piggy-back on the model of RGGI, using the existing process and structure wherever possible (while being careful not to take time and resources away from RGGI). The LCFS would complement RGGI – RGGI will reduce GHG emissions from stationary sources, while the LCFS would reduce emissions from transportation. There is already momentum building for this effort, but it will take leadership from the northeast states. Maine should be a leader in this regional effort.

At some point, however, if no individual states pass legislation, "regional action" becomes "action" in name only and can be used as a delay tactic. To give regional action more teeth, so to speak, the legislature could give the agencies some time (a year or so) to pursue the LCFS and RFS at a regional level before passing legislation that would trigger an RFS (designed to feed into an LCFS) when, for example, at least two other states in the region pass similar legislation. As discussed in chapter IV, Massachusetts is considering an RFS, as well as a regional approach to a LCFS. Maine should not have to wait until every other state in the region acts before it joins them.

Impact & Feasibility: Pursuing an RFS/LCFS at the regional level should not cost anything until the State takes action. As it is not fully designed, it is not clear what the low carbon fuel standard will cost. The California Air Resources Board will evaluate costs and cost-effectiveness (Farrell & Sterling, 2007). The RFS, however, is easier to guess at. Missouri's fiscal note for its RFS estimated no cost to its state government (HB 1270 & 1027, 2006). The cost to the public could be estimated by multiplying the incremental cost of the biofuels blend by the annual consumption. The Transportation and Land Use working group (2004) of the Maine Climate Action plan estimated that B5 would cost 5 cents more than diesel and E10 would cost 2 cents more than gasoline. This would result in a total cost of approximately $10 million for a B5 mandate and $14 million for an E10 mandate. This represents an upper limit, as the incremental cost estimates are out of date and high. Furthermore, if, as discussed below, the biofuels are produced in state, those costs and more could be recovered.

56 The federal government is also pursuing the LCFS. On December 5, 2007, it was added as an amendment to the Lieberman-Warner Climate Security Act, which has not yet passed the Senate (Lamar Alexander – "Press Releases," 2007).

As it is untested, it is difficult to judge the benefits of the LCFS. Two major benefits are intrinsic, however. Firstly, an LCFS would greatly reduce the GHG-intensity of transportation fuels (10% by 2020, if we follow California). Secondly, the LCFS would help increase the sustainability of biofuels production because GHG emissions are a good proxy for land-use and farming impacts (Farrell & Sterling, 2007). Additionally, as currently recommended, the LCFS would prohibit growing feedstocks on conserved lands and require producers to report on sustainability. An LCFS might obviate the need for sustainability certification.

The RFS would also lead to significant benefits. Firstly, it would result in direct benefits in energy independence and GHG reduction. An RFS requiring 2% biodiesel in all diesel would reduce dependence on diesel by 4 million gallons a year and reduce GHG emissions by 27,000 tons of CO2 equivalent a year. An E10 RFS would reduce dependence on gasoline by 72 mgy and reduce GHG emissions by 140,000 tons of CO2 equivalent a year. Secondly, particularly if it is triggered by production, an RFS could yield significant economic benefits. Minnesota, the first state to institute a 2% biodiesel RFS, credits its 60 mgy biodiesel industry with increasing gross state output by $928 million and creating 122 direct jobs (Ye, 2006). Washington, the second state to adopt a biodiesel RFS, now has six biodiesel plants with a combined capacity of 125 mgy (NWBiodiesel Network, 2007; NBB, 2007) – a significant amount, particularly for a state outside the grainbelt.

There is likely to be little or no political resistance to pursuing an RFS or LCFS at a regional level – both are broadly supported. The Transportation and Land Use Working Group of the Maine Climate Action Plan uniformly supported pursuing an RFS at the regional level (though it called it a low-GHG fuel standard, it was functionally an RFS), as did stakeholders present at the biofuels workshop. The Transportation and Land Use Working Group did not, however, uniformly support a state RFS. When it comes time to enact legislation, there may political resistance due to potential costs to the private sector and public.

Though agencies can begin to implement this recommendation through negotiations at a regional level, a regional RFS cannot be implemented without action at the state level. Once approved at a state level, an RFS would be straightforward to implement. The LCFS is not yet developed. Design, approval and implementation may take California a couple more years. Though Maine can wait for California to design the implementation strategy and follow its lead, implementation may still be challenging due to the complex nature of this policy option – any system that involves trading and self-certification processes (as is currently recommended) would take capacity to oversee. If done at a regional level, however, technical capacity could be shared. The model of RGGI may further ease the process.

	Action Item	Description	Target	Initial Implementation Steps	Next Steps?
Biofuels Industry in General	Clean Fuel Fund	Combine existing funds into a single fund to support clean fuel and biofuel production, distribution and consumption.	Legislature AND	Pass legislation* replacing existing funds with CFF	Add voluntary funding mechanisms
			DEP	Add CFF to list of SEPs	
	Study Sustainability Measures for Biofuels	Study sustainability certification, and, if recommended, restrict state support to certified biofuels	Legislature AND	Enact legislation* requesting a study	Enact legislation restricting state support to certified biofuels?
			OEIS	Research sustainability certification and report to the legislature	
	Improve Implementation	Hire alternative fuels point person	Governor's Office AND	Allocate funding for additional staff time	
			OEIS	Seek applicants	
Production	Support R&D	Make state resources available for R&D and work to attract federal grants	MTI AND	Seek out and support biofuels R&D with bond	If and when necessary, replenish MTI's biofuels R&D money
			Legislature AND	Commit to matching federal grants with MEIF	
			Agencies and Universities	Form a research consortium to attract grants	
Distribution	Exempt Alternative Fuels from Exclusivity Contracts	Allow retailers to provide biofuels even if their parent company does not offer them	Legislature OR	Enact legislation*	
			Attorney General	Exempt alternative fuels from exclusivity contracts under the Unfair or Deceptive Acts and Practices	
Consumption	Biofuels Excise Tax Cut	Decrease the excise tax on biofuels – possibly shift excise taxes to petroleum equivalent	Legislature	Enact legislation*	
	DOT Biodiesel Purchasing Requirement	Require the DOT to use B20 in its fleet	Legislature OR	Enact legislation*	
			DOT OR	Purchase B20 preferentially	
			Governor	Issue an executive order	
	Pursue LCFS/RFS at Regional Level	Seek regional adoption of fuel standards either requiring a percentage biofuel or reducing the GHG-intensity of fuel	DEP AND	Raise as a priority at NESCAUM	Legislature should enact RFS triggered by other northeast State adoption & instate production and designed to lead into LCFS
			DOT	Raise as a priority at NEG/ECP	

** To see draft legislation please refer to appendix III.*

Many of the recommendations discussed above build off of current or past policies or programs in Maine. In addition to those recommendations, there are other small ways Maine's existing policies could be modified or broadened to increase and strengthen their support of biofuels. The following chart shows both how the recommendations discussed above build off of Maine's current and past policies, and also how other small modifications could be made (please refer to chapter III to see more

details on the first column):

Previous action or existing policy	Recommendation	Objective
All alternative fuels policies	Hire alternative fuels point person	Improve implementation
CFVF and Agriculturally Derived Fuel Fund	Combine into CFF, add to list of SEPs	Broaden the applicability of the fund to increase applications, increase funding
MTI Forest Bio-Products fund	MTI should use some of its bond for similar purposes	Additional support for R&D
State support of UMO	State should commit to matching federal R&D grants	Additional support for R&D
Special Fuel Tax Act, excise tax cut on biodiesel	Reinstate with graduated tax cut (½ cent/percent), include other biofuels, require signs, and pay for through tax shift	Reinstate an effective policy, but reduce the cost, encourage higher blends, extend to all biofuels, and educate the public
State bioheat use, DOT B20 trial, recent DOT bid requests	DOT biodiesel purchasing requirement	Broaden visibility from state bioheat, set example for others, encourage distribution
Climate Action Plan, NEG/ECP negotiations, RGGI	Pursue regional RFS/LCFS	Build on past negotiations to put framework for action in place, extend GHG reduction to transportation sector
Previous action or existing policy	Small modification/extension	Objective
Renewable Resource Fund	Consider broadening definition of "renewable resource" or allowing unused funds to go to CFF	Increase biofuels' access to this fund.
Clean Fuel Infrastructure Tax Credit	Extend beyond 2008, consider removing "public" stipulation.	Extend incentive (there is an increased need for this incentive with rising petroleum prices) and broaden accessibility.
Exemption From the Sale or Lease Tax on the Incremental Cost of a Clean Fuel Vehicle	Reinstate	Encourage alternative fuel vehicles and decrease petroleum consumption.

