Kat Taylor Testimony in **support** of **LD 1297** ***Resolve, to Establish the Committee to Study the Use of Sunflower Crops to Produce Biofuels***

Tuesday, April 22, 2025

Good Afternoon Members of the Agriculture, Conservation and Forestry Committee:

My name is Kat Taylor and I am a resident and property owner in Argyle Township, an unorganized township located about 20 miles north of Bangor.

I am testifying in support of LD 1297 as it begins the process to add biofuels to our renewable energy resources by establishing a committee to investigate the growing and use of sunflowers as a fuel source.

The following is my written testimony for LD 1297 based on my research into renewable energy sources in Maine, my Interdisciplinary Master's Degree studies in Sustainable Systems (including studies in Permaculture) at UMaine, Orono and my experience living on farms most of my life.

For clarity I have divided my testimony into two sections. The first directly addresses LD 1297 to study the feasibility of using sunflowers as a biofuel source, some information on growing and processing and the potential use of biofuels as a renewable alternative energy in Maine.

The second section addresses my oral testimony on the additional benefits of the dual use of growing sunflowers for fuel *and* their capabilities in ***Phytoremediation***: cleaning soil contaminated with heavy metals and PFAS chemicals.

Biofuels are not a new concept. Rudolf Diesel, the inventor of the diesel engine in 1897, experimented with using vegetable oil as fuel in his engines. Farmers who want to save on diesel fuel costs have collected used cooking oil from restaurants to run their farm equipment for at least the last 30 years.

But the growing of fuel crops on fertile soil that would be better used to grow food has created controversy over the years. To achieve a truly "clean, renewable" fuel we have to look at the type of methods, and the types of energy, used in production.

It really doesn't make sense to use fossil fuels to make renewable energy; it counteracts the positive impact and contributes to the unpredictability of our climate.

Environmental sustainability of biofuels: a review
4 May 2020

> *"Greenhouse gas* ***(GHG) emissions from transport*** *have been* ***increasing*** *at a* ***faster rate than*** *from* ***any other sector****. The sector relies heavily on* ***fossil fuels****, which accounted for* ***96.3%*** *of* ***all transportation fuels in 2018****. Transport* ***is also responsible for 15% of the world's GHG emissions and 23% of total***

energy-related CO2 *emissions.* ***To reduce dependence on petroleum-based fuels, as well as to mitigate climate change, biofuels are viewed widely as promising alternative transportation fuels.****"*

https://pmc.ncbi.nlm.nih.gov/articles/PMC7735313/pdf/rspa20200351.pdf

Biofuels:

Biofuel in diesel and heating oil:

Office of the Chief Economist
Office of Energy Policy and New Uses
Tony Radich - Agricultural Economist
tradich@oce.usda.gov
EIA State Heating Oil and Propane Program Workshop
Washington, DC
July 13, 2016

- *What is distillate fuel and which biofuels are compatible?*
- *Federal, state, and local policies on biofuels in distillate fuel*
- *Economics of biodiesel production, including the effects of biofuels policies*

https://www.eia.gov/petroleum/heatingoilpropane/workshop/pdf/2016_shopp_workshop_radich.pdf
(See below for PDF)

Biofuels explained: Biodiesel, renewable diesel, and other biofuels:

https://www.eia.gov/energyexplained/biofuels/biodiesel-rd-other-basics.php

Biodiesel is produced by ***transesterification*** *of vegetable oils and animal fats. Vegetable oils (mainly soybean oil) are the main feedstocks for U.S. biodiesel production. Other* ***major U.S. biodiesel feedstocks include animal fats*** *from* ***meat processing*** *plants and* ***used (recycled) cooking oil*** *and* ***yellow grease from restaurants. Rapeseed oil, sunflower oil, and palm oil are major feedstocks*** *for biodiesel production* ***in other countries****.* ***Algae*** *are* ***potential sources*** *for biofuels. Algae contain pockets of fat that help keep them afloat that can be collected and processed into biofuels. The* ***feedstocks*** *used for biodiesel production can* ***affect*** *the* ***physical properties and uses*** *of biodiesel.*

What is Biodiesel?

"Biodiesel is a renewable alternative fuel created from vegetable oils, animal fats, and greases through a chemical process. ***The chemical process involves reaction of natural oils with an alcohol, and then refining the mixture to create molecules which can be easily burned in a diesel engine****.*

Biodiesel fuel ***can be used in any diesel engine*** *in* ***pure form*** *or* ***blended*** *with* ***petroleum diesel*** ***at any level****.* ***Even a blend of 20% bio- and 80% petroleum diesel will significantly reduce carcinogenic emissions and gases*** *that may contribute to global warming.* ***Glycerin*** *is the* ***byproduct*** *of the biodiesel*

production process, and can be used in personal care products or a variety of chemical applications." https://biodiesel.com/what-is-biodiesel/

Renewable diesel and other biofuels

***Renewable diesel** and other (non-fuel ethanol) biofuels and biointermediates **can be produced from nearly any biomass feedstock**, including those used for biodiesel production, **through a variety of processes**, such as:*

- *Hydrotreating*
- *Gasification*
- *Pyrolysis*
- *Other biochemical and thermochemical technologies*

***Renewable diesel is similar to biodiesel but with important differences**. Renewable diesel is a **hydrocarbon** that is **chemically equivalent to petroleum diesel** and can be:*

- *Used as a **drop-in biofuel*** (#2 heating fuel/Waste to Energy facilities)
- ***Transported in petroleum pipelines*** (Loring/Searsport pipeline)
- ***Sold at retail stations** with or without blending with petroleum diesel* (Transportation)

Renewable diesel** production **uses** a **hydrogenation process** rather than the **esterification** process **used to produce biodiesel**. Because **renewable diesel is a drop-in fuel**, it **meets ASTM D975 specification for petroleum diesel** and **can be seamlessly blended, transported, and even co-processed with petroleum diesel.

*Most renewable diesel is hydrogenation-derived renewable diesel (HDRD) or hydroprocessed esters and fatty acids (HEFA) produced by hydrogenation of triglycerides, a similar process used for desulfurizing petroleum diesel. So, **existing petroleum refineries can be converted to renewable diesel production with only modest changes.** However, **hydrotreating renewable feedstocks requires significantly more hydrogen** than **desulfurizing diesel**, and **the source of the hydrogen could affect whether or not the renewable diesel can meet national or state standards for biofuels**.*

***Other methods** can be used for **renewable diesel** production, such as **gasification** and **pyrolysis**. **Renewable heating oil is similar to renewable diesel fuel but meets ASTM D396 for fuel oils**.*

Renewable jet fuel** (Loring Energy) **may be called sustainable aviation fuel (SAF), alternative jet fuel (AJF), or biojet depending on the context or fuel standard under which it is used.** Renewable **jet fuel** meets ASTM D7566, which **allows up to a 50-50 blend of biomass-derived blending components

and petroleum jet fuel. *Other non-fuel ethanol biofuels include renewable naphtha, renewable gasoline, renewable propane (a by-product of renewable diesel and SAF production), and other emerging biofuels. Another aviation biofuel that is being tested for use is alcohol-to-jet (ATJ) (or ethanol-to-jet [ETJ]).*

Last updated: February 26, 2024

LD 1297 mentions a bio-diesel business in Maui that may be used as a model for Maine. **Pacific Biodiesel** https://biodiesel.com/ has been around for 30 years and uses the **Transesterification** method to extract oil from sunflowers for bio-diesel and other products.

