Renewable Fuel Oil

Renewable Fuel Oil for St. Lawrence University

By: Ms. Georgia Grzywacz

Executive Summary

Introduction

This section contains the context of the report, including the grant received by St. Lawrence from NYSERDA directed toward energy auditing and proposals for the future of the University as it relates to sustainability. Additionally, climate change is briefly examined, with a deeper look into renewable energy and the role local stakeholders play in facilitating change.

Renewable Fuel Oil

This section reviews the use of renewable fuel oil as an alternative energy source and the environmental and economic benefits associated with its implementation. Additionally, this section explains the Renewable Fuel Standard (RFS) and its associated implications.

Ensyn Corporation

This section covers Ensyn Corporation, a company that manufactures and distributes renewable fuel oil, and its various partnerships, with a specific focus on Bates College. Also considered are the drawbacks associated with renewable fuel oil.

Alternative Fuel Sources: Wood Pellets

This section will reflect on another alternative energy source, wood pellets. Case studies will briefly discuss the use of pellets in a university setting.

Proposal: Renewable Fuel Oil at St. Lawrence University

This section will contain the proposal. It will provide suggested sites for the construction of a renewable fuel oil system and the ways in which St. Lawrence University will benefit from its implementation, both economically and environmentally.

Conclusion

This section summarizes the content of the report, and reiterates St. Lawrence's role in mitigating the effects of climate change at a local scale.

Introduction

Global climate change is impacting our world in unprecedented ways. Much of these long-term alterations in Earth's climate and weather patterns are created by increased carbon dioxide emissions into the atmosphere, mostly sourced in anthropogenic practices. A number of alternative fuel sources have risen in popularity, including solar, geothermal, wind, and biomass. These renewable energy sources can be replenished by nature and are the most viable alternative to non-renewable resources such as fossil fuels, but have only recently gained popularity. Especially in response to federal

mandates, the consumption of alternative forms of energy has increased. In 2016, about 10% of total U.S. energy consumption was from renewable energy sources. Environmentally-conscious action is occurring at multiple levels, from individuals to large corporations. Universities, too, are looking for ways to curb carbon dioxide emissions in order to mitigate one of the main sources of global climate change, and have begun looking into various sources of alternative fuel to meet established sustainability goals.

Renewable Fuel Oil

Renewable fuel oil, or RFO, is an energy-laden liquid made by vaporizing surplus wood feedstock, typically left over from timber operations, at a very high temperature. The vapor retains the energy of the wood's organic compounds and is re-condensed into a fuel oil that is later burned and utilized as a heating source.

RFO is most often utilized for its environmental benefits. Burning biomass to create clean electricity releases no carbon back into the atmosphere. Rather, it releases what would be released naturally as the organic matter decomposed. It also forms a closed cycle because the carbon that is released when biomass is burned is re-absorbed by other plants in their growing cycle. Comparatively, when fossil fuels are burned they release trapped carbon, adding to the atmosphere that was previously sequestered underground. The environmental problems associated with wood feedstock sourcing will be addressed in later sections.

RFO is beneficial because it helps reduce greenhouse gas emissions by displacing fossil fuels in heating applications and lowering emissions associated with fossil fuels by between 70-90%. The benefits of RFO also include reduced wildfire risk to forests by providing an economic incentive for the sale of low value forest residuals, so timber owners can now economically manage their holdings and enhance their sustainable forest management practices.

RFO is preferred to other alternative fuel sources, such as biomass, due to policy mechanisms and payback periods. Similarities between the two are, if harvested sustainably, the environmental benefits are equitable. However, with RFO there is a built-in compliance mechanism related to the Renewable Fuel Standard, which guarantees that RFO will achieve sustainability goals. Additionally, though the actual price, not including implementation, of the two fuels are similar the payback on RFO is between three and five years; whereas, the payback for a biomass plant varies between ten and twenty years. RFO also has a number of benefits over natural gas, particularly related to carbon emissions. When looking at life-cycle greenhouse gas emissions, RFO produces 81% less CO2 natural gas. When comparing other emissions, RFO is only slightly higher than natural gas in terms of particulates and NOx, which may impact local air quality and respiratory health, however the impacts of RFO are only marginally higher than that of natural gas.

