Alternative Fuels

CAC Workgroup
Meeting #3

June 29, 2022

NEW YORK STATE | Climate Action Council

Agenda

Housekeeping

Literature Review on co-pollutant emissions from Alternative Fuels

CJWG feedback on Alternative Fuels in the Draft Scoping Plan

Discussion – Equity considerations for Alternative Fuels

Discussion – Presentation to CAC at July meeting

Co-Pollutant Impacts of Low-Carbon Fuels and Technologies

Effect of Low-Carbon Fuels on Co-Pollutant Emissions

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Presented June 29, 2022

New York State | Climate Action Council

Memo Origin and Objective

Memorandum entitled "*Effect of Low-Carbon Fuels and Energy Technologies on Co-Pollutant Emissions*" was prepared by Abt Associates for NYSERDA as background for the Integration Analysis health study.

The objective was to identify what is known about the effect of alternative fuels and carbon capture and storage on co-pollutant emissions relative to the fossil fuels they would replace in the context of the Integration Analysis.

Separately, NYSERDA also specifically evaluated NO_x emissions associated with combustion of hydrogen in turbines used for electricity generation and applied an estimate in a sensitivity analysis for the power sector.

Key Findings

- *Renewable Diesel*

  Use of renewable diesel in internal combustion engines (ICEs) may result in some decrease in $PM_{2.5}$ emissions, but NO_x may increase or decrease relative to fossil diesel. Benefits may depend on use and load, and there is uncertainty as to the effect of current control technologies. There may be some reduction in toxic emissions (e.g., benzene), but this is not expected to result in very substantial health benefits, as diesel is not a large source of air toxics in New York.

- *Biodiesel*

  Use of biodiesel in ICEs has some $PM_{2.5}$ benefits, but NO_x emissions may increase depending on use and load and needs to be further investigated. Similar to renewable diesel, there may be some reduction in toxic emissions (e.g., benzene) relative to fossil diesel. Use of biodiesel in boilers has not been well studied, but it may not provide substantial co-pollutant emission reduction benefits compared to ultra-low sulfur distillate fuel oil.

Key Findings (continued)

- *Renewable Natural Gas (RNG)* Emissions from RNG combustion are likely to be very similar to those from natural gas.

- *Biogas* Use of biogas in ICEs may result in little change in NO_x emissions relative to natural gas. Effect on $PM_{2.5}$ emissions are unknown. Emissions of SO_2 may substantially increase due to higher sulfur content of gas. Emissions also depend on the feedstock used to produce the fuel.

Key Findings (continued)

- *Hydrogen Combustion* Use of hydrogen as a fuel likely reduces $PM_{2.5}$ compared to natural gas in all end uses (and SO_2, which is very low from natural gas). For ICEs, hydrogen may increase NO_x compared with natural gas. Uncontrolled NO_x emissions from hydrogen combustion boilers and turbines may be higher (compared with natural gas) but well-understood control technologies achieve almost negligible NO_x emissions in demonstration-phase turbine applications. For appliances, such as stoves and grills, hydrogen combustion increases NO_x compared to natural gas.

- *Hydrogen-enriched Natural Gas* Blending hydrogen in natural gas (or RNG) is likely to increase NO_x or leave it unchanged in appliances such as stoves and ovens compared with natural gas. It may decrease NO_x in ICEs compared with natural gas. It does not substantially reduce SO_2 emissions, and its effect on $PM_{2.5}$ emissions has not been well studied. It may reduce $PM_{2.5}$ but increase ultrafine particulate matter with unknown net health effect. Similar to pure hydrogen, combustion of hydrogen-enriched natural gas has the potential to increase NO_x emissions in boilers and turbines.

Alternative Fuel or Technology	Fossil Fuel Compared	Application	NO_x	SO_2	$PM_{2.5}$	Overall Net Benefit or Disbenefit
Renewable diesel	Diesel*	Internal combustion engine (ICE)	22% decrease to 25% increase	Possible decrease, but likely not a large change if both are ULSD	0-40% decrease	Net benefit, with uncertainty depending on the NO_x emissions
Biodiesel	Diesel*	Boiler	Unknown			Unknown; not well studied; potentially not a large change if both are ULSD
		ICE (B20)	Slight decrease to ~10% increase	Possible decrease, but likely not a large change if both are ULSD	Slight decrease (<6%)	Possibly a net benefit, depending on the NO_x emissions
Renewable natural gas	Natural gas	ICE	Little to no change	Little to no change	Little to no change	No substantial difference
		Boilers, other combustion	Unknown			Unknown; not well studied
Biogas	Natural gas	ICE	Little to no change	75% average increase for biogas	Unknown	Possibly a net disbenefit for biogas because of higher SO_2 emissions
Hydrogen	Natural gas	ICE/other	Potential to double emissions	100% decrease (H_2 has no SO_2 emissions) but very small benefit	Unknown, but potentially up to 100% decrease, although may increase ultrafine	Possibly a net benefit, depending on the NO_x emissions
Hydrogen-enriched natural gas	Natural gas	ICE	Slight decrease to slight increase	Unknown, but likely not a large change	Unknown	Unknown; depends on NO_x emissions
		Appliances (e.g., stoves, ovens, furnaces)	20% decrease to 15% increase	Unknown, but likely not a large change	Unknown	Unknown; depends on NO_x emissions