> *"While **Pacific Biodiesel** is headquartered on Maui, it has nearly **100 employees statewide**, including **50 who work at its biodiesel refinery** on Hawai'i Island. Additionally, Pacific Biodiesel announced earlier this year it would expand its agriculture operations to Kaua'i. This was part of a **federally funded project to develop a model for regenerative agriculture-based biofuel** produced in Hawai'i from **multiple locally grown oilseed cover crops**."*

https://mauinow.com/2024/04/25/pacific-biodiesel-plants-its-first-kaua%CA%BBi-sunflower-field-modeled-after-mauis/
https://www.biobased-diesel.com/post/30-years-and-growing

> ***Transesterification** gained much acceptance in recent years for the **conversion** of **vegetable oils into products with technically more compatible fuel properties**. Transesterification is an imperative process for biodiesel production, as it can **reduce the viscosity of the feedstock/vegetable oils** to a **level closer to the conventional fossil-based diesel oil."***

https://www.sciencedirect.com/topics/engineering/transesterification
https://www.e-education.psu.edu/egee439/node/684

Sunflowers for Biofuel Production
Oilseed sunflowers are grown easily and profitably at both small farm and large field scales.

*"**Oilseed sunflower (Helianthus annuus L.)** is quickly gaining **popularity as a feedstock crop for biodiesel** because it shares several positive agronomic features with other common oil crops such as canola and soy; yields well in a variety of conditions, and can be grown easily and profitably at both small farm and large field scales. **The high oil content of sunflower seed, often over 40%, makes it an excellent choice for a biofuel crop.***

*Because it is already **grown widely for use as food oil, agronomic practices are well***

These sunflowers in southern Vermont were grown for on-farm biodiesel production.Photo: Vern Grubinger, University of Vermont Extension.

***established for regions where the sunflower is common in field rotations**. Although pests can present production problems, careful rotations can help reduce inputs from fertilizer to pesticides."*
https://farm-energy.extension.org/sunflowers-for-biofuel-production/

Crop Rotation

What is crop rotation?

A crop rotation is a cropping system in which two or more crops are grown in a fixed sequence to prevent diseases and control pests.

Correction: I said at the hearing that sunflowers used as soil remediation do not need rotation. But if sunflowers are grown continuously as a crop on the same land, then **rotations of 4 to 6 years** are commonly **recommended**; shorter rotations may be suggested when disease-resistant hybrids are used.

> **What Do You Use To Rotate Sunflower Crops?**
> Last updated: March 5, 2025
> *"Sunflower, a deeply-rooted crop, requires careful planning when choosing its place within a crop rotation. It grows well under dry conditions and is one of the most deeply-rooted crops with a root system that can dig down 5 to 7 inches."*
>
> *"Sunflowers can be **planted from April through July**, including **as a double crop after wheat**. By **adopting this sustainable practice**, farmers can optimize their yields while preserving the long-term viability of their land."*

Biofuel Production in Maine

Loring (https://www.loringenergy.com/)

Company slated to break ground on $4B Loring aviation fuel facility in 2026
November 11, 2024

> "LIMESTONE, Maine – *Plans are still underway to build a **$4.13 billion sustainable aviation fuel facility** at the former **Loring Air Force Base**, according to developers.*
>
> *In 2022, Washington D.C.-based **DG Fuels** announced its intentions to build within 1,240 acres of property at the **Loring Commerce Center**, **creating 2,300 jobs during construction and 650 jobs once production begins**.*
>
> *Loring was one of two locations, including one in Louisiana, where DG Fuels leaders said they wanted **to produce zero to low carbon jet fuel** for airports across the U.S. **The facility is one of several large projects expected to revive economic development at the Commerce Center**, including an over $55 million potato chip plant projected to bring 75 initial jobs to the region, and other aerospace and technology ventures."*

*"At Loring, **DG Fuels plans to revive an underground pipeline** that once **transported jet fuel** from the Maine coastal town of **Searsport to Loring** Air Force Base. If successful, DG Fuels would use the pipeline to **transport 33,500 barrels, equaling 557,500 gallons, of jet fuel from Loring to Searsport daily for shipment to airports along the northeastern U.S.***

*DG Fuels expects **to produce 190 million gallons of jet fuel at Loring every year** using **1.7 million tons of wood biomass** that would be **transferred to Loring via local rail lines**, and then passed throughout the Loring facility, Darcy said. **Six biomass gasifiers** would then **use heat, steam and oxygen** to convert biomass to hydrogen **without needing combustion**."*

*"Recent **PFAS investigations near Loring's vacant airport properties have not posed problems to DG Fuel's project**. To avoid potential contamination, the company decided to move their planned facility from its original 30 acres to another 30-acre plot farther from the airport, Darcy said.*

*"We've been working with the Air Force on this and it's been made clear that any **[PFAS] remediation** they'll need to do won't interfere with our ability to operate," Darcy said.*

***DG Fuels is working with Green 4 Maine**, which currently owns 450 acres at Loring but not the DG Fuels property, **to house construction employees at 750 renovated apartment units nearby.** Green 4 Maine **President Scott Hinkel** declined to provide an update on the housing project."*

https://thecounty.me/**2024/11/15**/business-news/company-slated-to-break-ground-on-4b-loring-aviation-fuel-facility-next-year/

Millinocket

January 30, 2025

Castlerock Biofuels selects Millinocket, Maine for renewable fuel oil facility

*"The new facility, which will be located within One North (the former Great Northern Paper mill site) will use **advanced thermal processing** (RTP®) technology developed by Ensyn Corporation to **convert renewable logging residue into up to 20 million gallons** of **Fast Pyrolysis** Bio-Oil (RFO®) annually. This renewable heating oil alternative will serve large institutional customers across the U.S. Northeast."*

https://www.onenorth.net/newsroom/castlerock-biofuels-selects-millinocket-maine-for-renewable-fuel-oil-facility/

Castlerock Biofuels to develop renewable fuel oil facility in Maine

*The project is expected to bring **significant economic benefits** to the region, including:*