APPENDICES

I. RESOLVE LD 1347, 2007

LD 1347

Resolve, Regarding Alternative Fuel Incentives To Stimulate the Production, Distribution and Use of Biofuels

Amend the bill by striking out everything after the title and before the summary and inserting the following:

Sec. 1. Study of policy options for alternative fuel incentives. Resolved: That the Executive Department, Office of Energy Independence and Security shall study and make policy recommendations regarding the establishment of an alternative fuel incentive program to stimulate the production, distribution and use of biofuels in the State. The study must address, but is not limited to: 1. A review of alternative fuel incentive laws and programs at the federal level and in other states including, but not limited to, the state of Pennsylvania; 2. Policy options for the form and type of incentives, including, but not limited to, grants for expenses relative to retrofitting vehicles to operate on alternative fuels; grants for incremental costs of purchasing alternative fuel vehicles; grants for the purchase of refueling equipment; grants for research and development of new applications of alternative fuel vehicles; rebates for residents who purchase alternative fuel vehicles; and incentive payments to producers of alternative fuels; 3. Goals and criteria to guide the awarding of alternative fuel incentives, including, but not limited to: improvement of air quality; protection of the natural environment; economic development; promotion of indigenous resources; reduction of the State's dependence on petroleum products; cost-effective use of private and public funding; and the transfer and commercialization of alternative energy technologies; 4. Policy options for administrative responsibility and oversight of an alternative fuel incentive program; and 5. Policy options for funding alternative fuel incentives; and be it further .

Sec. 2. Report. Resolved: That by January 15, 2008 the Executive Department, Office of Energy Independence and Security shall report its findings and recommendations to the Joint Standing Committee on Utilities and Energy. The report must include draft legislation to implement the recommendations; and be it further

Sec. 3. Authority to submit legislation. Resolved: That the Joint Standing Committee on Utilities and Energy may submit legislation relating to the subject matter of this resolve to the Second Regular Session of the 123rd Legislature.

Summary: This amendment replaces the bill with a resolve. The amendment directs the Executive Department, Office of Energy Independence and Security to study and make policy recommendations regarding the establishment of an alternative fuel incentive program in the State to stimulate the production, distribution and use of biofuels. The amendment requires the Office of Energy Independence and Security to report its findings and recommendations to the Joint Standing Committee on Utilities and Energy by January 15, 2008 and authorizes the committee to submit legislation related to alternative fuel incentives to the Second Regular Session of the 123rd Legislature.

II. RESOLVE LD 1159, 2007

LD 1159

Resolve, To Encourage Increased Use of Biofuel in Maine

Sec. 1. Development of a plan for a pilot program to establish refueling stations for biofuel. Resolved: That the Executive Department, State Planning Office, Office of Energy Independence and Security shall develop a plan for a pilot program to establish refueling stations for biofuel that is at least 85% ethanol. The office shall collaborate with the United States Department of Energy and the ethanol industry to secure resources and funding to facilitate the pilot program. The goal of the program is to convert up to 20 pump and tank systems to dispense biofuel that is at least 85% ethanol[57] in areas of the State that have the highest population density and percentage of vehicles capable of receiving the fuel; and be it further

Sec. 2. Report. Resolved: That, no later than January 31, 2008, the Executive Department, State Planning Office, Office of Energy Independence and Security shall report its plan under section 1 along with any recommended legislation related to the plan to the Joint Standing Committee on Transportation. The Joint Standing Committee on Transportation may submit a bill related to the plan to the Second Regular Session of the 123rd Legislature.

57 Stakeholders examined several policy options to fulfill this request at the biofuels workshop in October. There was a consensus, however, that these were not preferred policy options.

III. DRAFT LEGISLATION

1. CLEAN FUEL FUND[58]

1. This chapter is known and may be cited as "The Clean Fuel Act."

2. This chapter shall repeal and replace Title 10, sections 1023-k and 997-A

3. Definitions:

A. "Clean Fuel" "Clean fuel" means all products or energy sources used to propel motor vehicles, as defined in Title 29-A, section 101, other than conventional gasoline, diesel or reformulated gasoline, that, when compared to conventional gasoline, diesel or reformulated gasoline, results in lower emissions of oxides of nitrogen, volatile organic compounds, carbon monoxide or particulates or any combination of these. "Clean fuel" includes, but is not limited to, compressed natural gas; liquefied natural gas; liquefied petroleum gas; hydrogen; hythane, which is a combination of compressed natural gas and hydrogen; dynamic flywheels; solar energy; alcohol fuels containing not less than 85% alcohol by volume; and electricity.[1997, c. 500, §1 (new).]

B. "Biofuels" As used in this section, unless the context otherwise indicates, the term "biofuel" means any commercially produced liquid or gas used to propel motor vehicles or otherwise substitute for liquid or gaseous fuels that is derived from agricultural crops or residues or from forest products or byproducts, as distinct from petroleum or other fossil carbon sources. "Biofuel" includes, but is not limited to, ethanol, methanol derived from biomass, levulinic acid, biodiesel, pyrolysis oils from wood, hydrogen or methane from biomass, or combinations of any of the above that may be used to propel motor vehicles either alone or in blends with conventional gasoline or diesel fuels or that may be used in place of petroleum products in whole or in part to fire heating devices or any stationary power device.

4. Established. The Clean Fuel Fund, referred to in this section as the "fund," is established under the jurisdiction of the Finance Authority of Maine (the authority) with oversight from the Maine Office of Energy Independence and Security (OEIS) to support production, distribution and consumption of clean fuels and biofuels.

5. Sources of money. The following money must be paid into the fund:

A. All money appropriated for inclusion in the fund;

B. Subject to any pledge, contract or other obligation, all interest, dividends or other pecuniary gains from investment of money from the fund;

C. Subject to any pledge, contract or other obligation, any money that the authority receives in

58 Much of the language in this draft legislation comes from either the Clean Fuel Vehicle Fund (Title 10, § 1023-k). Parts also come from the original LD 1347 bill to create an Alternative Fuel Incentive Grant Program. The definition of Clean Fuel comes from Title 10, §963-A and the definition of biodiesel comes from Title 36 §5219-X of the Maine Statutes.

repayment of advances from the fund;

D. Any sums designated for deposit into the fund from any source, public or private, including, but not limited to, grants, air pollution penalties, bond issues and voluntary contributions through income tax forms or vehicle registration; and

E. Any other money available to the authority and directed by the authority to be paid into the fund.

6. Application of fund:

A. Insurance of loans: The fund may be applied to carry out any power of the authority under or in connection with section 1026-A, subsection 1, paragraph A, subparagraph (1), division (c), including, but not limited to, the pledge or transfer and deposit of money in the fund as security for and the application of the fund to pay principal, interest and other amounts due on insured loans.

