The Pathway to Clean Energy

Solutions for Carbon-Free Future

Town Of West Hartford

Biodiesel

- Cost-effective way to reduce GHGs
- Lead us into the future to zero emissions
- Industry has advanced technology & resources to create a cost-effective, zero-carbon deliverable fuel

Life Cycle Emissions

- **Connecticut must change how GHG's are measured. The old way of looking at tail pipe and burner tip emission is like driving down a road with side blinders on, you cant see the whole picture. Connecticut must adopt Life Cycle analysis.**
- **Where are the other places (ie. states, government entities, etc.) that life cycle analysis is used to measure emissions?**
- National Renewable Energy Laboratory
- Lawrence Berkeley National Laboratory
- Argonne National Laboratory
- U.S. Department of Energy
- U.S. Environmental Protection Agency
- U.S Federal Government
- European Union
- All states researched with portfolio standard programs
- The problem isn't finding what federal and state agencies use LCA, it's finding agencies that still use burner-tip emissions. Using LCA to measure emissions is widely accepted and has been for years.

Biodiesel: Use in NY & MA

MA & NY recognize the cost-effectiveness & impact to GHG reduction with the use

of biodiesel in comprehensive energy plans

- Positive results
  - Immediate GHG emission reduction, positive economic impact thru job creation, income tax revenue
- MA creates clean energy credits with the use of biodiesel
- NY incentivizes use of biodiesel with income tax deduction of $0.10 cpg