- *Up to **150 construction jobs** at peak development.*
- *Approximately **80 full-time jobs**, skill training and internships with local partners and stakeholders.*
- ***92 jobs in the forest industry supply chain**, supporting the harvest and transport of feedstock and the transport of finished fuel.*
- ***Increased tax revenues** and **indirect economic growth**, as supporting industries develop around the facility.*

Sean Dewitt, President** of **Our Katahdin**, the Millinocket-based non-profit organization that owns and operates the **One North industrial site**, said, "Castlerock's commitment to the Katahdin region represents a **transformative opportunity**. They bring premier engineering, top-tier financial backing and a proven product with strong market demand. **The Millinocket facility will be a larger version of the successful RTP processing plant in Quebec, where fuel oil production has been effectively established at scale since 2018."
https://biomassmagazine.com/articles/castlerock-biofuels-to-develop-renewable-fuel-oil-facility-in-maine

Pyrolysis

*"Pyrolysis is one of the technologies available to convert biomass to an intermediate liquid product that can be refined to drop-in hydrocarbon biofuels, oxygenated fuel additives and petrochemical replacements**. Pyrolysis is the heating of an organic material, such as biomass, in the absence of oxygen**. Biomass pyrolysis is usually conducted **at or above 500 °C**, providing enough heat to deconstruct the strong bio-polymers mentioned above.*

*Because no oxygen is present combustion does not occur, rather **the biomass thermally decomposes into combustible gases and bio-char** (Can use sunflower leaves and stalks for bio-char ~Kat). Most of these combustible **gases can be condensed into a combustible liquid**, called pyrolysis oil (**bio-oil**), though there are some permanent gases (CO-2, CO, H2, light hydrocarbons), **some of which can be combusted to provide the heat for the process.***

*Thus, **pyrolysis of biomass produces three products**: one **liquid, bio-oil**, one **solid, bio-char** and one **gaseous, syngas**. The proportion of these products depends on several factors including the composition of the feedstock and process parameters.*

*However, all things being equal, the yield of **bio-oil is optimized when the pyrolysis temperature is around 500 °C** and the **heating rate is high (1000 °C/s) fast pyrolysis conditions**.*

*Under these conditions, **bio-oil yields of 60-70 wt%** of can be achieved from a typical biomass feedstock, with **15-25 wt% yields of bio-char**. The remaining **10-15 wt% is syngas**."*
https://www.ars.usda.gov/northeast-area/wyndmoor-pa/eastern-regional-research-center/docs/biomass-pyrolysis-research-1/what-is-pyrolysis/

Both **Millinocket and Limestone** have other assets making them viable options for a biofuel production study.

Millinocket has **hydroelectric capability** in the **existing dams** and a **hydrokinetic project** by **ORPC** (https://orpc.co/modular-rivgen-power-system/) at **One North** industrial site providing renewable energy for production.

Loring AFB has a **9,000 acre campus** well suited for renewable wind and solar with battery storage for renewable energy production supply. There is also the **200 mile long Searsport Loring pipeline** to transport fuel from the county. **Biofuels produced can power production facilities creating a circular sustainable system.**

Adding Value to Biofuel Production: Phytoremediation

Both sites are contaminated by years of industrial uses and **Brownfield and Superfund money may fund research in Phytoremediation** efforts such as planting biofuel feedstock like sunflowers:

East Millinocket's Brownfields Assessment Program

> *"The Town of East Millinocket has been awarded a United States Environmental Protection Agency (US EPA) Brownfields Assessment Grant for conducting environmental assessments and cleanup planning at eligible properties in East Millinocket.*
>
> ***EPA defines a "Brownfields site" as any property for which the expansion, redevelopment, or reuse may be complicated by the presence or perceived presence of a hazardous substance, pollutant, or contaminant**. Many Brownfields sites are undeveloped and/or underutilized, and can have negative effects on property values, human health, the environment, and public safety.*
>
> ***When a site is redeveloped there is an opportunity for an increase in tax base, employment opportunities, tourism, and sustainable economic development** for the site as well as the rest of the community, among others*."

https://www.eastmillinocket.org/brownfields.aspx

LORING AIR FORCE BASE

> *"The **Loring Air Force Base Superfund site** is in Limestone, Maine. The roughly 9,000-acre Base was a major Strategic Air Command (SAC) base for the U.S. Air Force for over 40 years, before its closing in 1994. The Base housed a bomber wing and had SAC's largest capacity for weapons and fuel storage. **Military operations contaminated soil, groundwater, surface water and sediment. The EPA added the site to the National Priorities List (NPL) in 1990.** Cleanup included waste removal, excavations, landfill capping, institutional controls to prevent uncontrolled use and consumption of groundwater, provisional water supplies, long-term monitoring, and groundwater management zones.***"**

https://www.epa.gov/superfund-redevelopment/superfund-sites-reuse-maine

During my oral testimony on April 10th I brought up the use of **Hyperaccumulators** for soil remediation also known as ***Phytoremediation*** or ***Bioremediation***. To make the most of biofuel production using sunflowers we should look at land that is not suited for food production to discourage developers from acquiring high value farmland solely for fuel production.

Phytoremediation:

August 2023

Phytoremediation of soil and groundwater contaminated with per- and polyfluoroalkyl substances (PFAS)

> *"This thesis examines the efficacy of phytoremediation as a **potential technique for managing PFAS-contaminated soil and groundwater.***
>
> *The aim was to investigate the phytoextraction potential of trees growing at these sites. Plant tissue concentration and composition profiles highly depended on the soil and groundwater fingerprints. Birch and willow showed the highest PFAS concentrations in the field.*
>
> *Furthermore, the **phytoextraction potential of five plants** (i.e. **sunflower**, mustard, **hemp**, willow and poplar) was also investigated in pot experiments."*

https://pub.epsilon.slu.se/31571/1/nassazzi-w-20230821.pdf

Why Sunflowers Are The Finest Plants For Phytoremediation?