B. Direct Loans: The fund may be used for direct loans to finance all or part of any clean fuel or biofuel project when the authority determines that:

(1). The applicant demonstrates a reasonable likelihood that the applicant will be able to repay the loan;

(2). The project is technologically feasible; and

(3). The project will contribute to a reduction of or more efficient use of fossil fuels.

C. Grant Program: With OEIS, the authority shall establish a formula and method for the awarding of grants under the program to support biofuels and clean fuels production, distribution and consumption.

The authority, in conjunction with the OEIS, shall adopt rules for determining eligibility, project feasibility, terms, conditions and security for loans and grants under this section. Rules adopted pursuant to this section are routine technical rules under Title 5, chapter 375, subchapter 2-A. Money in the fund not currently needed to meet the obligations of the authority as provided in this section may be invested in such a manner as permitted by law.

7. Accounts within fund. The authority may divide the fund into separate accounts as it determines necessary or convenient for carrying out this section, including, but not limited to, accounts reserved for direct loan funds, accounts reserved for grants and accounts segmented to support production, distribution and supply.

2. BIOFUELS SUSTAINABILITY STUDY

1. Study. The legislature directs that the Executive Department, Office of Energy Independence and Security, in consultation with the Maine State Planning Office, the Maine Department of Environmental Protection and The Maine Department of Conservation, Maine Forest Service, shall

study and make policy recommendations regarding policies to encourage the sustainability of biofuels.

2. Report to the legislature. The Executive Department, Office of Energy Independence and Security must present a report with its findings and policy recommendations to the legislature no later than January 15, 2009.

3. Report content. The report must address, but is not limited to:

A. The benefits and detriments of restricting state support from all biofuels to sustainability-certified biofuels.

B. A review of biofuels sustainability programs and related policies in other states and other countries, including, but not limited to, the European Union and California's low carbon fuel standard.

C. A review of research related to sustainability certification of biofuels and their feedstocks including, but not limited to, forest feedstocks.

D. Policy options for sustainability measures for biofuels based on, but not limited to: 1. land-use practices, particularly sustainable forestry; and 2. life cycle greenhouse gas emissions.

4. Default. If, by January 15, 2010, the legislature has not received a report on sustainability measures for biofuels and/or has not adopted a sustainability program, such as the low carbon fuel standard, biofuels produced from forest feedstocks shall no longer be eligible for state support unless those feedstocks are certified sustainable by an existing, third-party certification.[59] If the Office of Energy Independence and Security has produced a report on certification or the legislature has adopted another policy to encourage biofuel sustainability, this default measure will not apply.

3. EXEMPT ALTERNATIVE FUELS FROM EXCLUSIVITY CONTRACTS

The following is excerpted directly from New York's general business laws:

§199-j. Dealer's right to deal with suppliers other than his distributor. 1. Any provision of a franchise which requires a dealer to purchase or sell products of the distributor other than motor fuel, or which prohibits a dealer from purchasing or selling such products of persons or firms other than the distributor, shall be null and void. Any person or firm who is a distributor, or an officer, agent or employee of a distributor, who shall threaten, harass, coerce or attempt to coerce a dealer for the purpose of compelling the dealer to purchase or sell such products of the distributor or to refrain from purchasing or selling such products of persons or firms other than the distributor shall be guilty of a violation and shall be subject to a fine in an amount up to five hundred dollars for each violation.

59 Some environmental groups recommend that the legislature limit support in this default measure to the Forest Stewardship Council certification only, because they believe FSC is the most rigorous. The legislature should discuss this further. The specific choice of certification is left open in this draft legislation because a previous stakeholder process in 2005 concluded that, "From a statewide, multiple-interest perspective...a large-scale statewide certification effort will have the broadest support if it incorporates a variety of certification systems and strategies" (Maine Forest Certification Advisory Committee, 2005, p. 26), and, throughout its report, treats all certification schemes active in Maine equally.

2. (a) Any provision of a franchise which prohibits a dealer from purchasing or selling any of the alternative motor fuels set forth in paragraph (b) of this subdivision from a person or firm other than the distributor, or limits the quantity of such motor fuel to be purchased from such other person or firm, or any provision of a franchise which directly or indirectly discourages a dealer from purchasing or selling such alternative motor fuels from such other person or firm, shall be null and void as it pertains to that particular alternative motor fuel if the distributor does not supply or offer to supply to the dealer such alternative motor fuel. Nothing contained in this paragraph, however, shall grant to any dealer any rights, authority or obligation with respect to the permissible uses of the premises or facilities owned, leased or controlled by a distributor pursuant to the terms of the franchise.

(b) For the purposes of this section, the term "alternative motor fuel" shall mean any of the following: (i) a blend of eighty-five percent ethanol and fifteen percent gasoline; (ii) a blend of at least two percent methyl-ester, commonly referred to as "bio-diesel", and diesel motor fuel; (iii) motor fuel comprised primarily of methane, stored in either a gaseous or liquid state and suitable for use and consumption in the engine of a motor vehicle, commonly referred to as "compressed natural gas"; or (iv) hydrogen.

(c) Any person or firm who is a distributor, or an officer, agent or employee of a distributor, who threatens, harasses, coerces or attempts to coerce a dealer for the purpose of compelling such dealer to refrain from purchasing or selling alternative motor fuel from a person or firm other than the distributor shall be guilty of a violation and be subject to a fine in an amount up to one thousand dollars for each violation.

4. EXCISE TAX SHIFT

In order to institute an excise tax shift favoring biofuels, the following changes could be made:

Maine's previous excise tax cut could be amended to read:

An Act To Further Maine's Energy Independence

Be it enacted by the People of the State of Maine as follows:

Sec. A-1. 36 MRSA §3203, sub-§1, as amended by PL 2001, c. 688, §5, is further amended to read:

1. Generally. Except as provided in section 3204-A, an excise tax is levied and imposed on all suppliers of distillates sold, on all retailers of low-energy fuel sold and on all users of special fuel used in this State for each gallon of distillate at the rate of 23¢ per gallon, ~~except that the rate for distillates containing 2% or more of biodiesel fuel by volume is 20¢ per gallon~~ and for each gallon of low-energy fuel based on the British Thermal Unit, referred to in this subsection as "BTU," energy content for each fuel as compared to gasoline. In the case of distillates, the tax rate provided by this section is subject to annual inflation adjustment pursuant to section 3321 <u>and section XXXX</u>. Applicable BTU values are as follows.

Fuel Type	BTU content per gallon	Formula (BTU value	Tax Rate

		fuel/BTU value gasoline) x tax rate gasoline	
Gasoline	115,000	100% x 22¢	22¢ per gallon as authorized in section 2903
Methanol (M85)	65,530	57% x 22¢	12.5¢ per gallon
Ethanol (E85)	81,850	71% x 22¢	15.6¢ per gallon
Propane	84,500	73% x 22¢	16¢ per gallon
Compressed Natural Gas	100,000 (BTU per 100 standard cubic feet)	87% x 22¢	19.1¢ per 100 standard cubic feet

2. Biofuels. Biofuels are eligible for a further excise tax decrease of ½ cent per percent in blended fuel, except when, as determined by the Office of Energy Independence and Security pursuant section XXXX, the price of pure biofuels is less than the price of its petroleum equivalent. This shall not be construed to reduce excise taxes below zero.

3. Notification. Retailers receiving a special tax rate because they supply biofuels or low-energy fuel must advertize the content of their fuel in order to receive the tax advantage.