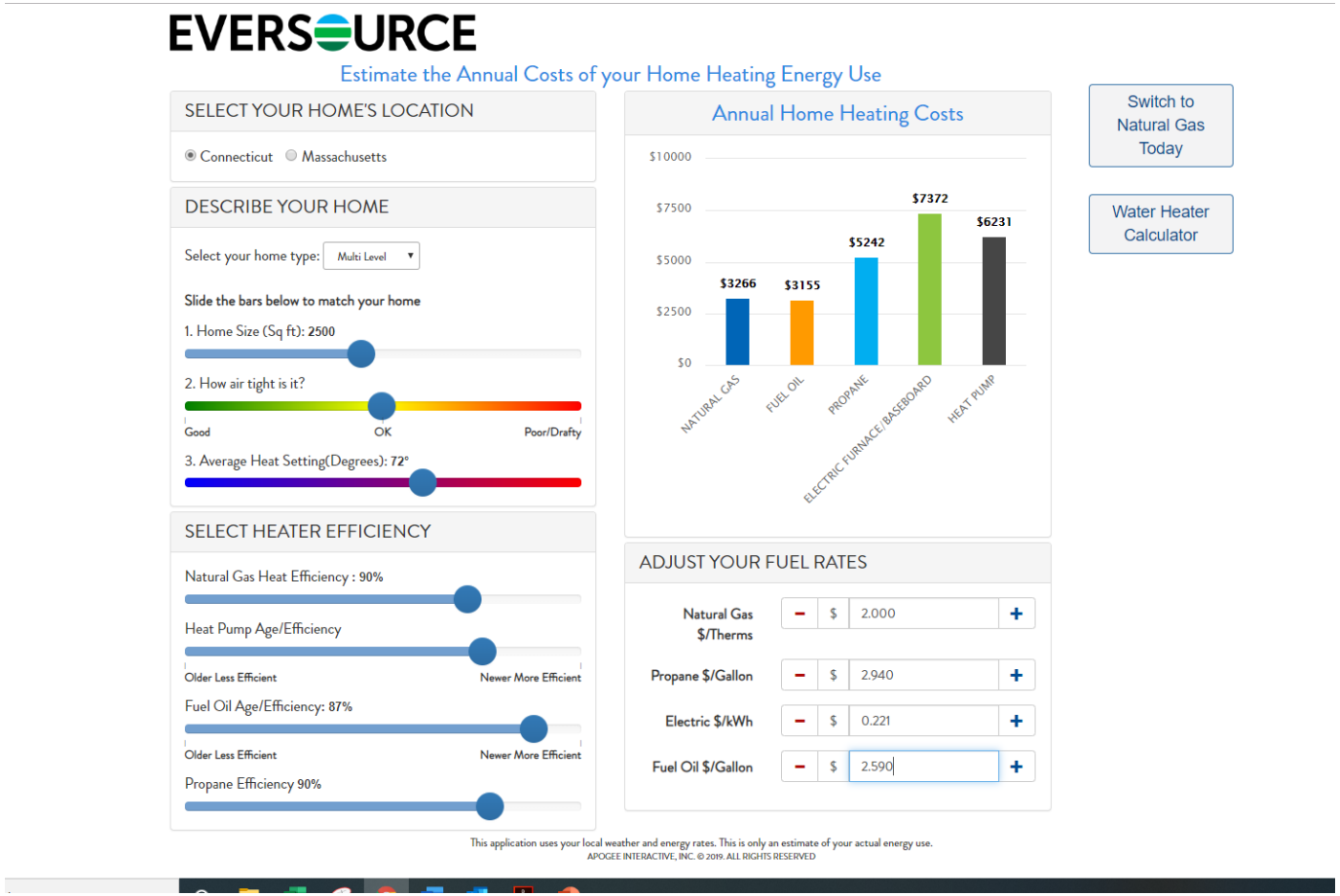
Consider This…

- Heat pumps cost more than double to operate than traditional fuel systems that run on biodiesel, and installation costs are intolerable to CT residents.
- Electric grid will need a complete overhaul to sustain & deliver the current load as well as the increased demand of electricity load required by the conversion to heat pumps and electric cars.
- How long will it take to install a modern electric grid? What will it cost?
- Connecticut will need to replace all of it’s electricity production and then double it to provide zero carbon power. How much will rates go up? What is a time frame for this? Can we afford it?

Heat Pumps – Conversion Cost

- Cost of conversion to electric air-source heat pumps is NOT affordable for low and middle-class residents
- 96% of current heat pump users state that it did not provide sufficient heat for entire home, thus the need for additional heat source
- MA reports conversion costs of an average sized house of 1502 sq ft is $20,428

Biodiesel vs. Heat Pumps – Operational Cost



Looking to the Future

CO2 Emissions (tons per year) for a Typical Single Family Home

	2020	2030	2040	2050
ULSD	8.0	8.0	8.0	8.0
B20	6.8	6.6	6.5	6.4
B50	4.8	4.6	4.4	4.0
Cold-Climate Heat Pump	5.0 ?	???	???	1.0 ?
B100	1.6	1.2	0.8	0.0

B50 and heat pumps competitive during next ten to fifteen years .

Cold-climate heat pump CO2 emissions dependent on hourly grid Marginal Emission Rates plus achievement of high levels of new renewable generation capacity.

	120% Thermal Heat Pump vs Electric Hrat Pump	90% Boiler vs Electric Heat Pump	Thermal Heat Pump MMBtu or kWh	Boiler MMBtu or kWh	120% Thermal Heat Pump	90% Boiler	Btu/Unit*	EIA March 2019 Cost per Unit		
Natural Gas	$1,925	$2,566	77.3	103.1	80.1	106.8	1036	$24.90	/thousand cu ft	https://www.eia.gov/state/data.php?sid=CT
Heating Oil	$1,731	$2,308	578	771	80.1	106.8	138,500	$2.99	/gal	https://www.eia.gov/dnav/pet/pet_pri_wfr_dcus_sCT_w.htm
Electricity (200% HP)	$3,507	$3,507	14,083	14,083	48.1	48.1	3412	$0.2490	/kWh	https://www.eia.gov/state/data.php?sid=CT
Propane	$2,324	$3,098	877	1,169	80.1	106.8	91,333	$2.65	/gal	https://www.eia.gov/dnav/pet/pet_pri_wfr_dcus_sCT_w.htm

* https://www.eia.gov/energyexplained/index.php?page=about_btu

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Delta Oil Heat ws Heat Pump	
$1,775	$1,198
51%	34%