Last updated: June 25, 2024

> *"Traditionally, **sunflowers are** grown for food and oil production but are **now being used in phytoremediation, a cost-effective and environmentally friendly technique that uses plants to extract metals and toxins from soil.** Sunflowers have shown high tolerance to heavy metals and are **considered the most important Asteraceae plant for phytoremediation of heavy metals such as cadmium and lead.***
>
> ***Phytoremediation uses plants to clean up contaminated environments**, including metals, pesticides, explosives, and oil. **Sunflowers are an excellent candidate for phytoremediation due to their adaptability to various environments and their capacity to uptake a wide range of pollutants**. They are also one of the **most studied species for phytoremediation** of **heavy metals** and are **considered the most ideal plant** due to its greater potential for removing pollutants."*

Phytoremediatiation At Chernobyl

> ***"Sunflowers** have been used to absorb radiation on the site of the Chernobyl nuclear disaster and in Fukushima. They **can take up high concentrations of radioactive isotopes, sequestering them in their stems and leaves** (Not seeds ~ Kat). They are called **hyperaccumulators** due to their **enhanced ability***

*to **uptake metal**. They **can absorb 95% of radioactive contaminants in a 24-hour** period."*

https://www.scienceabc.com/nature/why-were-sunflowers-planted-in-the-shadow-of-nuclear-disasters.html

A tribe in Maine is using hemp to remove 'forever chemicals' from the soil

*"For Stanley and Silliboy, the focus was not so much the hemp they were growing as what it was doing. Their farm, once part of the **Loring Air Force Base**, is also a **Superfund site** — an area so polluted it's **marked high-priority for federal cleanup**. Later, when the **Aroostook Band of Micmacs** took over the site's ownership, they found its **soil was rife with per- and polyfluoroalkyl substances, better known as PFAS,** cancer-causing compounds that are so difficult to break down they're commonly known as "forever chemicals."*

*"In 2020, researchers discovered that the Micmacs' **hemp plants were successfully sucking PFAS out of the contaminated soil**. This practice, known as **phytoremediation, could guide farmers across the country who have had to shut down after discovering their soil is tainted with the ubiquitous class of chemicals**."*

*"At the end of the day, **the data support phytoremediation as a viable approach and definitely established proof of concept**."*

https://grist.org/science/pfas-is-contaminating-farms-can-hemp-help/

What to do with the contaminated plants?

While Phytoremediation has proven to be a solution to cleansing soil and water, the question then becomes how to dispose of contaminated plants? Sunflower seeds that will be used in biofuels do not collect the contaminants. But the roots, stalks and leaves will need to be disposed of. Best scenario, the contaminants are removed prior to disposal.

Recent studies in PFAS contamination removal have brought forth so many solutions it would take pages of links to encompass them coherently. I've listed a couple that feasibly could be used onsite at biofuel facilities in Maine. **The state could incentivize biofuel crop production on contaminated land that will help bring back soil and water health** rather than food grade land which we need to keep our food suppliers viable.

Mineralization of captured perfluorooctanoic acid and perfluorooctane sulfonic acid at zero net cost using flash Joule heating
31 March 2025
Nature Water

"Granular activated carbon (GAC) is widely used for PFAS removal but becomes secondary waste (PFAS-GAC). Current treatment methods are energy intensive and release hazardous fluorocarbons. This study demonstrates electrothermal

***mineralization of PFOA and PFOS-GAC via flash Joule heating**, a scalable and efficient process.*

Heating PFAS-GAC with sodium or calcium salts converts PFAS into inert fluoride salts** with **>90% fluorine conversion** and **>99% PFOA and PFOS removal**. Simultaneously, **the spent carbon is upcycled into flash graphene**, offsetting **treatment costs by US$60–100 per kg**. **This solvent- and catalyst-free method substantially reduces energy use, greenhouse gas emissions and secondary waste.

*A techno-economic assessment highlights its scalability and environmental benefits, offering a rapid (~1 s), **cost-effective solution for PFAS remediation and upcycling of waste carbon into high-value products.***"
https://www.nature.com/articles/s44221-025-00404-z

Low-temperature mineralization of perfluorocarboxylic acids
18 Aug 2022
(Also contains information on **Decarboxylation** ~ Kat)

Forever chemicals' Achilles' heel

*"…current PFAS destruction strategies use nonselective destruction mechanisms, we found that perfluoroalkyl carboxylic acids (PFCAs) could be mineralized through a sodium hydroxide–mediated defluorination pathway. PFCA decarboxylation in polar aprotic solvents produced reactive perfluoroalkyl ion intermediates that **degraded to fluoride ions (78 to ~100%) within 24 hours**."*
https://www.science.org/doi/10.1126/science.abm8868#Science

Summary

Producing biofuel to replace fossil fuel here in Northern Maine is essential to reducing Green House Gas emissions. We are dependant on Canadian natural gas and hydroelectric and need to divest ourselves from foreign energy completely in order to achieve energy independence separate from Southern Maine and New England.

The transition from fossil to biofuel can be accomplished by phasing in biofuel in #2 heating oil and diesel fuel used in transportation and industrial use. At the same time we can use contaminated land to grow sunflower fuel instead of high value farmland.

The technologies for biofuel and pfas remediation overlap, funding is available for both renewable energy and pfas remediation efforts.

Using Northern Maine locations such as Millinocket and Limestone serves a dual purpose since both sites have biofuel projects in place and are **contaminated** so **brownfield and superfund cleanup money may help support** ongoing **efforts**. Both areas are economically depressed due to mill and air force base closures and **biofuel production would bring a much needed permanent economy**.

State PFAS funding could help support remediation efforts on farmland using natural Phytoremediation instead of expensive intrusive excavation methods.

Incorporating UMaine students into the study would position graduates to find employment in biofuel and pfas remediation sectors keeping them in the state. I would also add Technical schools to train certified staff in both fields.

The benefits of passing LD 1297 could go far beyond growing sunflowers for fuel. **Adding Phytoremediation and PFAS removal to the bill enhances the value of the study and could be the genesis of a new sustainable industry in Northern Maine.**

I would be happy to supply the ACF/EUT Committees with additional information to convince you to vote **Ought To Pass**.

Respectfully,

Kat Taylor
Argyle Twp.

Office of the Chief Economist
Office of Energy Policy and New Uses

Biofuel in diesel and heating oil

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EIA State Heating Oil and Propane Program Workshop
Washington, DC
July 13, 2016

Agenda

- What is distillate fuel and which biofuels are compatible?
- Federal, state, and local policies on biofuels in distillate fuel
- Economics of biodiesel production, including the effects of biofuels policies

Distillate and heating oil overlap but not perfectly

- Distillate fuel consists of No. 2 diesel fuel and No. 2 heating oil
  - Kerosene (No. 1 fuel oil) is a separate product in EIA data
  - Blends easily with No. 2 distillate, often used to improve cold flow
- “Heating oil” can also refer to grades heavier than No. 2
  - No. 6 heating oil is classified as residual fuel by EIA
  - No. 4 heating oil is a blend of No. 2 and residual fuel
- Two trends in heating oil
  - Reduction in sulfur levels
  - Addition of biofuels
- Diesel and heating oil can contain biodiesel and renewable diesel
  - Both produced from vegetable oil or animal fat but different production processes
  - ASTM standards for diesel fuel and heating oil allow 5% biodiesel in fungible products
  - Blends of up to 20% biodiesel are supported by many engine and burner manufacturers
  - Renewable diesel can be used in any proportion in diesel or heating oil
- Cellulosic diesel and cellulosic heating oil are under development
  - Both are produced by pyrolysis of wood fiber; more upgrading of pyrolysis oil is required for diesel use