And a section could be added to Title 36, Taxation:

§XXXX. Biofuel tax shift[60]

1. Generally. Beginning in 2008, and each calendar year thereafter, the excise tax imposed upon internal combustion engine fuel pursuant to section 2903, subsection 1 and the excise tax imposed upon distillates pursuant to section 3203, subsection 1 are subject to an annual rate of adjustment pursuant to this section. On or about February 15th of each year, the State Tax Assessor shall adjust the rates, in consultation with the Office of Energy Independence and Security, by estimating expected biofuels and petroleum consumption for the year, and dividing half the expected biofuel consumption by the expected petroleum consumption. This method shall be applied separately to rates for distillates and rates for internal combustion engine fuels. The adjusted rates must then be added to the excise tax adjustment defined in section 3321. They will become effective on the first day of July immediately following the calculation. The assessor shall publish the annually adjusted fuel tax rates and shall provide all necessary forms and reports to suppliers, distributors and retail dealers. These forms shall include the adjusted tax rates for common biofuels blends (B2, B5, B10 and B20 for biodiesel and E10 and E85 for ethanol). Tax rates for biofuel blends shall be calculated by applying the marginal increase described above to the petroleum portion of the blend and subtracting from it a ½ cent per percent tax decrease (pursuant section 3203, subsection 2) applied to the biofuel portion of the blend.

2. Method of calculation; biofuel tax shift defined. The adjusted rate for distillate and internal combustion engine fuel will reimburse the highway fund for a ½ cent per percent decrease of the excise tax on biofuels. The calculation estimates the total cost of a ½ cent per percent decrease in biofuels excise taxes and covers the expense through a marginal increase in petroleum excise taxes.

3. Exclusion. This section does not apply to internal combustion engine fuel purchased or used for the purpose of propelling jet or turbojet engine aircraft.

60 The language in this draft legislation comes in large part from Maine Revised Statutes, Title 36, section 3321.

4. Exceptions. The Office of Energy Independence and Security shall develop a method of determining when the price of pure, unblended biofuel in Maine is lower than the price of its petroleum equivalent. The Office of Energy Indendence and Security shall monitor these prices and alert suppliers, distributors and retail dealers, as well as the State Tax Assessor, when the price of unblended biofuel is lower than the price of its petroleum equivalent. The tax adjustment in Section XXXX, subsection 1 shall be lifted during such periods.

5. DOT BIODIESEL PURCHASE REQUIREMENT

Program established for biodiesel fuel use in MDOT vehicles, goals, rules.[61]

1. As used in this section, the following terms mean:

A. "B-20", a blend of twenty percent by volume biodiesel fuel and eighty percent by volume petroleum-based diesel fuel;

B. "Biodiesel", fuel as defined in ASTM standard PS121;

C. "Incremental cost", the difference in cost between blended biodiesel fuel and conventional petroleum-based diesel fuel at the time the blended biodiesel fuel is purchased.

2. On or before October 1, 2008, the Maine Department of Transportation shall develop a program that provides for the use of fuel with at least the biodiesel content of B-20 in its vehicle fleet and heavy equipment that use diesel fuel. The program shall have the following goals

A. On or before July 1, 2009, at least fifty percent of the department's vehicle fleet and heavy equipment that use diesel fuel shall use fuel with at least the biodiesel content of B-20, if such fuel is commercially available;

B. On or before July 1, 2010, at least seventy-five percent of the department's vehicle fleet and heavy equipment that use diesel fuel shall use fuel with at least the biodiesel content of B-20, if such fuel is commercially available.

3. The blended biodiesel fuel shall be presumed to be commercially available if the incremental cost of such fuel is not more than twenty-five cents.

4. The director of the Maine Department of Transportation may promulgate any rules necessary to carry out the provisions of this section.

61 The language in this draft legislation comes from Missouri's statute 414.365, "Program Established for biodiesel use in MoDOT vehicles, goals, rules." There are a few alterations to suit Maine.

IV. METHODOLOGY

The analytic process of this policy work derived primarily from "A Practical Guide for Policy Analysis," by Eugene Bardach (2005), which outlines an eightfold path for policy analysis: 1) define the problem; 2) assemble evidence; 3) construct alternatives; 4) select the criteria; 5) project the outcomes; 6) confront the trade-offs; 7) decide; and 8) tell the story (Bardach, 2005). The Rabinowitz model (1980) further influenced the content of this report, and Stone (1997) contributed a theoretical foundation.

1. RESEARCH QUESTIONS

There are two separate questions underlying this research:

- *Should the Maine State government promote biofuels?*
- *If so, how?*

These questions may be broken into constituent parts:
1) Should the Maine State Government promote biofuels?
- Is there a need for state involvement?
- Is this a good use of state resources – will it benefit the public good (improving the environment, economy and/or energy independence)?

2) What are the various biofuels policy options for Maine?
- What policies are effective in other states?
- What are the current barriers to biofuels in Maine?
- What policies will best suit Maine?
- What will be most cost-effective?
- What is politically possible?
- What policies will best serve Maine's economy, energy security and environment?
- What are the best funding mechanisms?
  - What is politically possible?
  - What might achieve congruent goals?

These two questions are interconnected. While it is obvious that the answer to the first question influences the second, the answer to the second question – what are the various policy options – also influences the answer to the first. The various policy options available and the potential outcomes of those policies may make state involvement more or less appealing. I thus attempted to address both questions congruently.

2. RESEARCH DESIGN

Research for this report can be divided into three parts: (1) determining the need for state involvement in the biofuels market; (2) creating a menu of policy options to promote biofuels; and (3), evaluating the policy options based on cost, efficacy, and the "three 'E's" (impact on economic development, energy independence, and environment).

(a) Part 1 - Determining the need for State involvement

To address part 1, determining the need for state involvement, I conducted an extensive literature

review of the impact of biofuels on environment, energy security and economic development to gain an understanding of biofuels controversies and their implications (for further details, see appendix V.1). In addition to a literature review on this subject, I also included a question on merits of state involvement in interview questions.

(b) Part 2 - Creating a menu of policy options

To address parts 1 and 2 congruently, I interviewed Maine's biofuel experts (non-profits promoting biofuels, universities, etc), biofuel distributors, current and potential biofuel producers, feedstock producers, oil industry associations, environmental groups and governmental entities to assess the merits of biofuels and reasons for state involvement, to gain an understanding of current barriers to the biofuels market and to collect a menu of biofuels policy options (interviews are listed at the end of this section). These exploratory interviews were semi-structured to accommodate the diverse background and opinions of the subjects. They were not intended for quantitative use or analysis, but rather to gain an in-depth understanding of the issues (Creighton, 2005; Bardach, 2005) and to build a menu of policy options.

Interviews included the following questions:

1. Should the Maine State Government promote biofuels? If so, why (what are the drivers)?
2. What do you think is particularly important to include in this report? If you were writing the report, what would you say?
3. What do you think are the major barriers to biofuels in Maine right now?
4. Where do you think the State should focus its efforts? (new pumps, instate production, ethanol, emerging technologies, which feedstocks, etc.)
5. Are there any specific policies you would recommend? Any you think the State should expressly avoid?
6. How would you recommend paying for biofuels incentives or policies?

An array of policy white papers further contributed to a menu of policy options. Past research on Maine and northeastern biofuel policy options also provided a good foundation.

Maine is not a blank slate. It already has a number of policies in place. In order to formulate appropriate options for the future, it was necessary to review and evaluate Maine's current policies. The outcome of this research is detailed in chapter III.

