

# **Biodiesel Blending in Home Heating Oil**



## **A Smart Choice for New York**

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# Blending Biodiesel in Home Heating Oil: A Smart Choice for New York

## Executive Summary

This report explores the potential benefits of blending biodiesel into heating oil for New York State. The findings of this report indicate that standardized blending of modest amounts of biodiesel into home heating oil across New York would result in substantial environmental, public health, consumer and economic benefits.

## Key Findings:

- 1) Biodiesel blending in heating oil offers *reductions in harmful emissions* such as particulate matter, sulfates and air toxics, significant lifecycle reductions in climate-altering carbon emissions, and increased sustainability in energy practices.
- 2) Biodiesel blends are *cost-competitive* with standard petroleum-based heating oil, and when blended into heating oil, biodiesel acts as a solvent and lubricant, extending the life of the consumer's equipment.
- 3) New York has the potential to increase local biodiesel production sufficiently to meet a biodiesel blending standard in heating oil, and such an effort would *create jobs, boost household income* and increase Gross Domestic Product (GDP).

## Introduction

The twentieth century model of meeting our energy needs through extracting and burning fossil fuels is no longer a sustainable model. We have learned from experience over the last century that extracting and burning fossil fuels leads to air and water quality problems that compromise human health and contaminate our environment while driving climate change. New York needs a clean energy future, and that starts by weaning ourselves off fossil fuels and transitioning to clean energy sources like wind and solar. However, with many New Yorkers currently relying on heating oil to meet their energy needs, biodiesel derived from organic matter offers a potential alternative to relying exclusively on fossil fuels. This report explores the potential environmental benefits, consumer benefits and considerations, and economic implications of integrating biodiesel blends into heating oil.

## Environmental and public health benefits of biodiesel blending

The environmental and public health benefits of blending biodiesel into heating oil are substantial. Unlike petroleum diesel, biodiesel is non-toxic and biodegradable,<sup>1</sup> making it less of a threat to human health and the environment than petroleum-based fuels in instances of spills and other direct exposure scenarios. Blending biodiesel into home heating oil leads to reductions in emissions, like particulate matter (PM), sulfates and air toxics that are harmful to public health, reductions in lifecycle carbon dioxide (CO<sub>2</sub>) emissions, reductions in agricultural and food waste, and increased sustainability in fuel production practices.

New York has already made large strides in reducing particulate matter (PM) emissions from home heating oil by instituting an ultra-low sulfur (less than 15 parts per million sulfur content) requirement for No. 2 heating oil in 2012.<sup>2</sup> New York City is in the process of a long-term phase-out of the use of the heavier, dirtier residual fuels such as No. 4 and No. 6 heating oils between now and 2030.<sup>3</sup> While these are both positive developments in reducing particle pollution, the blending of biodiesel into heating oil, including residual heating oil still in use in New York City and across the state, would result in significant emissions reductions.

As seen in the chart below, for example, the emissions profile of B20 (a 20% biodiesel blend) compared to 100% typical petroleum-based diesel results in average reductions of soot, or particulate matter, (PM) by 10%, a 10% reduction in the carbon monoxide (CO) emissions that lead to greenhouse gases, and a 20% reduction in the sulfates (SO<sub>x</sub>) that cause acid rain, while resulting in no additional smog-forming emissions of nitrogen oxides (NO<sub>x</sub>).<sup>4</sup> Compared with ultra-low sulfur petroleum diesel, biodiesel and biodiesel blends also release lower amounts of toxic emissions such as benzene and formaldehyde.<sup>5</sup>

Average Emissions of biodiesel Fuel Compared to Petroleum-based Diesel		
Emission Type	100% Biodiesel	20% Biodiesel
Sulfates (SO <sub>x</sub> ) <i>causes acid rain</i>	-100%	-20%
Particulate Matter (PM) <i>contributes to soot</i>	-50%	-10%
Carbon Monoxide (CO) <i>leads to greenhouse gases</i>	-50%	-10%
Nitrogen oxides (Nox) <i>Forms smog</i>	+10%	0%

Source: <http://www.epa.gov/region9/waste/biodiesel/questions.html>

In addition to these direct reductions in harmful pollutants, the lifecycle implications of integrating biodiesel into home heating oil make it a valuable tool in reducing waste, improving sustainability in energy practices, and combatting climate change. According to the United States Energy Information Administration (EIA),

“most of the biodiesel used in the United States is made from soybean oil that is a byproduct of processing soybeans for animal feed and numerous other food and non-food products, and from waste animal fat and grease.”<sup>6</sup>

Because biodiesel is generated largely from byproducts of other agricultural and food production activity, the environmental footprint from producing biodiesel and lifecycle carbon emissions from burning it are far lower than that of petroleum-based fuels.