U.S. policies on biofuels are moving away from subsidies…

- Federal tax incentives for corn ethanol expired at the end of 2011
  - Ethanol blending tax credit (45 cents per gallon)
  - Ethanol import tariff (54 cents per gallon)
- Two other Federal incentives are still available
  - Biodiesel and renewable diesel blending tax credit ($1 per gallon)
    - Has lapsed several times but then renewed retroactively
    - In place at the beginning of 2016 and available for the entire year
  - Cellulosic biofuels tax credit ($1.01 per gallon) through 2016
  - In contrast to the Renewable Fuels Standard, there is no greenhouse gas reduction threshold for blending tax credits

…and toward consumption standards that can act like subsidies

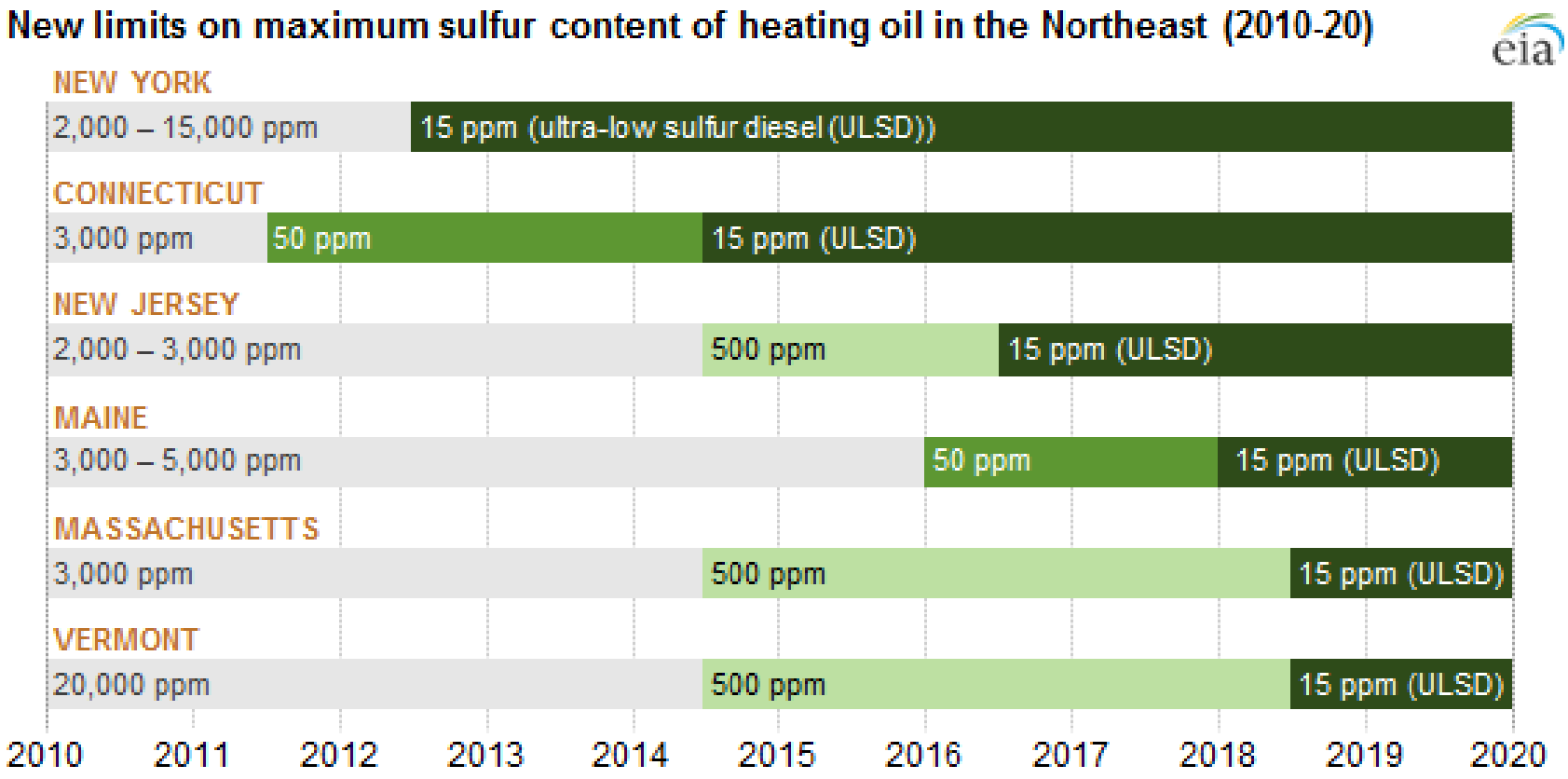
- Federal Renewable Fuels Standard
  - Petroleum refiners and importers are obligated in proportion to their total volumes of petroleum-based gasoline and diesel sold into the U.S. market
  - Compliance is demonstrated by Renewable Identification Numbers (RINs) which can be traded between parties
  - 4 nested standards (RIN type in order of descending value):
    - Cellulosic biofuel (D7, D3)
    - Biomass-based diesel (D7, D4)
    - Advanced biofuel (D7, D3, D4, D5)
    - Total renewable fuel (D7, D3, D4, D5, D6)
- California Low Carbon Fuel Standard (LCFS)
  - Each biofuel and associated production process (pathway) receives a carbon score
    - Yellow grease biodiesel has lower (better) score than soybean biodiesel
  - LCFS credits can be traded between parties
- Commercial data services collect prices of D4, D5, and D6 RINs and LCFS credits

State and local standards for biodiesel blending also play a role in diesel and heating oil markets

State or locality	Laws and regulations relating to biodiesel in distillate fuel
Minnesota	All diesel fuel must be B10 in summer and B5 in winter; summer requirement for B20 in 2018
Maryland	3 cent-per-gallon tax credit for bioheat blends with at least 5% biodiesel, $500 limit per taxpayer; half of oilheat equipment in state buildings must use bioheat with at least 5% biodiesel
New York City	2% biodiesel blend required for No. 2 and 4 fuel oil
New York	Each percentage point of biodiesel in heating oil up to 20% earns a credit of 1 cent per gallon against the state income tax through December 31, 2016
Rhode Island	4% biodiesel blend required; 5% as of July 1, 2017
Massachusetts	5% biodiesel blend requirement legislated *but not implemented*
Connecticut	10% biodiesel blend if neighboring states establish similar requirements
Vermont	7% biodiesel blend if surrounding states establish similar requirements