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Electricity (250% HP)	$2,805	$2,805	11,266	11,266	38.4	38.4	3412	$0.2490	/kWh	https://www.eia.gov/state/data.php?sid=CT
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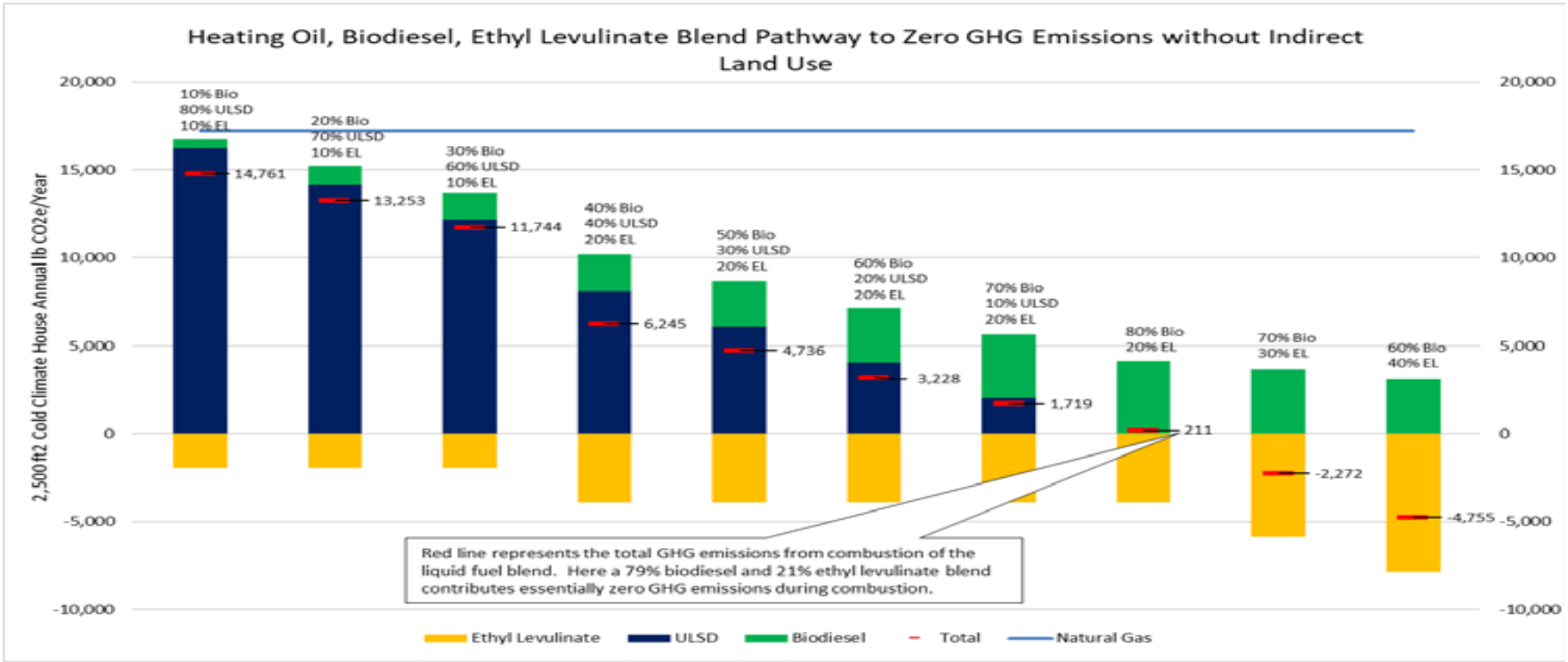
Comparing Future Biodiesel and ULSD Blended Fueled Boiler and Thermal Heat Pump Emissions with Electric Heat Pump Emissions Based on System Average Locational Marginal Unit Emissions for Residential Heating and DHW

