Transportation Recommendations to Climate Emergency Mobilization Work Group for Frederick County and City

a. Recommendation: Encourage renewable/low carbon intensity fuels availability and use in Frederick Agriculture

b. Expected GHG Impact:

The GHG impact will depend on the type of renewable fuel that is replacing diesel or other fossil fuel. Carbon intensity for fuel depends on the feedstock, the conversion technologies and other factors.

From farm equipment and long haul trucks used to transport agricultural products are likely to continue to use diesel (compression ignition) engines for a long time[1], not only because they are so useful for efficient freight transportation and heavy duty work, but also because they last for many years. In addition, economically replacing diesel engines with electric powered-alternatives will take quite a while since only about a third are expected to be replaced by other drivetrains by 2035[2].

Renewable alternative fuel options for compression ignition engines include:

- Biodiesel
- Renewable diesel which goes by many names including:
  - Hydrotreated vegetable oil (HVO)
  - Hydrogenation-derived renewable diesel (HDRD)
  - Hydroprocessed renewable diesel (HRD)
  - and others
- Co-processed diesel
- Straight vegetable oil (SVO)
- Renewable dimethyl ether (rDME)
- Ethanol
- Lignin ethanol oil (LEO)

Each of these will have a different carbon intensity and varied environmental impacts. For example, biodiesel significantly reduces life-cycle greenhouse gas (GHG) emissions. Life cycle analysis using Argonne National Laboratory's GREET (Greenhouse Gases, Regulated Emissions, and Energy Use in

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[1] Gehm, Ryan "Deere bullish on biodiesel, renewable diesel," SAE Internationa/Truck and Off-Highway Engineering https://www.sae.org/news/2021/03/deere-alternative-propulsion

[2] Clevenger, Seth. "The Dawn of Electric Trucks." Transport Topics, December 6, 2019. https://www.ttnews.com/articles/dawn-electric-trucks. and Hurd, Byron. "Report: Long-haul electric semis aren't yet cost-effective." Green Car Reports, October 22, 2019. https://www.greencarreports.com/news/1125634_report-long-haulelectric-semis-aren-t-yet-cost-effective.

Transportation Model) analysis found that greenhouse gas emissions for B100 are 74% lower than those from petroleum diesel. The California Air Resources Board (CARB) reported similar values for its life-cycle analysis of biodiesel from various sources using CA-GREET 2.0[3].

Renewable diesel has some of the largest lifecycle greenhouse gas reductions with a carbon intensity of about 30 compared to 102 for ultra low sulfur petroleum diesel[4]. This can vary depending on the feedstock and generally ranges from 50% to 85% lower than baseline diesel fuel[5].

According to Nick Block, director of worldwide marketing, sales & customer support, John Deere Power Systems (JDPS), biodiesel and renewable diesel will lead the way for alternative-fuel integration into the heavy equipment industry.[6]

Some farmers make their own biodiesel. Agricultural Engineering and Agronomy Researchers at University of Vermont Extension in partnership with farmers and the Vermont Bioenergy Initiative have developed a model of local minded, on-farm production of biofuels that can help rural communities transition away from unsustainable models of food, feed and fuel production. [7]

Kubota allows the use of biodiesel fuel concentrations up to 20 percent.[8]

c. Recommended Timeline for Action: We recommend that the city proceed as quickly as possible to encourage and facilitate transition to sustainable renewable fuels in agriculture.[9]

d. Rationale:

d1 Findings are based on research and data:

For research related to specific statements, see footnotes.

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[3] Alleman, Teresa L, Robert L McCormick, Earl D Christensen, Gina Fioroni, Kristi Moriarty, and Janet Yanowitz. Biodiesel Handling and Use Guide (Fifth Edition). Alternative Fuels Data Center. U.S. Department of Energy, 2016. https://afdc.energy.gov/files/u/publication/biodiesel_handling_use_guide.pdf. And S. Patricia Batres-Marquez, "Readoption of the California Low Carbon Fuel Standard," Agricultural Marketing Research Center. https://www.agmrc.org/renewable-energy/renewable-energy-climate-change-report/renewable-energy-climate-change-report/may-2016-report/readoption-of-the-california-low-carbon-fuel-standard

[4] U.S. Energy Information Administration. "Renewable diesel is increasingly used to meet California's Low Carbon Fuel Standard." U.S. Environmental Information Administration, November 13, 2018. https://www.eia.gov/todayinenergy/detail.php?id=37472.