While understanding the state-specific context is important, it is also important to learn from the experience of other states. To this end, I attended a Department of Energy conference on state biofuels policy in July. This conference highlighted the most effective state biofuel policies and created a network of contacts among the states. I continued to examine other state policies this fall, building on a report I wrote for the Biodiesel for Maine project, which evaluated the efficacy of various state policy instruments in stimulating instate biodiesel production. The outcome of this research is included in chapter IV.

(c) Part 3 – Evaluating policy options

To address part 3, evaluation of policy options, I analyzed the policy options based on a range of criteria. This analysis is included in chapter V of this report and was also included in materials sent to

stakeholders in mid-October, prior to a stakeholder workshop. A workshop of interested stakeholders was convened in late October 2007 to evaluate the menu of policy options collected in part 2. Participants had the opportunity to discuss the menu of policy options and evaluate them based on the criteria of cost, efficacy, energy independence, economic development, environmental impact and other criteria discussed in chapters I and V. Workshop participants are listed at the end of this section.

Creighton's (2005), "The Public Participation Handbook" influenced the public participation aspect of this research, providing general information on facilitation and stakeholder workshops. To narrow policy options, we used two decision-making tools – consent and multi-voting. Consent is a model of decision-making used in dynamic governance, that, unlike consensus, seeks to ascertain that no one strongly *opposes* a proposal (Prendergast, 2006). Multi-voting (the dots exercise) allows participants to weight their preferences and was helpful for prioritizing policies for deeper discussion.

While this stakeholder workshop was helpful for narrowing down policy options, it had some limitations, discussed below.

3. LIMITATIONS AND CHALLENGES

(a) Data

Some of the data included in this report is out-of-date, contested or uncertain. The most recent fuel comsumption data, for example, is from 2005. Cost estimates are the most problematic. In chapter V, I have included footnotes explaining the source of the estimate, but there is still great uncertainty involved, particularly for those estimates involving projection, such as per-gallon tax incentives. The following chart shows the projection underlying cost estimates for per-gallon tax incentives. Production estimates are based on the potential producers who control their feedstocks and utilize first generation technology, as these have the highest chance of success. Consumption estimates (at least for biodiesel) are based partly on production and partly on the current trend of slightly more than annual doubling. This projection is based on imperfect information, and, particularly for ethanol importation (because it is new to Maine), conjecture:

Ethanol	Producers on-line	Production	Imported	Consumption
2007	n/a	0	50,000	50,000
2008	n/a	0	200,000	200,000
2009	Red Shield	200,000	250,000	2,250,000
Biodiesel	Producers on-line	Production	Imported on-road	Consumption
2007	Green Bean	150,000	400,000	550,000
2008	+Maine Bio-Fuel	1,200,000	600,000	1,800,000
2009	+Maliseet Project	1,700,000	700,000	2,400,000
Ethanol & Biodiesel Combined		Production	Imported	Consumption
2007		150,000	450,000	600,000
2008		1,200,000	800,000	2,000,000
2009		3,700,000	950,000	4,650,000
Tax credits:	Producers credit (total production * .10)		Excise tax cut (total consumption * .25-.5/percent)	
2007		$15,000		$150,000-$250,000
2008		$120,000		$500,000-$1,000,000
2009		$370,000		$1,162,500-$2,325,000

FIGURE 12: BIOFUELS MARKET PROJECTIONS

The GHG data used in this report is from the U.S. EPA or the U.S. DOE, generally reliable sources, but, as discussed in appendix V, emissions reductions are contested.

As governments invest more heavily in biofuels, a debate is emerging. The science behind these contentious issues (discussed in chapter V) is far from complete, leaving evaluation uncomfortably subjective. At this point, it is difficult to assess whether benefits outweigh detriments for many of these concerns. New information is emerging all the time, making it challenging to synthesize it all.

Data collection was qualitative, as time allowed. Information on Maine's current biofuels market is mostly from interviews. There may be missing information. Much of the analysis and evaluation of policy options is based on interviews and a stakeholder workshop, both of which were qualitative, not quantitative. Any conclusions drawn from these research methods are qualitative in nature.

(b) Time constraints

This research began in June 2007, allowing a little over six months. This is a short time frame for handling such complexity and scope, particularly when it includes a degree of public involvement. Given the time constraints, it was impossible to quantitatively assess policy options. Cost-benefit analysis, for example, was out of the question. Time constraints also affected the efficacy of the public involvement process, as discussed below.

(c) Multiple goals and variables

Even given unlimited time, it would have been difficult to quantitatively evaluate policy options. The multiplicity of goals (energy independence, economic development, and the environment), and other variables (cost, efficacy, viability, timeline, etc) demands a complex, multi-dimensional analysis. How does one decide what energy independence is worth compared to federal research dollars or compared to tons of CO2 saved? How does one choose between recommending a highly effective policy that has little or no chance of surviving the political process or a risky, difficult to implement policy with substantial political support and appeal? The stakeholder workshop was intended, in part, to overcome these challenges, which it did, to some degree. But the stakeholder workshop had its own limitations.

(d) Stakeholder workshop

The stakeholder workshop was meant to mitigate some of the problems above, reducing bias and uncertainty by bringing together a diversity of viewpoints and evaluating the trade-offs between a diverse, and sometimes conflicting, set of variables and goals. This workshop was useful in narrowing the field of policy options and in refining top policy preferences. It also provided an opportunity for an educational, open exchange of ideas between many of Maine's biofuel experts. It had several limitations, however, some of which were mentioned during the workshop discussion and in the evaluations. Some of these problems should be attributed to time constraints, discussed above – in order to make complex decisions in a short time period, we used less than optimal decision-making tools, such as multi-voting. The multiple goals and variables exacerbated these limitations, as it was difficult to factor all variables into the discussion. Lack of facilitation experience and the inability to hire an experienced facilitator did nothing to overcome these hurdles. I maintain that, despite these limitations, the outcome of this research is superior for having included public input and involvement.

i. Unrepresentative group

Several participants noted that the workshop was a self-selected group and not necessarily representative. This limitation particularly presented a challenge for the multi-voting exercises where selections of policies could be strongly biased by the participants in the room.

ii. Cost

Some policies cost more than others. Our discussions of policies may not have adequately addressed this variability. An attempt to use multi-voting that included cost was unsuccessful due, at least in part, to questionable cost estimates. The dots exercise encouraged participants to make choices between policies on a level playing field, irrespective of cost. The top three policies selected through this exercise were perhaps the most expensive policies, resulting in an optimistic outcome, given the total cost to the State.

4. INTERVIEWS

1. Pattie Aho, American Petroleum Institute
2. Glen Andersen, National Conference of State Legislatures
3. Peter Arnold, Chewonki Foundation
4. Sen. Phil Bartlett, Chair of Energy and Utilities Committee
5. Randy Bean, Green Bean Bio-Fuel
6. Bill Bell, Maine Bioenergy Alliance
7. Rep. Seth Berry, lead on LD 1347
8. Mike Bilodeau, Director, Process Development Center; Industrial Outreach Liaison, Forest Bioproducts Research Initiative, University of Maine at Orono
9. Bob Blanchard, Irving Oil
10. Rep. Larry Bliss, Chair of Energy and Utilities Committee
11. Jim Brooks, Director, Bureau of Air Quality, Department of Environmental Protection
12. W. Scott Bush, Dirigo Bio-Fuels
13. Tony Buxton, Preti Flaherty
14. Andy Cadot, Maine League of Conservation Voters
15. Steve Catir, formerly of American Alternative Energy
16. Scott Christiansen, formerly of the Fractionation Development Center
17. Brooke Coleman, Northeast Biofuels Collaborative
18. Matthew Davis, Environment Maine
19. Kate Dempsey, The Nature Conservancy
20. Maureen Drouin, Maine League of Conservation Voters
21. Tim Dysart, Dysart's
22. Betsy Elder, formerly of the Maine State Planning Office
23. Rep. Ken Fletcher, lead on LD 1159
24. Alec Giffen, Maine Forest Service Director, Department of Conservation
25. Joel Glatz, Frontier Energy
26. Steven Greenlaw, Capital Programs Administer, Office of Passenger Transportation, Maine DOT
27. Rick Handley, Director, Northeast Regional Biomass Program, Coalition of Northeastern