				2017 GHG Emissions		Electric Grid GHG Emissions 25% reduction		Electric Grid GHG Emissions 50% reduction		Electric Grid GHG Emissions 75% reduction		Electric Grid GHG Emissions 100% reduction	
Description	**Thermal/Electric Eff. %**	**Idle Loss (%)**	**Boston, MA MMBtu or kWh**	**Annual CO2 Emissions lbs**	**Biodiesel Blend**	**Annual CO2 Emissions lbs**	**Biodiesel Blend**	**Annual CO2 Emissions lbs**	**Biodiesel Blend**	**Annual CO2 Emissions lbs**	**Biodiesel Blend**	**Annual CO2 Emissions lbs**	**Biodiesel Blend**
Oil boiler	90%	0.5	106.8	17,979									
Thermal Heat Pump includes Elec parasitic estimate)	120%		80.1	13,484									
Biodiesel and ULSD Blend Boiler	90%		106.8	14,928	17.0%	11,196	37.7%	7,464	58.5%	3,732	79.2%	0	100.0%
Biodiesel and ULSD Blend Thermal Heat Pump	120%		80.1	13,484	0.0%	11,196	17.0%	7,464	44.6%	3,732	72.3%	0	100.0%
Electric Heat Pump Stage 2 Heating Excluding Necessary Electric Resistance Low Ambient Backup Heating	200%		14,083	14,928		11,196		7,464		3,732		0	

Zero Carbon Combustion by 2040

The heating oil industry is actively incorporating existing biofuels into product blends in order to reduce GHG emissions and is working with suppliers to ensure these product blends are compatible with existing and new oil heating equipment.

Advanced biofuels, such as ethyl levulinate, show even greater promise at reducing the GHG footprint of heating oil blends, well beyond the levels of competing fuels such as natural gas. Figure 3 illustrates the total annual GHG emissions from providing heating and hot water services to a representative 2,500 square foot house in the New York City regions for typical replacement boilers being sold today using a blend of ULS heating oil, biodiesel and ethyl levulinate as fuel. A blend of just 10% biodiesel, 10% ethyl levulinate and 80% ULSD has lower annual GHG emissions than natural gas. The graph shows that increasing biodiesel and ethyl levulinate blend content significantly improves GHG emission compared to natural gas. In fact, because of the feedstock used, production techniques and multiple usable products, ethyl levulinate actually enables the potential for reduction of GHG beyond a neutral point – a blend of 79% soybean-based biodiesel and 21% ethyl levulinate contributes zero total fuel cycle GHG emissions, based on using the 100-year atmospheric lifetime global warming potential (GWP) factors with carbon feedback.



West Hartford Energy Action Plan – Draft for Discussion

Municipal

2020

1. Complete schedule of upcoming municipal building HVAC and roof upgrades
2. Investigate Microgrid for town center
3. Analyze interval energy usage on town buildings and develop plan to reduce peak demand
4. Complete assessment and plans for EV charging infrastructure.
5. Review feasibility of shared solar facility on town land (e.g., landfill)
6. Conduct annual update on municipal energy usage using the town's energy monitoring toolkit. Integrate with residential and business use
7. Explore town efficiency incentives through building and/or tax codes
8. Investigate bio diesel for town diesel fleet
9. Investigate electric vehicle for town municipal fleet

Next

1. Inventory brownfields for alternate use
2. Develop electric vehicle strategy on town fleet.
3. Develop pilot renewable energy microgrid around critical town properties.
4. Consider implementing Community Choice Aggregation
5. Retrofit a town building – at least in part - with a heat pump and monitor results for future installations.

Residential & Business

2020

1. Conduct residential heat pump campaign
2. Conduct energy survey of town residents
3. Propose renewable energy/energy efficiency policy for new construction in town
4. Update residential and business energy benchmark
5. Work with High Schools on Real Estate Agent Recycle "Carbon Challenge"
6. Have West Hartford sign the Ready For 100 Resolution
7. Work with Pedestrian and Bicycle Commission to develop a transportation Plan
8. Work with Conservation and Environment Commission to complete a Greenhouse Gas Inventory

Next

1. Develop a means of reaching the community for energy issues
2. Conduct residential Home Energy Audit (HES) audit campaign.
3. Restart Small Business Energy Advantage (SBEA)
4. Promote C-PACE financing of commercial projects
5. Engage the community in a discussion of responsible and sustainable solar development
6. Expand local bike trail
7. Work with town staff and zoning and planning commissions to promote solar, heat pumps and EV-readiness in new construction.