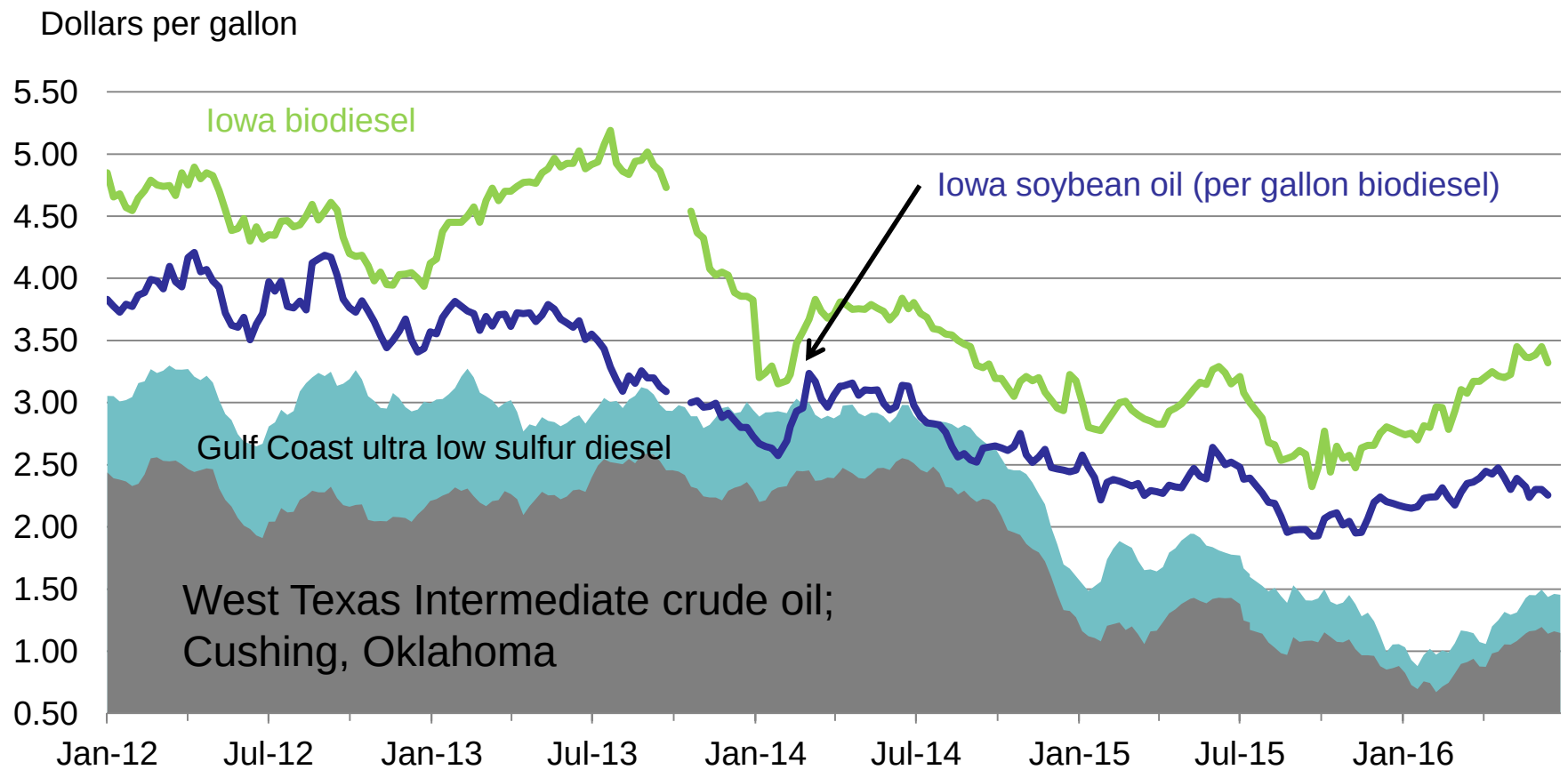
Source: National Oilheat Research Alliance, https://noraweb.org/2015/07/sulfur-and-bioheat-requirements-in-the-northeast-states/

Since May 2013, the New York Mercantile Exchange has based its heating oil contract on ultra low sulfur diesel



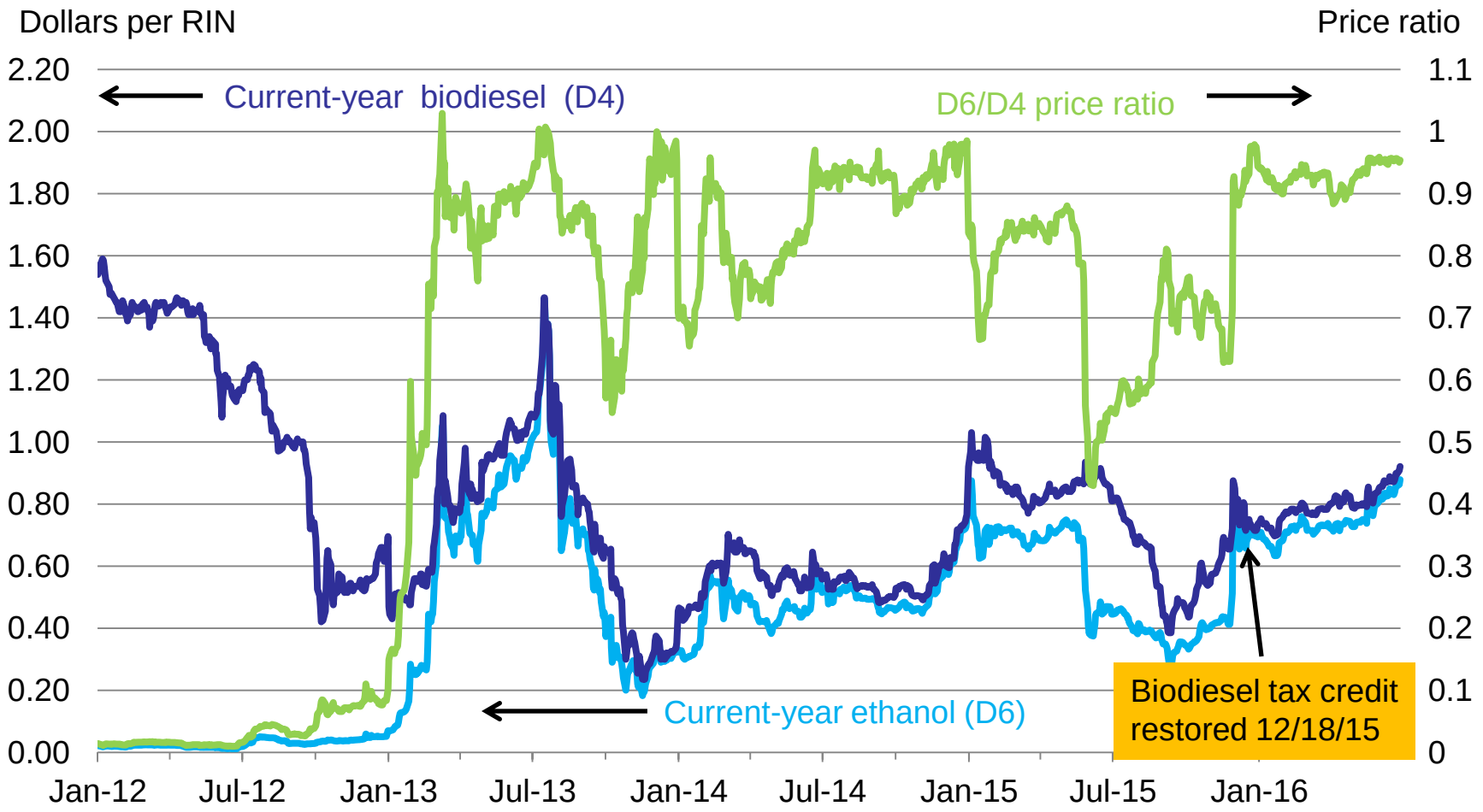
Source: Energy Information Administration *Today In Energy*, May 10, 2013
http://www.eia.gov/todayinenergy/detail.cfm?id=11211