Governors Policy Research
28. George Haselton, Harvest Fuels
29. T. Chuck Hazzard, Maine Energy Investment Corporation
30. Paul Heider, potential ethanol producer
31. Ralph Howe, BR Fuels
32. Jarmin Kaltsas, Maine Bio-Fuel, Inc.
33. John Kerry, Director of Energy Independence and Security
34. Erik Kingsley, Innovative Natural Resources Solutions LLC
35. Steve Linnell, Maine Clean Communities
36. Andy Meyer, Safe Handling
37. Erika Morgan, CitizenRe (formerly of Maine Energy Investment Corporation)
38. Gregory Nadeau, Deputy Commissioner, Maine DOT
39. Dale Peabody, Transportation Research Engineer, Maine DOT
40. Rick Porensky, Maine Bio-Fuel, Inc.
41. Jamie Py, Maine Oil Dealers Association
42. Bill Rees, potential biofuel producer
43. Ford Reiche, Safe Handling
44. Andrew Schuyler, Northeast Biofuels Collaborative
45. Peter Sexton, UMaine Cooperative Extension Crops Specialist
46. Dean Sgouros, Maine Bio-Fuel, Inc.
47. Mike Tetreault, The Nature Conservancy
48. Uldis Vanags, formerly of the Maine State Planning Office
49. Dylan Voorhees, Natural Resources Council of Maine

5. BIOFUELS STAKEHOLDER WORKSHOP PARTICIPANTS

1. Pattie Aho, Attorney, Pierce Atwood Consulting, representing the American Petroleum Institute
2. Peter Arnold, Sustainability Coordinator, Chewonki Foundation
3. Bill Bell, Executive Director, Maine Association of Conservation Districts
4. Nick Bennett, Staff Scientist, Natural Resources Council of Maine
5. Peter Beringer, Forester, Maine Forest Service
6. Mike Bilodeau, Director, Process Development Center; Industrial Outreach Liaison, Forest Bioproducts Research Initiative, University of Maine at Orono
7. Ronald Dyer, Regional Environmental Manager, Poland Spring Bottling
8. Ed Dysart, President, Dysart's Service
9. Tim Dysart, V.P., Dysart's
10. Bill Ferdinand, Attorney, Eaton Peabody
11. Kenneth Fletcher, State Representative, District 54 Legislator
12. Lorraine Garcia, Marketing Manager, CN Brown
13. Steve Greenlaw, Capital Program Administration, Maine DOT
14. Rick Handley, Director, Northeast Regional Biomass Program, Coalition of Northeastern Governors Policy Research
15. Chris Jackson, V.P. Government Relations, Maine Oil Dealers Association
16. Tim Keaveney, Marketing Manager, Sprague Energy
17. Steve Linnell, Coordinator, Maine Clean Communities
18. Chris McKenna, Fleet Manager, Poland Spring Bottling
19. Andy Meyer, V.P. Business Development, Safe Handling

20. Melissa Morrill, Environmental Specialist, Maine DEP
21. Dale Peabody, Research Engineer, Maine DOT
22. Sam Reiche, Special Projects, Safe Handling
23. Steve Robe, Business Development, Plum Creek
24. Jonathan Rubin, Associate Professor, University of Maine at Orono
25. Andrew Schuyler, Director, Northeast Biofuels Collaborative
26. Ronald Severance, Director, Program Planning, Maine DEP/Air
27. Peter Sexton, Crops Specialist, University of Maine Cooperative Extension
28. Dean Sgouros, Executive VP of Sales and Marketing, Maine Bio-Fuel, Inc.
29. Jim Therriant, VP, Marketing, Sprague Energy
30. Peter van Walsum, Associate Professor, University of Maine at Orono
31. Dylan Voorhees, Energy Director, Natural Resources Council of Maine

V. SUPPLEMENTAL BIOFUELS BACKGROUND

1. CRITIQUES AND CONTROVERSIES

The increasing popularity of biofuels has sparked a lively debate within the academic community and beyond. Biofuel critics question whether the energy necessary to produce it undermines its contribution to energy independence, as well any positive impact on climate change. They express concern over monocrops of corn and soy, the heavy use of pesticides and fertilizers as well as genetically modified organisms. In addition, there is concern that growing crops for fuel will reduce the amount of arable land available for food production, raising food prices and threatening food security. While the areas for concern are extensive, I will provide here only a brief overview of the major biofuel critiques and controversies.

(a) Energy balance

The most contentious (and potentially damaging) of the arguments against biofuels is the energy argument – that it takes more fossil energy to make the biofuel than the resulting fuel contains. This debate intensified in 2005 when David Pimental of Cornell and Tad Patzak of Berkeley published an article in *Natural Resources Research* claiming that, to produce corn ethanol, it requires 29% more fossil fuel than the amount of fuel produced, 50% more for ethanol from switch grass, and 27% more for soy biodiesel. A year later, Farrell et al (2006) published an article in *Science* synthesizing six energy studies, and concluded that Pimental and Patzak's negative energy ratio was erroneous. The discrepancy is mainly due to the inclusion of coproducts in the energy equation. Producing ethanol from corn also produces animal feed, displacing other feeds that also take energy to make. If some of the energy used to produce ethanol is proportionately assigned to the coproduct (subtracted from the ethanol), then the net energy is positive (meaning more energy results than was used in production) (Farrell et al, 2006). Coproducts can be contentious, however. Some argue that coproducts have saturated the market, are mostly waste, and therefore should not be assigned any energy value (Anslow, 2007).

While the debate continues, most agree that corn ethanol's net energy balance is positive, but not by much. Cellulosic ethanol, ethanol from sugar cane and biodiesel all have better energy balances than corn ethanol (Farrell et al, 2006; Dias De Oliveira, 2005; National Renewable Energy Lab [NREL], 1998; Hill et al, 2006; Worldwatch Institute, 2006). Despite corn ethanol's slim margins, there is still more *fossil* energy embodied in a gallon of gasoline than in a gallon of corn ethanol. This is because the fossil energy in a gallon of gasoline consists of two components – the fossil energy invested to drill and refine the oil and the gallon of gasoline itself. The fossil energy embodied in a gallon of ethanol only consists of only one component – the fossil energy invested in making the ethanol, not the gallon of ethanol, which is not a fossil fuel (Paustian et al, 2006).

(b) Greenhouse gas emissions

Energy balance is important not only because it potentially undermines biofuels' contribution to energy independence, but also because it impacts estimates of net greenhouse gas emissions. Estimates for net GHG emissions from corn ethanol fall at about 21% better than conventional gasoline (U.S. EPA, 2007a), but with a broad uncertainty band from –36% to +29%. This is due to large uncertainties associated with emissions from crop inputs, particularly nitrogen-based fertilizer and lime (Farrell et al, 2006). Farrell et al (2006) point out that better, more sustainable agricultural practices could

substantially reduce ethanol's life cycle GHG emissions and that policies should support this.