Renewable Fuel Standard

The Renewable Fuel Standard (RFS), created under the Energy Policy Act of 2005, is a national policy that requires a certain volume of renewable fuel to replace or reduce the quantity of petroleum-based transportation fuel, heating oil, or jet fuel. The Act was further amended in 2007 under the Energy Independence and Security Act. This amendment increased the size of the program and incorporated changes which include augmenting long-term goals to 36 billion gallons of renewable fuel, extending yearly volume requirements, adding explicitly definitions for renewable fuels to quality, and creating grandfathering allowances for volumes from certain existing facilities. For a fuel to qualify as a renewable fuel under the RFS, the EPA must determine that the fuel abides

by the statue and regulations. The fuels must achieve a reduction in greenhouse gas emissions as compared to a 2005 petroleum baseline. The EPA continues to review and approve new pathways. The Ontario facility of Ensyn Corporation, which produces RFO, (see below) has been qualified by the EPA under the U.S. RFS Program and expects that sales of RFO will qualify for Renewable Identification Numbers (RINs) under the RFS. RINs are the credits that obligated parties use to demonstrate compliance within the standard. RINs can be traded within parties and are generated when a producer makes one gallon of renewable fuel.

Ensyn Corporation

Ensyn Corporation is a company dedicated to the production of RFO from forest and agricultural residues using its proprietary thermal technology. Since 1989, Ensyn has produced over 37 million gallons of RFO, and is increasing its production in conjunction with key strategic partnerships with Honeywell UOP, Chevron Technology Ventures, Fibria Celulose, and Felda Palm Industries. To date, Ensyn's focus was on commercial production of heating fuels and chemicals for the food industry, but recently they expanded their capacity to produce biofuels to serve a broader base, including schools with aggressive carbon reduction goals, which are discussed below.

Partnerships

ENYSN has partnered with a number of businesses, including Memorial Hospital in North Conway, New Hampshire. In 2014, the hospital signed a five-year commercial contract with the intent to convert to 100% RFO, replacing petroleum-based fuels. This shift was expected to lower Memorial's environmental footprint and represent a net cost savings for the hospital.
Estimates claim that the hospital's conversion reduced greenhouse gas emissions from heating fuels by 85% and total emissions by 75%.

In June 2015, Ensyn and Youngstown Thermal in Youngstown, Ohio signed a RFO biofuel supply agreement. Ensyn will provide up to 2,500,000 gallons of RFO per year, which will displace up to 50% of its fuel needs currently powered by natural gas. Youngstown Thermal is responsible for providing steam for heat and hot water for the central business district in the city, including Youngstown State University.

Looking forward, in response to increasing demand for RFO, Ensyn plans to expand the capacity of its Renfrew, Ontario plant and hopes to develop more projects in the United States and Brazil. At a more local scale, the company also plans to establish facilities in the northeast to reduce the costs and CO2 emissions associated with travel. One proposed site was in Lyonsdale, NY, which is located about 90 miles from Canton, NY.

Bates College

On January 10th 2017, the Bates College campus partnered with Ensyn to shift from natural gas to renewable fuel oil. Since the early 2000s, the college's greenhouse gas emissions have shrunk by roughly 83%. Bates was looking to achieve carbon neutrality by 2020 and wanted to center its focus on the central steam plant because that was the largest cause of CO2 emissions.
After negotiating a beneficial supply deal, the college spent $1 million to convert the boiler and storage tank to stainless steel, due to the fuel's acidity. During the construction process, a storage tank and air compressor were added. Additionally, the most expensive aspect of the conversion was the stainless steel insulation of the outdoor storage tank. The equipment they added is sized for two boilers, rather than one, because they are planning to implement an additional RFO boiler in the coming years. The addition of the second boiler would cost significantly less, around $175,000. At this

point, Bates is receiving and burning 800,000 gallons of RFO this year for their approximately 1.2 million ft2 campus. Specifically, 80% of heating needs are covered by RFO, while the other 20% remains natural gas. It takes about 14 pounds of dry wood to make one gallon of RFO, so Bates currently requires about 11,000,000 pounds of dry wood per year, which is currently sourced from sawdust at lumber mills.