Repurposing waste soybean oil, animal fats, and used cooking oil reduces waste that otherwise may be discarded. That, in itself, offers a clear environmental benefit over extracting crude oil from the ground. However, when contrasted with extracting carbon-intensive fossil fuels, the lifecycle benefits of relying on organic material also offer significant environmental benefits. **Extracting and burning petroleum-based fuels releases carbon into the atmosphere that otherwise would have remained sequestered underground, thus increasing atmospheric concentrations of CO<sub>2</sub> and contributing to climate change. In contrast, the carbon released from burning biodiesel comes from CO<sub>2</sub> previously absorbed from the atmosphere by plants during the growing process.** This leads to a much more carbon-neutral lifecycle for biodiesel

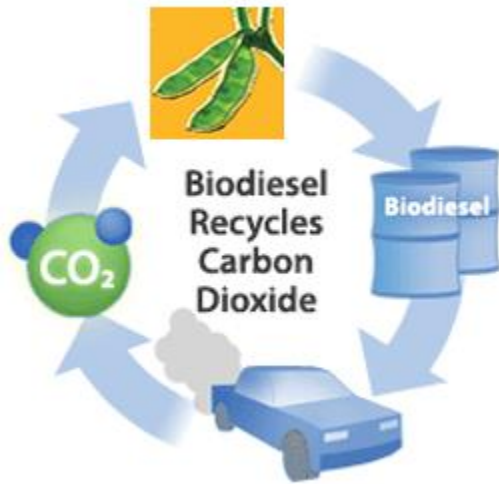


Image Credit: Greenfuelsolar.com

compared to petroleum-based fuels. And while it is not a truly carbon-neutral process, it compares quite favorably to the lifecycle of fossil fuels, even when considering factors like energy used to transport and process biodiesel.

Research is sparse on direct lifecycle greenhouse gas comparisons between heating oil and biodiesel, but comparisons between biodiesel and highway petroleum diesel – which is very similar to standard heating oil – have shown huge reductions in lifecycle emissions for biodiesel compared to petroleum diesel. A joint U.S. Department of Energy and U. S. Department of Agriculture study comparing the two

showed that biodiesel reduces net emissions of CO<sub>2</sub> by an incredible 78.45%.<sup>7</sup> **Based on that figure, using a 20% blend of biodiesel in petroleum heating oil (B20) would reduce lifecycle CO<sub>2</sub> emissions from heating oil by over 15% compared to pure petroleum heating oil.**

Prioritizing clean energy such as wind and solar power over fossil fuels is important to New York’s long-term health. However, 80% of the nation’s households that rely on home heating oil are in the northeast, including New York.<sup>8</sup> With millions of New Yorkers and businesses currently dependent on home heating oil, blending in biodiesel offers clear, immediate environmental and public health benefits while reducing waste and improving sustainability in our energy practices.

**Public Health and Environmental Benefits**

- Biodiesel is **nontoxic and biodegradable**
- Biodiesel **reduces harmful emissions** of PM, SO<sub>x</sub>, CO and air toxics like benzene and formaldehyde
- Lifecycle carbon emissions are less than ¼ of those for petroleum diesel. Using B20 would **reduce carbon emissions** more than 15% compared to petroleum heating oil
- Biodiesel **reduces waste** from agriculture and food production and increases sustainability in energy practices

## Consumer benefits and considerations of biodiesel blends in heating oil

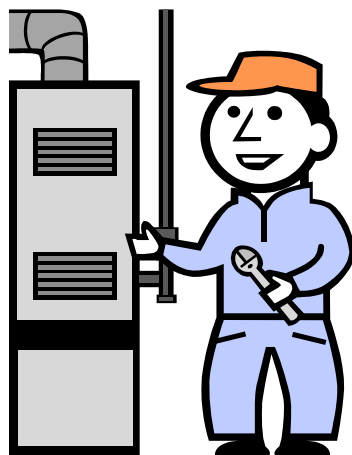
Alongside the intrinsic rewards of utilizing a more sustainable, less polluting source of heat than pure petroleum-based heating oil, biodiesel blending in heating oil offers direct benefits for consumers.

### Fuel Quality:

Fuel quality is an important consideration in any discussion of blending biodiesel into heating oil. While problems using biodiesel as a transportation fuel in vehicles converted to run on homemade biodiesel as well as in home heating applications have been reported, this seems to chiefly stem from quality control issues when individuals attempt to make their own biodiesel, rather than relying on fuels that meet acceptable standards. ASTM International, formerly known as the American Society for Testing and Materials (ASTM) has established ASTM D6751 standard specifications for biodiesel (B100) blend stock for middle distillate fuels, as well as ASTM D396 standards for fuel oils.<sup>9</sup> Using fuel that meets such standards is an easy but important way to avoid nuisance and potential mechanical complications associated with using substandard fuels.