Land-use practices add yet another layer of complexity to this debate. Estimates of biodiesel's effect on GHG emissions are generally favorable (67% [U.S. EPA, 2007a]), but an unpublished study including land-use changes estimated that, throughout its life cycle, biodiesel releases more CO2 per gallon than diesel (Delucchi, 2006). If, for example, tropical forests are cleared for energy crops, this can release significant greenhouse gases. Furthermore, a recent article in *Science* argues that restoring forests may mitigate more CO2 than growing biofuel feedstocks on the same land (Righelato & Spracklen, 2007), though carbon sequestered through reforestation may not be permanently stored, whereas CO2 mitigated through displacing fossil fuels will be more permanent (because, ideally, the fossil fuels displaced will remain in the ground).

(c) Sustainable agriculture

Critics suggest that the major crops used to make biofuels (especially corn) pose serious environmental problems. Corn has one of the highest soil erosion rates of any crop grown in the U.S. (Maynard, 2007). Additionally, growing corn and ethanol production are both water-intensive, potentially contributing to water shortages (Food and Water Watch & Network for New Energy Choices, 2007). This is a concern for other biofuels crops, as well.

Ample use of pesticides and fertilizers are also bad for the environment. Excessive use of fertilizers is contributing to a "dead zone" in the Gulf of Mexico, (Food and Water Watch & Network for New Energy Choices, 2007), which has recently increased to 8,500 square miles. This recent increase in area might be attributed to increased corn production for ethanol (Barringer, 2007).

Critics are also concerned about genetically modified organisms (GMOs) in both biofuel crops and the processes used to convert cellulosic feedstocks to biofuels (discussed below). They charge that the GMO industry is using genetically modified biofuel feedstocks to make inroads into markets traditionally resistant to GMOs in food (Maynard & Thomas, 2007).

It is difficult to blame biofuels for the long-lived, systemic problems with industrial agricultural, but biofuels and policies promoting biofuels may exacerbate these problems and strengthen the status quo. On the other-hand, Amory Lovins (2005) argues that by designing industry standards and certification into the biofuel market from the start, biofuels could help ameliorate two of these problems: "The first is unsound practices that deplete topsoil, biodiversity (especially in soil microbiota), groundwater, and rural biotic cultures. The second, due largely to distorting subsidy patterns and to lax antitrust enforcement against giant grain dealers and packing houses, is unhealthy market concentration and near-monopsony" (Lovins et al, 2005, p. 109).

There is less controversy over the impacts of second generation energy crops such as forest residues. There is warranted concern, however, that if Maine becomes the "Saudi Arabia" of biofuels due to its vast wood resources, our forests may suffer.

(d) Food versus fuel

The public is increasingly concerned about biofuels' impact on food supply. Biofuels may compete for land and market-share with food. If energy prices are high enough (or subsidies great enough) biofuels

may drive up the price of land. Land prices have, in fact, risen in the past year, and some attribute this to the increasing demand for ethanol (Davey, 2007). With higher land prices, the price of food will rise as well, potentially increasing the risk of hunger (Azar, 2005). The price of food has climbed 3.9% in the last year in the U.S., which may be partially attributable to ethanol (Hagenbaugh, 2007). The relationship between corn and food prices is complex, however, and does not always correlate (Food & Water Watch, 2007).

The concern over food is important, but often over-simplified (Worldwatch Institute, 2007). Higher food prices might not be all bad. Much of the world's poor live in rural agricultural areas and could benefit from higher land and food prices (Azar, 2005). Much of the developing world is located closer to the Equator, with the potential to grow feedstocks with higher energy contents, and thus export to the developing world (Worldwatch Institute, 2007). Furthermore, biofuels support is increasingly substituting for food subsidies, which encourage over-production and dumping of excess crops on world markets, undermining local agriculture (Worldwatch Institute, 2007). Higher food prices might also drive up production, making up for losses from diverted crops (Azar, 2005). High prices might, however, push subsistence farmers off their land, exacerbating deforestation (Azar, 2005). They might also starve the poor (Runge & Senauer, 2007). It is difficult to blame biofuels for global hunger, as distrubution inequities and structural problems are more culpable (Worldwatch Institute, 2007; Muller et al, 2007), but biofuels may contribute to and help reinforce the status quo.

Though worthy of concern, the food versus fuel debate is over-simplified, and it is difficult at this point to determine whether the benefits to the world's poor will outweigh the detriments, or vice versa (Hazell & Pachauri, 2007). Policies can and should help to tip the balance towards benefits.

Some environmentalists and environmental groups, such as Amory Lovins of the Rocky Mountain Institute and the Worldwatch Institute, bypass some of the contentious issues discussed above by relegating traditional crop-derived biofuels the status of a stop-gap. They argue that second generation biofuels that use cellulosic feedstocks, discussed below, will out-compete first generation biofuels from crop feedstocks, reducing competition with food, reducing GHG emissions and improving biofuels' environmental impact and energy balance. In the meantime, it is possible that traditional biofuels can help prepare the infrastructure and accustom the market to biofuels. They also remind critics that biofuels are only a part of the solution. Efficiency and conservation are critical (Lovins et al, 2005).

2. EMERGING TECHNOLOGIES AND SECOND GENERATION BIOFUELS

The total potential of ethanol and biodiesel from traditional crops is widely debated. Some studies assert that even if all corn were diverted to ethanol, it could only meet 12% of current U.S. fuel demand (Bettelheim, 2006). Near term policy targets may be feasible, they argue, but even that may be a stretch. For the U.S. to meet a 5% displacement of gasoline in ethanol, it may have to dedicate 8% of all available cropland to the task. A 5% displacement of diesel may require 13% of all cropland (Demirbas, 2007). These figures are disputed, however. A spokesmen for Iowa's Renewable Fuels Association claims that merely following current trends of corn production ten years out leads to 30 billion gallons of ethanol production with plenty of corn left over for food (Shaw, 2007).

Regardless of the potential from traditional energy crops, emerging technologies may increase biofuels' potential substantially. A joint study by the U.S. Department of Agricultural and the Department of

Energy estimates that cellulosic processes could expand biofuels' potential to meet a third of current U.S. fuel demand (Perlack et al, 2005). Some now criticize this study for underestimating the potential – not fully accounting for woody biomass and underestimating the potential of traditional crops (State Biofuels Workshop, 2007).

Climate change and energy prices are driving fast innovation on the biofuels front. Emerging technologies promise to broaden the processes for feedstock conversion (biorefinery), broaden the array of possible feedstocks, and expand the range of outputs. Many of these technologies are already developed but not yet economically viable.

(a) Biorefineries

There are three main emerging processes that could revolutionize the industry by vastly expanding the variety of biofuel feedstocks: thermal, biological and chemical conversions.

Thermal conversions include gas-to-liquids and pyrolysis. Gas-to-liquids processes first gasify solid biomass to synthesis-gas (syngas), which is mainly a mixture of hydrogen and carbon monoxide. The syngas can then be converted using Fischer-Tropsch synthesis, which makes long-chain hydrocarbons from the carbon monoxide and hydrogen, to form to a wide array of liquid fuels, including diesel and gasoline (Scott, 2006; Ragauskas, 2006; Demirbas, 2006). This is the same process used in coal liquification (Demirbas, 2006). A second process, pyrolysis, uses heat to "crack" long strings of molecules into smaller ones. Thermal depolymerization, a type of pyrolosis owned by Changing World Technologies, replicates the natural geologic process that produces fossil fuels over millions of years (Lemley, 2003). While barriers to full deployment of thermal conversion exist (the production of tar and the need to clean syngas adds prohibitive expense [van der Laak et al, 2007]), several biorefineries currently utilize gas-to-liquids conversion and pyrolysis.