Though the college considered utilizing wood chips as an alternative energy source, the benefits of RFO were more significant. The main incentive to choosing RFO over wood chips was economic. Bates was able to use most of its existing equipment, only expending costs on conversions. The implementation of a wood chip system would have necessitated additional equipment and storage areas. The college itself is also saving money on fuel, and expects a payback between four and five years. In terms of environmental advantages, it is difficult to gauge the total decrease in carbon emissions that can be attributed to the shift because of the recent nature of the system's implementation. However, it is important to acknowledge that the aforementioned Memorial Hospital, since converting their entire system to RFO, has reduced their greenhouse gas emissions from heating fuels by 85%.

The facilities staff identified additional benefits of the boiler system. Previously, the staff complained of inactivity due to the lack of daily maintenance necessary on existing boilers. After the implementation of the RFO boiler system, however, the staff responded positively to the training and slight increase in maintenance.

The only problems mentioned by John Rasmussen, the Energy Manager at Bates, were related to programming. Specifically, he referenced bad sensors and difficulties with the heat exchanger struggling to maintain appropriate fuel temperature. He asserts that there were no problems related to the fuel itself. Rasmussen recommended the use of RFO to other colleges in the northeast due to the economic and environmental benefits, as well as the broad resource base in the region.

Associated Drawbacks

The downsides to RFO cited by Greg Gosselin, Northeast Regional Sales Manager of Ensyn Corporation, are that RFO is about two times as heavy as water, so it requires more deliveries. Each truck can carry about six thousand gallons at any time. In the specific case of Bates College, nearly a full truck load is burned every day, and they have three days of storage at peak load. During the colder months, the college receives five to six deliveries a week. The transportation of the fuel by these vehicles creates a carbon footprint, and detracts about 1% from the reduction in emissions created by utilizing RFO. However, these truck loads travel from Ontario to Lewiston, Maine, which is about 3,000 miles round trip. To combat this transportation time and the associated emissions, Ensyn is looking into localizing their sources closer to their northeastern customer base. This fuel type also produces more waste product in the form of ash as compared to natural gas. Still, he emphasizes the efficiency of the process, particularly with the technology of Ensyn, which increases yield.

Alternative Fuel Sources: Wood Pellets

Wood pellets as an alternative form of energy are appealing for a number of reasons and, thus, are utilized at various scales as a source for heating fuel. In addition to the obvious environmental advantage of wood pellets compared to fossil fuels, pellets are also 25 to 50% less expensive than fossil fuels, can be bulk stored in less space, and have a high energy content. The heat provided by one ton of wood pellets is equal to heat provided by 120 gallons of heating oil. Similarly, paying $200

for wood pellets is the same as paying $1.67 for heating oil. Wood pellets are typically utilized in smaller buildings between 10,000 and 50,000 ft2, however large scale buildings have begun increasingly utilizing pellets as a source of heating fuel.

The largest difference between using pellets and using RFO is the cost to purchase the fuel. Pellets are typically between $12-16/MMBtu, whereas RFO is around $5/MMBtu. Additionally, the new equipment needed to burn pellets will cause significant financial impact.

The demand for biomass in the form of wood pellets, commonly utilized in Europe, quadrupled between 2012 and 2015. Companies have invested billions into this alternative fuel, and European companies are now turning to the southeastern United States where logging is well-established and less restricted, importing more than 4 million tons of wood pellets from the US in 2014. As progressive as this reliance on fuel alternatives to fossil fuels may seem, environmentalists argue that logging biomass for wood pellets is actually more environmentally dangerous in the short term. Stakeholders have voiced concerns about logging and carbon released by the combustion of biomass. They argue that industry practices are far from carbon-neutral and are currently threatening ecosystems.

Burning wood releases as much or more CO2 per unit of energy as burning coal, so in order for biomass production to be considered carbon neutral, the CO2 must be recaptured in regenerated forests. In ideal circumstances, waste wood and low-grade wood were utilized. However, companies investing in logging in the southeast rely on trees from virgin growth and second-growth hardwoods, which grow more slowly and require a longer time frame to recapture released carbon. Data from the U.S. Energy Information Administration and International Energy Agency show that burning wood pellets results in major impacts on forests for only modest quantities of bioenergy. Specifically, the IEA projects that to produce 6.4 % of global electricity from burning wood biomass in 2035, the global commercial tree harvest would have to increase by 137%.