[5] Leonard, Jon, and Patrick Couch. "The Potential - and Challenges - of a Renewable Diesel Fuel for Heavy-Duty Vehicles." GNA - Clean Transportation & Energy Consultants, 2017. https://www.gladstein.org/the-potential-and-challenges-of-renewable-diesel-fuel-for-heavyduty-vehicles/

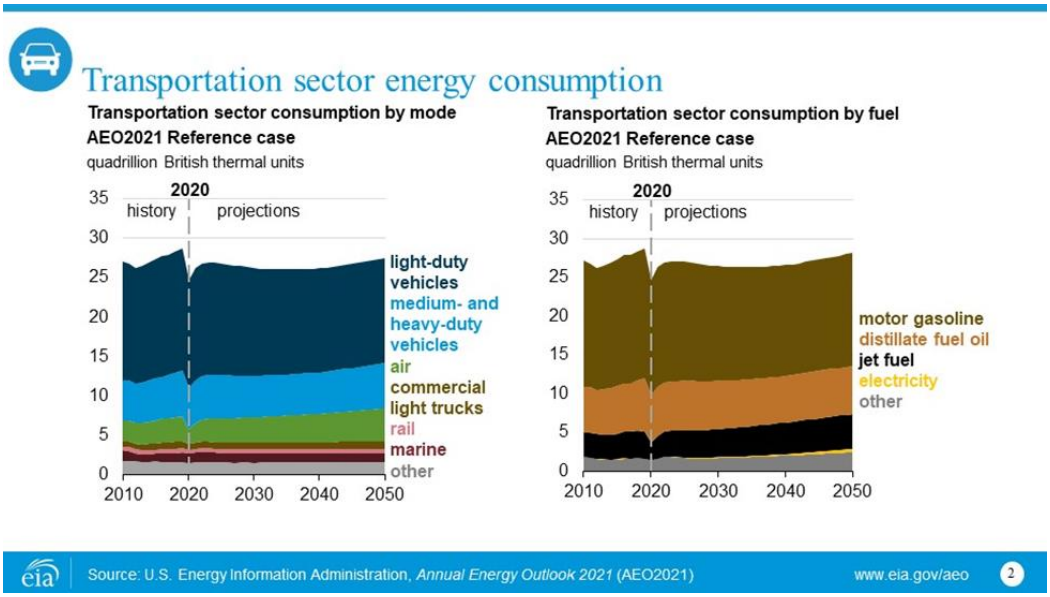
[6] Gehm, Ryan "Deere bullish on biodiesel, renewable diesel," SAE Internationa/Truck and Off-Highway Engineering https://www.sae.org/news/2021/03/deere-alternative-propulsion

[7] Vermont Bioenergy Initiative, "FOOD VERSUS FUEL – LOCAL PRODUCTION FOR LOCAL USE – BIODIESEL AS PART OF SUSTAINABLE AGRICULTURE" http://vermontbioenergy.com/food-versus-fuel-local-production-for-local-use-biodiesel-as-part-of-sustainable-agriculture/#.YJ2XNbVKhPY

[8] Kubota, "KUBOTA USER'S GUIDE TO BIODIESEL FUEL (BDF) CONCENTRATIONS UP TO 20% (B20)" https://www.kubotausa.com/service-support/maintenance-schedules/lubricant-maintenance-schedule/biodiesel

[9] Advanced Biofuels USA, How to De-Fossilize Your Fleet: Suggestions for Fleet Managers Working on Sustainability Programs. https://advancedbiofuelsusa.info/how-to-de-fossilize-your-fleet/

d2 Equity considerations: This graphic[10] from the US Department of Energy's Energy Information Administration clearly shows that even in 2050 significant aviation fuel will be used. That fuel should be as low polluting, low carbon and affordable as possible.



https://www.eia.gov/outlooks/aeo/ Transportation PDF PPT

d3 Co-Benefits Cleaner, less-polluting[11] and less expensive[12] options will be benefit the health of farm workers. Diesel exhaust contains substances that can pose a risk to human health and to the environment. Containing more than 40 toxic air contaminants[13], the exhaust itself is a complex mixture of thousands of gases and fine particles. These include many known or suspected carcinogens and other harmful pollutants. Older diesel engines in particular are substantial emitters of particulate matter (PM) and nitrous oxides (NOx), but relatively small emitters of carbon monoxide (CO) and volatile organic compounds (VOCs). New emissions

[10] U.S. Department of Energy Energy Information Agency, "Transportation sector energy consumption" https://www.eia.gov/outlooks/aeo/ Transportation PDF https://www.eia.gov/outlooks/aeo/pdf/05 AEO2021 Transportation.pdf PPT https://www.eia.gov/outlooks/aeo/ppt/05 AEO2021 Transportation.pptx