Biological or enzymatic conversion relies on enzymes such as cellulase to break down the insoluble sugars in woody feedstocks, depolymerizing cellulose to glucose for fermentation. These enzymes can be added to microbes that also help in fermentation, or they could be made endogenous to the plant, triggered by an inducer (Ragauskas, 2006).

Chemical processes use chemicals to remove oxygen from carbohydrates to yield oxygenated hydrocarbons, which, through further use of chemical catalysts, can be dehydrated and converted into biofuel. This process is novel and not as thoroughly researched as thermal and enzymatic conversions (Ragauskas, 2006), although chemicals are often used in tandem with other processes to help hydrolize the biomass.

(b) Feedstocks

The conversion processes discussed above greatly expand the variety of biomass that can become fuel. With greater deployment of these emerging technologies, traditional grain and oil-seed crops will have to compete with cellulosic feedstocks, as well as just about any kind of organic waste. A biorefinery using thermal depolymerization in Carthage, Missouri currently uses turkey offal as a feedstock, but this process could also use everything from municipal waste to plastic bottles to sewage (Lemley, 2003).

Even without the cutting edge biorefineries discussed above, feedstocks are expanding, and waste could

become a boon to biofuels. A New Zealand company is growing algae for biodiesel in a sewage system. The algae helps treat the sewage, and harvesting the algae for biodiesel reduces odors (Kiong, 2006). Some strains of algae are as much as 50% oil (Professional Engineering, 2007). Several companies are feeding algae for biodiesel with carbon-dioxide emissions from coal plants, reducing greenhouse gas emissions (Greentech, 2007). The benefits of creating fuel from waste are manifold, bypassing many of the controversies discussed in the previous section.

Cellulosic feedstocks may potentially decrease biofuels' impact on ecology, food security and decrease greenhouse gas emissions (as compared to crop feedstocks). Native grasses such as switchgrass may help prevent erosion (with ten-foot long roots), improve soil and are drought and flood-resistant. Short-rotation woody crops such as poplar and willow are also popular prospects (Lovins et al, 2005). Growing energy crops, such as switchgrass, however, might still compete with food for land (Walsh et al, 2003).

Scientists are seeking better feedstocks both through genetic engineering and through selective breeding. Perennials have not undergone the same intensive selection as annuals such as corn, so there may be room to improve yields, especially with modern technology (Ragauskas, 2006). To improve yields, genetic engineers are investigating means of increasing photosynthesis, manipulating nitrogen metabolism, and reducing the energy and matter invested in reproductive apparatus. Research is also focusing on improving crops for energy by reducing or altering the structure of lignin to make the plant cellulose more accessible (Raguaskas, 2006). While these breakthroughs may increase energy yield, they are cause for concern among anti-GMO environmentalists, who worry that cross-pollination of trees with manipulated lignin with wild trees would reduce their rigidity (Maynard & Thomas, 2007).

(c) Outputs – second generation biofuels

Many of these novel conversions and feedstocks do not produce fuels that can easily be classified as either biodiesel or ethanol. Pyrolysis and gas-to-liquids processes produce fuels (such as renewable diesel and bio-oil) that are more like their petroleum counterparts than biodiesel or ethanol. These second generation biofuels have fewer infrastructure problems than ethanol or biodiesel.[62] Bio-butonal, which, like ethanol, can be blended with gasoline, is another novel biofuel gaining popularity. DuPont and British Petroleum are working together to make bio-butonal, which has more energy than ethanol and is compatible with existing infrastructure (Carey, 2007). While these advances can be beneficial from an infrastructure, energy and environmental perspective, many of the existing subsidies support only biodiesel and ethanol. New biorefineries sometimes have to fight to receive the same treatment (Carey, 2007). However, proponents of traditional biofuels argue that these novel outputs, such as renewable diesel, lack some of the environmental benefits of traditional biofuels, such as improved emissions and decreased toxicity (Stearns, 2007a).

(d) Biogas

The anaerobic decomposition of organic material produces a gas, frequently called biogas, which is a mixture of mostly methane and some carbon dioxide (U.S. EPA, 2002). It is similar in composition to natural gas. As such, it can be used to produce heat, electricity or as an alternative transportation fuel.

62 Ethanol is hydrophilic and a solvent, so it needs separate pipe-lines and pumps. Pure biodiesel has a higher gel temperature than diesel (causing problems in cold weather), and is also a solvent, so it may dissolve old rubber parts and clog filters.

The byproduct is a non-toxic fertilizer. Sweden, which plans to be "oil-free" by 2020 (Commission on Oil Independence, 2006), has invested substantially in biogas production, transportation and refueling infrastructure. Proponents argue that biogas is superior to traditional biofuels (ethanol and biodiesel) because it comes from waste feedstocks, skirting the food versus fuel debate and other sustainability concerns (Smith & Hughes, 2007). From a transportation perspective, however, biogas requires more investment in infrastructure than biodiesel or ethanol. However, this investment may help transition infrastructure to a hydrogen economy, as hydrogen can be blended with natural gas to produce a cleaner burning fuel, called HCNG (U.S. DOE – AFDC, 2007).

Maine already uses landfill gas to produce electricity (Turkel, 2007), and there is some interest in producing biogas from manure at some of the dairy farms in Maine (Linnell, 2007; Hazzard, 2007). Due to the scale of the subject matter and time constraints, biogas is not included in detail in this report. It is a fuel that deserves state support, however, and several of the recommendations discussed in chapter VI could benefit it.

VI. FURTHER READING

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VII. ABBREVIATIONS

AFDC	Alternative Fuels Data Center
AG	Attorney General
B2; B5; B10; B20	A biodiesel blend – the number indicates the percentage biodiesel in the blend (B2 means 2% biodiesel, 98% diesel, for example)
BFM	Biodiesel for Maine
Btu	British thermal unit
CFF	Clean Fuel Fund
CFVF	Clean Fuel Vehicle Fund
CO2	Carbon dioxide
cpg	Cents per gallon
DEP	Department of Environmental Protection
DOE	Department of Energy
DOT	Department of Transportation
E10, E85	An ethanol blend – the number indicates the percentage ethanol in the blend (E10 means 10% ethanol, 90% gasoline, for example)
EIA	Energy Information Administration
EPA	Environmental Protection Agency
FAME	Finance Authority of Maine
FBRI	Forest Bioproducts Research Institute
FDC	Fractionation Development Center
FFV	Flexible Fuel Vehicle (a vehicle that can run on E85 or gasoline)
GHG	Greenhouse gases
gy	gallons a year
LCFS	Low Carbon Fuel Standard
MEIC	Maine Energy Investment Corporation
MEIF	Maine Economic Improvement Fund
mgy	million gallons a year
MTBE	Methyl Tertiary Butyl Ether
MTI	Maine Technology Institute
NBB	National Biodiesel Board
NEG/ECP	New England Governors/Eastern Canadian Premiers
NESCAUM	Northeast States for Coordinated Air Management
NOx	Nitrogen oxides
NRBP	Northeast Regional Biomass Program
NRCM	Natural Resources Council of Maine
NREL	National Renewable Energy Lab
NSF	National Science Foundation
NYSERDA	New York State Energy Research and Development Authority

OEIS	Office of Energy Independence and Security
OPEC	Organization of the Petroleum Exporting Countries
PUC	Public Utilities Commission
R&D	Research and Development
RFS	Renewable Fuels Standard
RGGI	Regional Greenhouse Gas Initiative
SEP	Supplemental Environmental Projects
SPO	State Planning Office
State	The Maine State Government
tCO2e	tons of carbon dioxide equivalent
“three 'E's”	Economic development, energy independence, and environmental health
UMO	University of Maine at Orono
UN	United Nations
USDA	United States Department of Agriculture

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