Like other heating fuels, burning wood pellets produces particulate matter, CO2, nitrogen oxides, and sulfur dioxide. Burning wood produces more particulate matter than fossil fuels, but less sulfur dioxide, and the resulting ash residue is often used in fertilizer and compost.

Greg Gosselin argues that the benefits of utilizing RFO outweigh the benefits of biomass. Though both are less expensive than fossil fuels, when implementing RFO, one can utilize existing equipment, with a shorter payback period. Bates considered utilizing wood chips as an alternative fuel source but, due to the $10-$12 million construction costs and operational challenges, ultimately chose RFO. With RFO, they were gaining the same benefits of reduced emissions without having to buy a new boiler. Wood chips are typically recommended for smaller installations, but there are some colleges and universities have also successfully installed larger-scale systems.

Local Sourcing

The aforementioned drawbacks associated with Ensyn's RFO, namely the significant travel costs and vehicle emissions, are eliminated through locally sourced biomass production. Through the Adirondack Model Neighborhood Wood Heat Initiative, a program of the Northern Forest Center, financial and technical assistance can help homeowners and businesses successfully switch to high-efficiency wood pellet heating in areas of upstate New York, including Saranac, Saranac Lake, and Tupper Lake. This project aims to help businesses and individuals lower heating costs, support jobs in the forestry sector, and keep money in the local economy. Biomass Magazine cites that, by purchasing wood pellets instead of oil, participants will help keep more than $5 million in the regional

economy. To launch this initiative, the Northern Forest Center is partnering with various organizations, including the Adirondack North Country Association and the New York State Energy Research and Development Authority. NYSERDA has also provided support through Governor Cuomo's Cleaner, Greener, Communities Program, which encourages local communities to become more sustainable and energy efficient.

Case Studies

Anna Maria College in Paxton, Massachusetts, houses the largest wood pellet-fueled boiler in the state, producing 5.63 MMBtu/hour to supply 90% of the 341,000 ft2 campus. Since its implementation in early 2012, the college has saved over 40% on heating fuel, and full payback is expected in ten years. The system requires maintenance weekly, and replacement parts will cost $20,000 per year while still allowing 33% savings. On the downside, however, the system is close to its upper limit for particular matter emissions. In order to combat the problem, the college would need to install an exhaust filtration system to ensure appropriate standards.

Paul Smith's College also made the switch to a biomass heating system in 2015. The boiler is intended to heat all of the college's academic buildings, and eventually expand to incorporate the Visitors Interpretive Center. Paul Smith's use of wood pellets is unique in that their goals were advanced by Renewable Heat NY, which is an initiative that supports quicker development of the biofuel industry, raises consumer awareness, and encourages local sustainable heating markets and sustainable forestry. The pellets utilized by Paul Smith's are locally sourced from Massena, which ensures that money will remain in the region and keeps jobs in the local economy. Additionally, the system saves $50,000 per year and is expected to pay for itself in fifteen years. In the long-term, the college hopes to have every building on campus running on mini-district heating grids by 2029.

Proposal: Renewable Fuel Oil at St. Lawrence University

St. Lawrence aims to achieve carbon neutrality by 2040. In order to achieve these goals, the University must target one of the main source of emissions, our heating plant. Our current heating system is not only cost ineffective, but also accounts for 75% of St. Lawrence's scope 1 emissions.

The University's reliance on natural gas comes at a cost. Currently, our central heating plant consists of three water-tube steam boilers, all of which were installed in the 1970s. Switching to alternative fuel sources would reduce the costs directed toward campus heating and boiler maintenance. Additionally, according to Wendel's energy audits, St. Lawrence University consumes a cumulative annual average of approximately 173,524 mmBTU of natural gas which, when combined with the average annual electricity consumption, equates to greenhouse gas emissions of 11,832 MT CO2e per year. Therefore, it is recommended that St. Lawrence adopt RFO in the near future to both work toward carbon neutrality as well as decrease costs spent on heating.