[11] Trinity Consultant and National Biodiesel Board, "Health Benefits Study -- New Biodiesel Study Highlights Fuel's Ability to Make Impact: NOW" https://www.biodiesel.org/news-resources/health-benefits-study and Skor, Emily "Replacing toxic additives in our fuel" Growth Energy and Biofuels International https://biofuels-news.com/news/replacing-toxic-additives-in-our-fuel/ and Nigel N. Clark, David L. McKain Jr., Tammy Klein & Terence S. Higgins (2021) Quantification of gasoline-ethanol blend emissions effects, Journal of the Air & Waste Management Association, 71:1, 3-22, DOI: 10.1080/10962247.2020.1754964

[12] For examples of price comparisons in the US of current regular gasoline (E10) and high ethanol blends (E15, E30, E85), see the website E85Prices (https://e85prices.com/).

[13] "Health Effects of Diesel Exhaust." OEHHA California Office of Environmental Health Hazard Assessment, May 21, 2001. https://oehha.ca.gov/air/health-effects-diesel-exhaust.

controls reduce all types of emissions and pending US regulations will reduce NOx potentially by another 90%[14].

Concerns about particulate matter and hydrocarbon emissions from diesel engines which may be toxic and/or carcinogenic are mitigated by use of biodiesel[15]. Other environmental impacts vary depending on the feedstock. For example, recycling used cooking oil for fuel keeps contaminated UCO out of use and prevents it from being dumped into municipal sewer systems where it can cause clogs and additional expense for water treatment.

Renewable diesel can help improve air quality. Based on limited data, the California Air Resources Board (CARB) determined that RD100 can decrease NOx by roughly 10 percent when used in older heavy-duty engines that don't have state-of-the-art emission controls. Preliminary data also indicate renewable diesel can reduce particulates emitted from older diesel engines by about 30 percent. When used in newer engines or vehicles with diesel engines compliant with 2010 standards, the NOx and particulate reduction benefits are likely to be reduced significantly.[16]

In addition, the use of biodiesel and renewable diesel fuel results in improved lubricity, zero aromatics and minimal sulfur. It has a very favorable energy balance – the difference between the energy produced by one kilogram of fuel and the energy necessary to produce it – of 3.2 to 1. This means a gallon of biodiesel provides users with 3.2 times the energy it takes to produce it, which is a higher ratio than most alternative fuels.[17]

The local production for local use model results in two products from one crop: oil and meal (animal feed or fertilizer). By growing oilseed and pressing the seed to extract the oil, farms are creating a valuable livestock feed at home, rather than importing it. The oil can be sold as a food

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[14] Employees and Contractors of Chevron Corporation. "Diesel Fuels Technical Review." Chevron. 2007. https://www.chevron.com/-/media/chevron/operations/documents/diesel-fueltech-review.pdf.

[15] Steiner, Sandro, Jan Czerwinski, Pierre Comte, Olga Popovicheva, Elena Kireeva, Loretta Müller, Norbert Heeb, Andreas Mayer, Alke Fink, and Barbara Rothen-Rutishauser. "Comparison of the Toxicity of Diesel Exhaust Produced by Bio- and Fossil Diesel Combustion in Human Lung Cells in Vitro." Atmospheric Environment 81 (Sep tember 21, 2013): 380–388. https://doi.org/10.1016/j.atmosenv.2013.08.059. Bass, Virginia L., Mette C. Schladweiler, Abraham Nyska, Ronald F. Thomas, Desinia B. Miller, Todd Krantz, Charly King et al. "Comparative cardiopulmonary toxicity of exhausts from soybased biofuels and diesel in healthy and hypertensive rats." Inhalation toxicology 27, no. 11 (2015): 545-556. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4768834/. Shvedova, Anna A., Naveena Yanamala, Ashley R. Murray, Elena R. Kisin, Timur Khaliullin, Meghan K. Hatfield, Alexey V. Tkach et al. "Oxidative stress, inflammatory biomarkers, and toxicity in mouse lung and liver after inhalation exposure to 100% biodiesel or petroleum diesel emissions." Journal of Toxicology and Environmental Health, Part A 76, no. 15 (2013): 907-921. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4671493/.

[16] [98] GNA. "Renewable Diesel as a Major Transportation Fuel in California: Opportunities, Benefits and Challenges." GNA - Clean Transportation & Energy Consultants, August 2017. https://www.gladstein.org/wp-content/uploads/2018/05/Final-Report-August-2017.pdf. And, California Air Resources Board. "Final Supplemental Disclosure Discussion of Oxides of Nitrogen Potentially Caused by the Low Carbon Fuel Standard Regulation." ca.gov, September 17, 2018. https://ww3.arb.ca.gov/regact/2018/lcfs18/finaldisc.pdf.