### Use In Current Heating Systems:

Another key consideration in utilizing biodiesel blends in home heating oil is biodiesel compatibility with existing heating equipment. Consumers with warrantied heating systems should check their warranty and ensure that it will be honored with the use of biodiesel blends. Fortunately, biodiesel blends of up to five percent in heating oil (B5) are already accepted by most major manufacturers of home heating equipment and typically will not jeopardize a consumer's warranty.<sup>10</sup>



Biodiesel cleans and lubricates heating oil systems

In fact, Brookhaven National Laboratory (BNL) on Long Island has conducted testing to explore the compatibility of biodiesel blends with existing oil-fired heating systems with very encouraging results. BNL's research has found that use of blends of up to 30 percent (B30) in existing oil-fired heating systems result in **"nearly identical, and even somewhat improved combustion performance"** compared to traditional petroleum heating oil.<sup>11</sup> BNL also noted that **"bioheat blends of up to B20 biodiesel concentration have been used successfully without heating system adjustment or cold weather problems."**<sup>12</sup>

In addition to compatibility with existing heating oil systems, biodiesel has unique properties that offer potential benefits to equipment owners in extending the life of equipment. Improved

lubrication of fuel-wetted components (parts of the system that come in direct contact with heating oil), for example, can reduce wear and extend the life of moving parts in the heating oil system. Researchers have established that biodiesel offers better lubricating properties than traditional petroleum diesel fuel, and can be an effective additive to enhance lubricity.<sup>13</sup> Biodiesel can also act as an effective solvent.<sup>14</sup> Blending biodiesel into petroleum heating oil can help to clean out deposits that build up inside the heating oil system. When Warwick Public Schools in Oregon experimented with various blends of biodiesel in school boilers, they found that the parts of the boiler containing B20 heating oil were very clean after a year of use, and even saved money on cleaning costs because of using biodiesel blends in heating oil.<sup>15</sup> Increased lubricity and solvent properties of biodiesel blends in heating oil offer clear benefits for consumers compared to traditional petroleum heating oil.

**Price:**

When assessing the impacts of blending biodiesel into home heating oil, price is a primary concern for many consumers. **According to industry trade groups, biodiesel is already priced competitively with petroleum heating oil in New York.**<sup>16</sup> Retail pricing from local fuel oil companies bears this out. For example, to deliver to Westchester County, one online heating oil ordering service offered a May 2014 residential base price of \$3.599 per gallon for petroleum heating oil and a price of \$3.649 per gallon for a B20 biodiesel blend – a difference of just \$.05, or about 1.4%.<sup>17</sup> Comparing New York barge average prices for ultra-low sulfur heating oil to New York harbor average prices for soy biodiesel over the past two years, biodiesel was actually priced 28.7 cents per gallon lower than the ultra-low sulfur petroleum heating oil.<sup>18</sup> Regardless, when considering biodiesel blends in the range of B2 to B20, the impact of any price difference between pure biodiesel (B100) and petroleum heating oil is marginalized by the fact that biodiesel only makes up a small fraction (1/50 to 1/5) of the total composition of the blended heating oil. In addition, New Yorkers are currently eligible for a tax credit of \$.01 for each percent of biodiesel blended into home heating oil up to twenty cents per gallon.<sup>19</sup> **Thus this tax benefit allows a consumer using B20 heating oil to be eligible for a \$.20 per gallon credit.**

With competitive pricing, an available tax credit, enhanced lubricity and solvent properties, and compatibility with existing heating oil systems, using biodiesel blends up to 20% in home heating oil offers direct benefits to consumers in New York.

<u>Consumer Benefits</u>
<ul style="list-style-type: none"><li>• Light biodiesel blends are <b>compatible with existing oil heat systems</b></li><li>• Biodiesel acts as a <b>lubricant and solvent</b>, which can extend the life of moving parts and clean internal components</li><li>• Biodiesel is <b>competitively priced</b> with petroleum diesel, and a consumer tax credit is available</li></ul>



## New York State economic benefits of biodiesel blending in heating oil

There are significant economic benefits to boosting production of biodiesel for use in home heating oil in New York — even beyond the positive effects of reducing consumption of petroleum extracted elsewhere in favor of locally-produced biodiesel.