Soybean oil is generally not cost-competitive with crude oil or diesel fuel



Sources: United States Department of Agriculture, Agriculture Marketing Service; and Thomson Reuters as republished by the Energy Information Administration

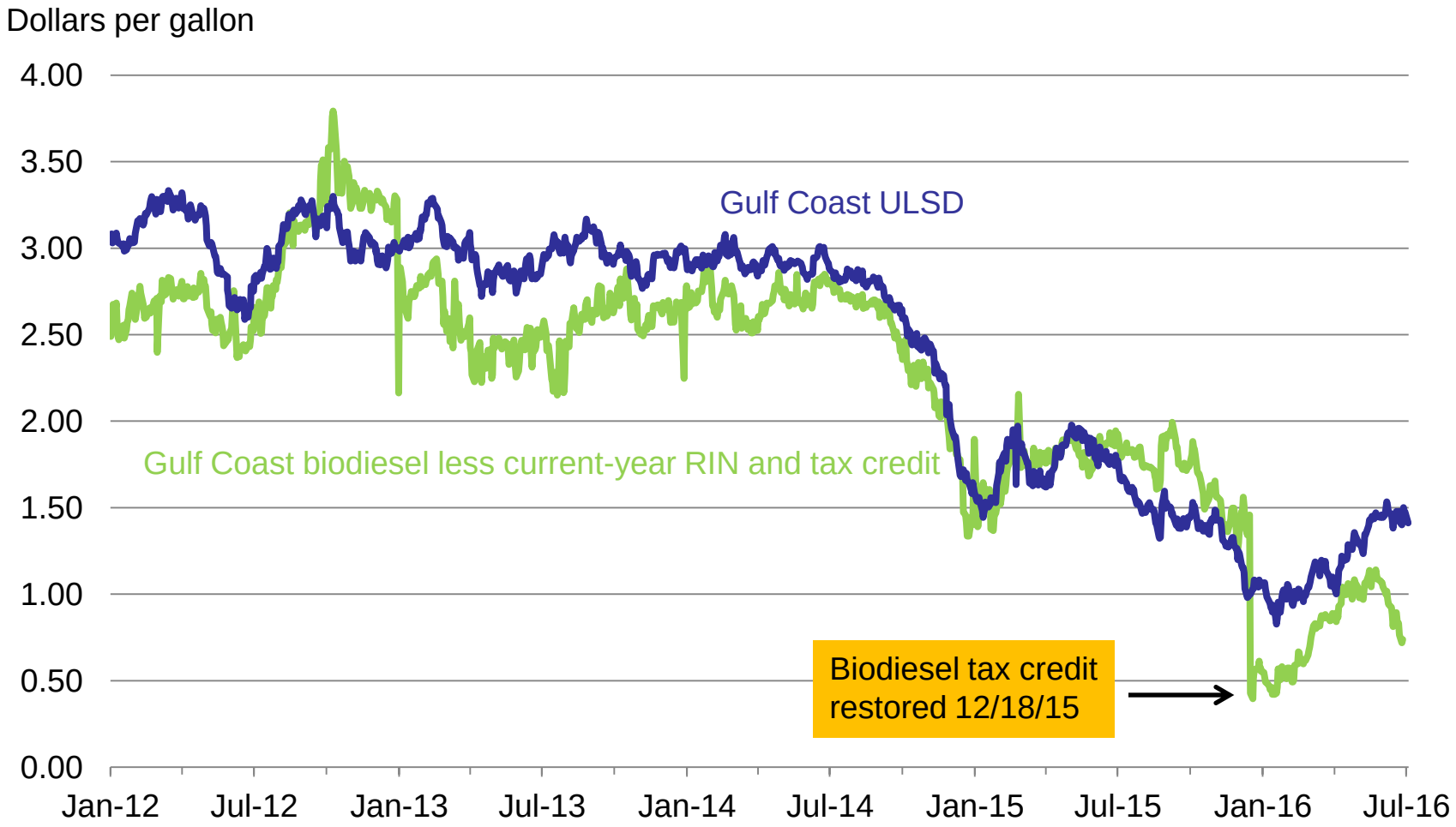
The relationship between D6 and D4 RIN prices indicate that ethanol blending alone cannot meet the total renewable fuel requirement