[17] Gehm, Ryan "Deere bullish on biodiesel, renewable diesel," SAE Internationa/Truck and Off-Highway Engineering https://www.sae.org/news/2021/03/deere-alternative-propulsion

product, used directly in a converted engine or converted to biodiesel for use in a standard diesel engine. In this way, oilseed crops offer flexibility in the end-use of the products. [18]

d4 Experience of other cities and counties:

The Vermont Bioenergy Initiative cautions that the model developed in Vermont and described elsewhere in this recommendation has wider-reaching implications in that this can be replicated in rural farm communities across the US, although the specifics will vary.

d4 Interface with the Livable Frederick Plan and Frederick City Master Plan: The Recommendation is consistent with the objectives if both Plans.

d5 Cost-benefit- analysis:

As Allen Schaeffer of Diesel Technology Forum located in Frederick explained, consumers of biodiesel and renewable diesel fuel will have to pay about the same for their fuel as regular petroleum diesel. Those looking for B20 will typically pay about 21 cents less per gallon compared to regular petroleum diesel, according to the most recent data collected by the Department of Energy as of October 2019 (**Table 1**).

TABLE 1 Biodiesel blends: Biodiesel (B20) relative to diesel

Region	B20 prices ($/gal)	Diesel prices ($/gal)	Price difference*
New England	$2.74	$3.14	-$0.40
Central Atlantic	$2.64	$2.89	-$0.25
Lower Atlantic	$2.52	$2.93	-$0.41
Midwest	$2.90	$2.95	-$0.05
Gulf Coast	$2.78	$2.69	$0.09
Rocky Mountain	$3.03	$2.91	$0.12
West Coast	$3.25	$3.89	-$0.64
National average	**$2.87**	**$3.08**	**-$0.21**

*Negative numbers represent average B20 prices that are lower than diesel, on a $/gal basis.

Since renewable diesel fuel volumes are lower than biodiesel, government agencies do not track prices as they do for biodiesel. Recent surveys of fleets which have made the switch to renewable diesel fuel report that they pay a 21-cent premium above petroleum diesel fuel. Much of the fluctuation in price reflects change in demand. With more interest and demand for

[18] Vermont Bioenergy Initiative, "FOOD VERSUS FUEL – LOCAL PRODUCTION FOR LOCAL USE – BIODIESEL AS PART OF SUSTAINABLE AGRICULTURE" http://vermontbioenergy.com/food-versus-fuel-local-production-for-local-use-biodiesel-as-part-of-sustainable-agriculture/#.YJ2XNbVKhPY

the fuel, survey respondents expect that price fluctuation will even out. (Source: Government Fleet – Renewable diesel still a miracle fuel)[19]

Because California and other states have enacted low carbon fuel standards or clean fuel standards or policies, fuel producers of limited quantities of renewable diesel are selling into those markets due to the advantage of their incentives. Until more production facilities are built, unless Maryland also adopts incentive programs for renewable fuels, renewable diesel sources will be limited.

Ethanol blends and Biodiesel do not have the same production limitations.

Biodiesel production costs of between $0.60 and $2.52 per gallon have been estimated for farm-scale production models, which are generally below market price for diesel fuel. [20]

d. Finance:

Many fuel retailers have used state funding and federal USDA funds (currently the Higher Blends Infrastructure Incentive Program) to upgrade tanks and pumps to be able to sell competitive higher blends of renewable fuels.

Transitions to renewable fuels should be part of farm sustainability programs, especially those that are encouraged or required by customers. The transition may pay for itself with savings in fuel prices as described above.

e. Recommended actions:

a. No Legislative Action Necessary

b. Encouragement and Facilitation

The County and City should meet with local agricultural groups to encourage and facilitate use of more renewable fuel in agricultural equipment.

Write-up drafted by Joanne Ivancic

[19] Schaeffer, Allen, "All the buzz on biodiesel fuels: Fill it up please," Progressive Dairy March 31, 2020 https://www.progressivedairy.com/topics/barns-equipment/all-the-buzz-on-biodiesel-fuels-fill-it-up-please

[20] Vermont Bioenergy Initiative, "FOOD VERSUS FUEL – LOCAL PRODUCTION FOR LOCAL USE – BIODIESEL AS PART OF SUSTAINABLE AGRICULTURE" http://vermontbioenergy.com/food-versus-fuel-local-production-for-local-use-biodiesel-as-part-of-sustainable-agriculture/#.YJ2XNbVKhPY