Heating and Cooling

Heating and cooling account for almost half of the energy use in a typical U.S. home. In West Hartford, the majority of homes heat with gas (66%) or oil (31%) Air-source heat pumps offer an opportunity for homeowners to lower their energy costs, and at the same time reduce greenhouse gas (GHG) emissions. Long used for cooling in warm climates, heat pumps are now able to provide efficient heating in cold climates even at outdoor temperatures as low as -15 °F.

Air-source heat pumps are capable of not only heating in the winter (by extracting heat from outside air) but also cooling in the summer (by extracting cold from outside air.) Heat pumps use the same technology as a refrigerator or air conditioner.

Heat pumps can be used alongside existing heating systems to address specific needs and lower costs. This hybrid system can either be standalone or integrated with controls that determine whether to heat with fossil fuel or use the heat pump

Progress to date:

- Considerable deployment in the residential sector
- Being investigated in the Municipal sector

Benefits:

- Lower heating and cooling costs
- Comfort – With advances in controls, heat pumps can maintain very constant temperatures.
- False See Eversource cost sheet
- Safety – Because heat pumps are electrically powered, there is no risk of combustion gas leaks.
- Improved air quality – Heat pumps filter indoor air all year and dehumidify it in the summer,
- All systems with duct's have filters
- Room-by-room control Only with some systems
- Reduced greenhouse gas emission
- As compared to what? Not Bioheat.

An illustration of a ductless mini-split system.

Actions:

- Create schedule of upcoming HVAC upgrades on town buildings, including schools.
- Ensure heat pumps are considered in town building upgrades.
- Carry out town-wide campaign to educate about and promote heat pumps
- Work with town staff and zoning and planning commissions to promote heat pumps in new construction.
- Publicize examples of heat pump installations, both new and retrofits, for town buildings, households and businesses.

2024 Goals:

- 10% of homes (800) using heat pumps

2039 Goals:

- 90% of homes using heat pumps

Why? This should not be until Connecticut can generate 100% green electricity and be able to deliver it..

Biofuel In Our Town

- 1. West Hartford Should look at installing new fuel tanks at town owned buildings and convert to Bioheat. This will result in immediate GHG reduction that will take up to 30years for the electrical system to match.
- Talk to DOT/State to use a B20 in transit buses and use Connecticut made Biodiesel.
- Encourage homeowners to use and convert gas heat to Bioheat.
- Meet with town maintenance staff about bioheat and how it works in heating systems.

Other Benefits

Biodiesel use improves air quality and helps a jurisdiction meet their environmental goals. The use of biodiesel results in substantial reduction of unburned hydrocarbons, carbon monoxide, and particulate matter compared to emissions from diesel fuel. The exhaust emissions of sulfur oxides and sulfites (both components of acid rain) from biodiesel are significantly lower than traditional diesel.[26]

Using biodiesel also reduces greenhouse gas emissions. B100 reduces carbon dioxide emissions by more than 75 percent compared with petroleum diesel, and using B20 reduces carbon dioxide emissions by 15 percent.[27] To estimate the energy and emissions impacts of biodiesel, fleet managers can use the U.S. Department of Energy's Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model. GREET is a full life-cycle model that allows fleet managers and others to evaluate various vehicle and fuel combinations and evaluate their environmental impacts.[28] California's Air Resources Board has also confirmed biodiesel to be the best option for reducing GHGs and provides the lowest carbon intensity fuel under the Low Carbon Fuel Standard.

In addition, biodiesel is made from a diverse mix of domestic feedstocks, and is reducing U.S. dependence on foreign petroleum and growing the U.S. economy. There are currently about 200 biodiesel plants across the country, with registered capacity to produce some 3 billion gallons of fuel. The biodiesel industry is supporting more than 62,000 jobs, and is poised to grow significantly with continued production increases. Using biodiesel can help fleets meet their "Buy America" commitments and energy security goals.

This truck belongs to a fleet based at a Walmart distribution center that was converted to run on biodiesel.

Biodiesel fire engine in San José, California.