* Renewable diesel and biodiesel were compared to fossil diesel (D100) in the studies; however, most diesel available today is B5. Therefore, the benefits of renewable diesel and biodiesel may be slightly lower when compared to B5. Note also that studies have found that biodiesel in engines can improve the performance of diesel particle filters, potentially improving the benefits from PM reductions.

Data paucity and uncertainty

In all cases, broader research and testing would greatly benefit understanding

- We did not find broad definitive studies directly relevant to most applications or to various types of engines/systems and use cases
- Much of the existing data are from studies that are *not* directly relevant to current applications (e.g., accounting for the use of ultra-low sulfur diesel in on- and non-road applications and diesel particle filters)
- Little if any study of non-criteria pollutant (e.g., toxics) was found

Limitations

The literature review was focused on—

- direct emissions (most relevant for the New York health study); there may be other emissions associated with fuel lifecycle occurring elsewhere (upstream)
- Particulate matter and its precursors – while benzene was mentioned, there was no extensive evaluation of metals, acid gases, or other hazardous emissions

The review does not draw conclusions about health outcomes from ambient or indoor air quality changes

CJWG feedback on Alternative Fuels in the Draft Scoping Plan

CJWG Feedback Documented in Draft Scoping Plan

Chapter	Topic (Location in Draft Scoping Plan)	CJWG input as reflected in the Draft Scoping Plan
Transportation	Lower Carbon Renewable Fuels (p. 96, 118)	The CJWG opposed policies supporting renewable fuels on the grounds that they still release harmful air pollutants, particularly in areas overburdened with diesel emissions, and that the State should focus instead on expeditiously electrifying vehicles and the use of hydrogen fuel cells. Development of these policies would need to be mindful of the CJWG's admonition to avoid fuel policies that extend reliance on fossil fuel infrastructure or allow emissions from fuel combustion to continue to disproportionately impact Disadvantaged Communities.
Transportation	TCI (pp. 116, 257)	Oppose participation in the TCI program based on its position that such programs do not guarantee reductions at individual facilities, raising the potential for pollution hotspots. Some of those stakeholders recommend instead proposed legislation that would adopt an economy-wide carbon price.
Electricity	Explore Technology Solutions (p. 177)	The CJWG supports the near-term focus on achievement of 70x30 via deployment of currently available solutions. However, it expresses strong concern about the promotion of some emerging technologies, including green hydrogen, RNG, biofuels, biomass, and waste-to-energy, which it claims can add more GHGs to the environment rather than less, and also leads to more localized pollution which is concentrated in environmental justice communities. The CJWG highlights the need for further research and consideration of lifecycle GHG accounting and potential air quality and health impacts of these technologies prior to supporting demonstration projects.

Defining Assessment Criteria

Simplified Threshold Assessment Criteria (Yes/No)*	(More complex) Assessment Criteria	
Is this allowed by CLCPA?	Could this use assist with safety, reliability, resilience, and affordability?	
Does this use existing fossil fuel infrastructure? Does it require expansion of fossil fuel infrastructure?	Can this reduce emissions as we advance along the electrification trajectory?	Does using this fuel (in this application) provide more electric system capacity for the least-cost electrification applications?
Does this allow for the use of existing end-user appliances without modifications?	Does the potential scale make this worthwhile?	
Would this reduce GHG emissions from status quo? Would it be a meaningful reduction?	Will it be commercially available on the right timeframe?	
	What is the scale of the GHG emission reduction?	
Would this reduce co-pollutants from status-quo? Would it be a meaningful reduction?	Based in IA modelling, will this lead to the use of more fossil fuel than other future scenarios?	
	What is the scale of the co-pollutant reduction?	
Could this reduce the use of fossil fuels in DACs? Would it reduce emissions of GHGs and/or co-pollutants in DACs?	Is this a priority or preference for DACs or CJWG?	How can this be structured to assure the greatest potential for emissions reductions and co-pollutant reductions in DACs? Can it serve to prioritize emissions reductions (electrification) in DACs?
Does this address a challenging-to-electrify use? Or the need for ~10%	[illegible]	

Next Steps