With its magnitude of agricultural activity, New York State has the potential to reap significant economic benefits from increased biodiesel production to meet heating oil needs. Soybeans are among New York’s most widely grown field crops, with an estimated total yield value of \$195 million in 2012.<sup>20</sup> Despite this potential, New York currently lacks the infrastructure needed to process biodiesel. According to the U. S. Energy Information Administration, as of January, 2014, New York State housed only one plant with operable capacity to make biodiesel, and virtually no

current annual production capacity.<sup>21</sup> A concerted statewide effort to blend biodiesel into heating oil in the state could act as a strong economic driver in boosting New York’s biodiesel production capacity, including bolstering the agricultural industry within New York and propelling the development and maintenance of biodiesel processing facilities.

The northeast — and New York in particular — consumes a huge portion of the nation’s home heating oil.<sup>22</sup> In 2012, New Yorkers consumed over 835 million gallons of number two diesel for residential use, primarily for home heating oil.<sup>23</sup> **If just five percent of that residential heating oil were replaced with biodiesel produced in New York, it would create a demand for over 40 million gallons of biodiesel to meet residential heating needs.** Researchers exploring the impacts of similar policies have found that a demand of this scale could be met within New York – largely from soybean oil and waste grease – and would spur thousands of jobs in biodiesel infrastructure development and continued operation, agriculture, transportation, and other related sectors. Such a boost is projected to generate over a hundred-million dollars in household income annually, and contribute hundreds of millions of dollars to New York’s gross domestic product (GDP).<sup>24</sup>

### Economic Benefits

- Increased demand for biodiesel would drive biodiesel processing **infrastructure development**, creating **jobs** in construction, continued operation and other sectors such as transportation
- Biodiesel production creates a new **revenue stream for farmers**, boosting **household income** and creating jobs in the process
- Boosting NY-based production would **increase New York’s GDP**

## **Study limitations**

It is important to note that the conclusions of this report support blending modest amounts of biodiesel into home heating oil, but should not be construed as embracing a broader approach to replacing all heating oil or diesel fuel with pure biodiesel (B100). New York has the potential to meet a modest biodiesel blending standard and existing heating oil systems are warranted for blends up to five percent biodiesel (B5) and compatible with blends up to twenty percent (B20), but exceeding those levels raises questions this report did not explore. One such consideration is that of appropriate land use. This report assumes some shifting of other agricultural crops to soybean production and utilization of currently idle croplands, but large displacement of other food crops and conversion of non-agricultural lands have the potential to diminish environmental benefits associated with embracing biodiesel blends that are within New York's current agricultural capacity. In addition, many heating oil systems are not currently designed to utilize higher blends of biodiesel, which could undermine the consumer benefits.

## **Conclusion**

When compared to pure petroleum heating oil, biodiesel blends offer numerous benefits. Blending biodiesel into home heating oil offers a way to reduce petroleum consumption and negative environmental impacts. Contrasted against the full lifecycle impacts of extracting and burning fossil fuels, biodiesel's improved emissions profile and origins in organic matter – largely agricultural and food production byproducts – help the fuel compare quite favorably to pure petroleum fuel. Biodiesel's competitive pricing and unique properties such as being able to act as a solvent and a lubricant offer benefits for consumers as well. New York already has the potential to meet a modest biodiesel blending standard, and would benefit economically from doing so through bolstering agricultural activity, creating jobs in infrastructure development and continued operation, and increased Gross Domestic Product. Because of these numerous benefits and the opportunity to improve sustainability in energy practices, NYPIRG endorses biodiesel blending in heating oil sold in New York.

## End Notes

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- <sup>4</sup> *Supra* note 1.
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- <sup>12</sup> *Ibid*.
- <sup>13</sup> Hu, Jianbo et al. *Study on the lubrication properties of biodiesel as fuel lubricity enhancers*. *Fuel*. Vol. 84 (2005). pp. 1601-1606. Available at [www.sciencedirect.com](http://www.sciencedirect.com)
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- <sup>16</sup> *Bioheat Heating Oil*. New York Oil Heating Association. <http://www.nyoha.org/bioheat.php>
- <sup>17</sup> Codfuel.com Price Comparison for White Plains, NY, 10601. Accessed 5/27/2014 at: [www.codfuel.com](http://www.codfuel.com)
- <sup>18</sup> Analysis based on Argus Media "U.S. Products" daily report. Prices are per gallon of fuel for the first market day of each month from April, 2012 through March, 2014.
- <sup>19</sup> New York State Tax Law Section 210, Subdivision 39 – Clean heating fuel credit.
- <sup>20</sup> Ag Facts. New York State Department of Agriculture and Markets. Available at: <http://www.agriculture.ny.gov/agfacts.html>
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