Vehicles that use biodiesel can help build system resilience by diversifying an emergency response fleet. If a storm or other emergency disrupts a region's primary fuel supply, emergency managers should be able to turn to public and private biodiesel suppliers so that their diesel fleets can be used to help during the emergency. By knowing the location of biodiesel refueling facilities, emergency managers will be able to better prepare for and respond to disasters.

Biodiesel is a readily-accessible alternative fuel that is an asset to communities during emergencies, particularly when there is an increased need for heavy-duty, diesel-fueled equipment. Biodiesel can be used in existing diesel engines, and fleets that have transitioned to biodiesel have used the vehicles to perform critical services during gasoline and diesel shortages. Moreover, fleets that have installed biodiesel storage tanks and generators have used their on-site refueling capability to ensure continuous operation during disasters, and provide needed fuel to other emergency fleets. Fleets that transition to biodiesel have also experienced lower fuel costs and have lessened their environmental impact.

While vehicles that run on biodiesel can provide needed services during fuel supply disruptions, they can be impacted by climatic conditions and electricity outages. Higher-level blends of biodiesel can gel in cold temperatures, which can present storage and operational issues in northern climates. In addition, during power outages, refueling sites without generators will not be able to pump the fuel from underground storage tanks until electricity is restored.

The following pages include examples of cities and states that have incorporated biodiesel into their emergency fleet, and provide additional information that fleet and emergency managers should consider when considering the use of biodiesel in their vehicles.

Biodiesel Fueled Vehicles in Disasters

PROS:

- ✓ A variety of biodiesel blends can be used in all existing dieselengines
- ✓ On-site storage tanks can provide fuel to emergency services fleets and others during disasters
- ✓ Readily-accessible alternative forheavy-duty fleets

CONS:

- × Higher-level blends can gel in cold temperatures
- × Natural solvent can release deposits that may clog fuel filters and require replacement with higher biodiesel blends
- × Underground refueling sites without generators may be rendered inoperable during power outages

CASE STUDY

New York City's Biodiesel Fleet

One of New York City's biodiesel snow removal vehicles.[1]

New York City's Department of Citywide Administrative Services (DCAS) oversees fleet operations for New York City (the City).

DCAS operates the largest municipal fleet in the U.S., with over 28,000 vehicles across emergency departments, including the Police Department, Fire Department, and Emergency Management, as well as non-emergency services.[2] The City's clean fleet requirements commits the City to a 50 percent reduction in greenhouse gas emissions from fleet operations below 2005 levels by 2025 and an 80 percent reduction by 2035.[3] Biodiesel is one of the city's strategies for achieving that goal.

The City has been aggressively using biofuels and other alternative fuels for ten years to help achieve City-wide air quality, environmental, and energy security goals. Biodiesel use was mandated in 2013 when the Mayor announced that the city's 9,000 diesel-powered municipal fleet would burn a B5 biodiesel blend year round. Local Law 73 passed by the City Council in that year states that each on-road diesel fuel-powered vehicle owned or operated by a city agency shall be powered by an ultra-low sulfur diesel fuel blend of B5 or higher.[4] The mandate also calls for B20 to be used during the summer months starting in 2016 in non-emergency fleets. Importantly, the law mandating biodiesel use also contains a waiver provision, allowing the City to suspend biodiesel use if biodiesel is not readily available. This waiver can be used during times of emergency if biodiesel is in short supply, or if the vehicles are not able to perform their duties.

Currently New York City pays approximately 3-7 cents more per gallon for biodiesel.[5] However, the City takes advantage of the federal blending credit, which reimburses the city the equivalent of $1 per gallon of biodiesel purchased. Thanks to the federal blending credit, New York City is saving approximately $1.4 million per year in fuel costs.[6]

Consider a Waiver Provision

If your community is considering mandating biodiesel use, consider including a waiver provision that would allow the community to use additional fuel sources during times of emergency. See New York City's *Local Law 73 of 2013* for sample language.[7]

NYC saves even more using biodiesel because they combined the switch to biodiesel with a switch to No. 2 diesel from No. 1. Historically New York City used No. 1 diesel year round, even though No. 1 is most appropriate for extremely cold weather and costs over 60 cents more per gallon than No. 2 diesel. When the City switched from No. 1 diesel