Note: One RIN represents the energy equivalent of one gallon of ethanol

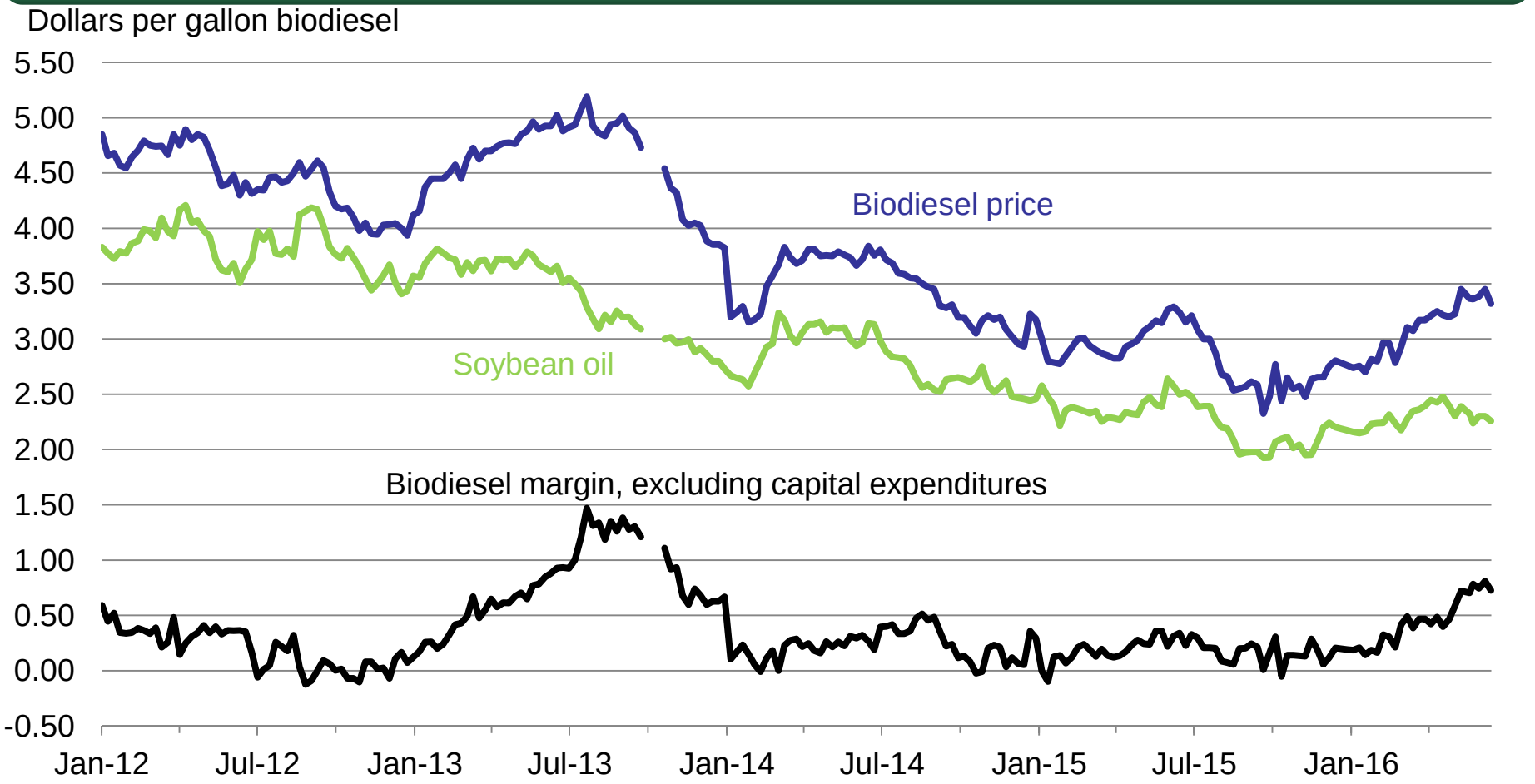
Source: Oil Price Information Service

The biodiesel blending tax credit has more than offset biodiesel's price disadvantage relative to petroleum diesel



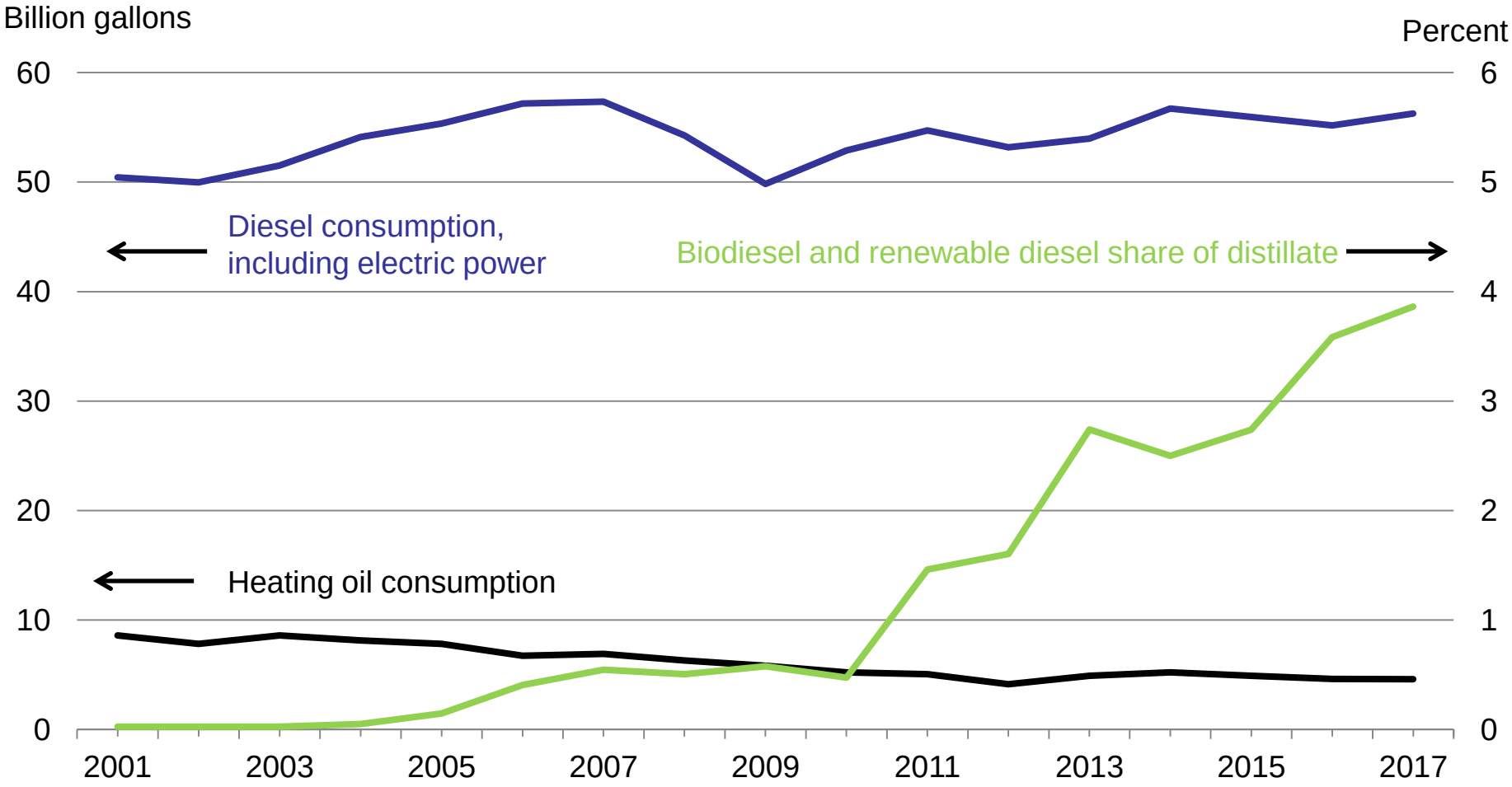
Source: Oil Price Information Service and Thomson Reuters as republished by the Energy Information Administration

Biodiesel producer margins have improved in 2016



Source: Oil Price Information Service and Thomson Reuters as republished by the Energy Information Administration

The biofuels share of distillate has grown substantially since the commercialization of biodiesel in 2001



Source: Energy Information Administration, *Short-Term Energy Outlook July 2016*