Four sites have been suggested as potential locations for the unit necessary to store the surplus RFO. Each of these sites carries merit, however Site 1 has proven most cost-effective. The construction of an entirely new facility, as Site 4 suggests, would be unnecessary and expensive, given our ability to burn RFO using our current boiler systems, after certain modifications. The slope on which Site 3 is set makes it ineffective as a viable location for a storage tank, as well as its relatively larger distance to the central heating plant compared to both Sites 1 and 2. Site 2, while located closest to the central heating plant, is too significant visually, and thus an ineffective site. Therefore, Site 1 is the most appropriate site, as it is only moderately distanced from central heating facility, accessible to the road, situated on a negligible slope, and has minimal visual impact.

Drawbacks to the implementation of an RFO fuel system at St. Lawrence include costs spent on staff training and modifications of current equipment, air emissions associated with this fuel type, and the viability of alternative fuel sources. The costs associated with staff training would be simple, negligible and, as the staff of Bates College can attest to, ultimately create a more engaging work environment. In regards to equipment alteration, the payback period for RFO is roughly four to five years, which is nearly half the time it would take to regain the money spent on a wood pellet system. Additionally, the air emissions associated with RFO are common of most other fuel types, however its carbon emissions are dramatically lower. The slight increase in NOx and particulate emissions would affect air quality only marginally. Finally, the viability of other alternative fuel sources is jeopardized by the cost effectiveness of an RFO system. The utilization of wood pellets at St. Lawrence is difficult in that, not only is it relatively unconventional to utilize pellets in a university setting, but purchasing pellets becomes less cost effective as both the size of the heating grid and distance from distribution centers increase.

The most significant drawback relates to the lack of regulatory approval. Currently, there are no installations of RFOs in New York, and the Department of Environmental Conservation has yet to approve the its use. However, as this product becomes increasingly common at universities throughout the northeast, demand will rise within the state, and the DEC will face a more straightforward decision.

Conclusion

To help achieve its long-term goal of carbon neutrality, St. Lawrence should consider the implementation of renewable fuel oil as a viable alternative to our current natural gas heating system. Despite its drawbacks, including particulate emissions that affect air quality and costs associated with the transportation of the fuel, the benefits of the utilization of RFO are significant, especially when compared to other renewable energy sources, such as wood pellets. Through the use of RFO, the University can achieve its goal of carbon neutrality, while also minimizing the costs associated with the implementation of a new system. This process has proven successful in similar settings, such as Bates College, where the use of RFO has led to a dramatic decrease in both carbon dioxide emissions and heating costs. In short, though many forms of alternative fuel exist, RFO proves the most cost-effective option. In response to global climate change, actors at all levels must take initiative in mitigating the effects of anthropogenic carbon dioxide emissions. St. Lawrence's actions in obtaining carbon neutrality are not negligible, and will help foster a more environmentally-conscious student body and more sustainable world.

References

Bennett, Bob. "Fuel For Change." Sequel Magazine. Paul Smith's College: September 2015. Accessed 11 Mar 2018. https://cpb-us-west-2-juc1ugur1qwqqqo4.stackpathdns.com/www.paulsmiths.e... (https://cpb-us-west-2-juc1ugur1qwqqqo4.stackpathdns.com/www.paulsmiths.edu/dist/1/24/files/2015/09/Pellet-Boiler-xpa9jh.pdf)

Biomass Energy Resource Center. "Wood Pellet Heating." Massachusetts Division of Energy Resources. June 2007. Accessed 18 Feb 2018. https://www.biomasscenter.org/pdfs/DOER_Pellet_Guidebook.pdf (https://www.biomasscenter.org/pdfs/DOER_Pellet_Guidebook.pdf)

Carr, Robert C. and David McDermott. "HECO Successfully Cofires Biofuel as No. 6 Oil Substitute." Power, vol. 158, no. 6, June 2014, pp. 48-53. EBSCOhost, search.ebscohost.com/login.aspx?direct=true&db=eih&AN=96368071&site=ehost-live.

Drouin, Roger. "Wood Pellets: Green Energy or New Source of CO2 Emissions?" Yale E360, Yale School of Forestry & Environmental Studies, 22 Jan. 2015, e360.yale.edu/features/wood_pellets_green_energy_or_new_source_of_co2_emissions.

"ENSYN and Youngstown Thermal Sign RFO Biofuel Supply Agreement" Biofuels International. 4 Jun 2015. Accessed 13 Nov 2017. https://biofuels-news.com/display_news/9279/Ensyn_and_youngstown_thermal... (https://biofuels-news.com/display_news/9279/Ensyn_and_youngstown_thermal_sign_rfo_biofuel_supply_agreement/)

Ensyn Corporation. "Ensyn—Renewable Fuels and Chemicals from Non-Food Biomass." Ensyn. Accessed 5 November 2017. www.Ensyn.com/ (http://www.Ensyn.com/)

Environmental Protection Agency. "Overview for Renewable Fuel Standard." 7 Jun 2017. Accessed 11 Nov 2017. https://www.epa.gov/renewable-fuel-standard-program/overview-renewable-f... (https://www.epa.gov/renewable-fuel-standard-program/overview-renewable-fuel-standard)

Gosselin, Greg. (2017 November 6). Personal interview.

Government of British Columbia. "FactSheet: Air Emissions." Ministry of Environment, July 2011. https://www2.gov.bc.ca/assets/gov/environment/waste-management/industria... (https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/pulp-paper-wood/woodpelletmanfacfs.pdf)

Harrington, Rebecca. "Europe's 'Renewable' Energy Plan is Actually Destroying US Forests." Business Insider. 23 Dec 2015. Accessed 18 Feb 2018. http://www.businessinsider.com/europe-imports-wood-biomass-from-us-for-p... (http://www.businessinsider.com/europe-imports-wood-biomass-from-us-for-power-2015-12)

Hubley, Doug. "Campus Construction Update Jan. 27, 2017" Bates College. 26 Jan 2017. Accessed 11 Nov 2017. http://www.bates.edu/news/2017/01/26/campus-construction-update-jan-27-2... (http://www.bates.edu/news/2017/01/26/campus-construction-update-jan-27-2017/)

Landis, D. A., Gratton, C., Jackson, R. D., Gross, K. L., Duncan, D. S., Chao, L.,... Werling, B. P. (2017). Biomass and Biofuel Crop Effects on Biodiversity and Ecosystem Services in the North Central US. Biomass and Bioenergy, xxx, 1-12.

Northern Forest Center. "Project Aims to Help Adirondack Residents Switch to Pellet Heat." Biomass Magazine. 10 Mar 2015. Accessed 14 Apr 2018. http://biomassmagazine.com/articles/11643/project-aims-to-help-adirondac... (http://biomassmagazine.com/articles/11643/project-aims-to-help-adirondack-residents-switch-to-pellet-heat)

Rasmussen, John. (2017 November 14). Telephone interview.

Rasmussen, John. (2018 January 10). Personal interview.

The Conway Daily Sun. "Memorial Hospital to Adopt New Renewable Biofuel from Ensyn Corporation." 12 Mar 2014. Accessed 13 Nov 2017. https://www.conwaydailysun.com/community/memorial-hospital-to-adopt-new-...

(https://www.conwaydailysun.com/community/memorial-hospital-to-adopt-new-renewable-biofuel-from-Ensyn-corporation/article_a824bb75-a80f-550d-bc1e-baf59f131be2.html)

Turkel, Tux. "Company Envisions Maine as Site for Biorefinery." Press Herald. 21 Feb 2017. Accessed 11 Mar 2018. http://www.Ensyn.com/uploads/6/9/7/8/69787119/portland_press_herald_feb_... (http://www.Ensyn.com/uploads/6/9/7/8/69787119/portland_press_herald_feb_2017.pdf)

Print

Contact Us

Green Pages
St. Lawrence University
23 Romoda Drive
Canton, NY 13617

sustainability@stlawu.edu (mailto: sustainability@stlawu.edu)

Connect with Us:

(http://www.facebook.com/St.LawrenceUniversityGreen/)

St. Lawrence University
23 Romoda Drive, Canton, NY 13617
800-285-1856

(https://www.instagram.com/stlawrenceu/)

SUPPORT ST. LAWRENCE (HTTPS://CAMPAIGN.STLAWU.EDU/)