Re: IE3.1

Evaluation of the Impact of Using Biodiesel and Renewable Diesel to Reduce Greenhouse Gas Emissions in City of Toronto's Fleet Vehicles

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Outline

- Context/Study scope
- Biodiesel and Renewable diesel
- Biobased diesel considerations
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  - Cold weather operability
  - Vehicle and infrastructure compatibility
  - Experience in other jurisdictions
  - Cost implications
  - Greenhouse gas (GHG)
  - Air quality impacts
- Final Recommendations

Context and Study Scope

- **Annually, City of Toronto Fleet Services and the TTC**
  - Use ~100 million L diesel fuel
  - Resulting in greenhouse gas (GHG) emissions of over 300,000 tonnes carbon dioxide equivalent (CO_2e)
  - ~4% of Toronto's transportation emissions
  - City vehicles currently using B5 (5% by volume biodiesel)

- Our aim:
  - **Identify and balance benefits versus risks of increased use of biobased diesel in the City's fleet vehicles**

Biodiesel and Hydrogenation Derived Renewable Diesel (HDRD)

- Same feedstocks (e.g., canola oil, soy oil, animal fats, used cooking oil) can be used for production of both types of fuels

Biodiesel

- Chemically different from petroleum diesel due to production process
- Moderate price premium over petroleum diesel

HDRD

- Chemically equivalent to petroleum diesel
- Higher price premium over petroleum diesel

Canadian General Standards Board Biodiesel (CGSB) Specifications

- **Most stringent biodiesel standards in the world**

- **Cloud point**
  - Ensures operability in cold weather

- **Water limit, particulate contamination limits and cold soak tests**
  - Protect against premature filter changes or vehicle damage

- **Oxidation stability test**
  - Ensures stability during fuel storage

Cold Weather Operability

- **Cloud point**:
  - Applies to all types of diesel fuel
  - Must be **lower** than ambient temperature

- Biodiesel generally has poorer low temperature properties than diesel (warmer cloud point); more difficult to meet cloud point specification in winter with higher level blends.
  - Our data suggests B5 acceptable year-round; temperature may limit B10 in winter
  - Soy and canola = Lower cloud point – easier to manage in winter
  - Tallow and yellow grease = Warmer cloud point – more frequently used in summer

- **Blended fuel must meet CGSB seasonal temperatures for cloud point for region of use**
  - Responsibility of the fuel provider

Biodiesel Infrastructure Compatibility & Fuel stability

- No infrastructure changes required
  - Delivered as blended fuel
  - Supplier manages cloud point

- Fuel turnover in storage tanks is sufficient given CGSB fuel stability standards

Biodiesel Vehicle Compatibility

Warranties

- Reviewed all Fleet Services and TTC vehicles, gensets and storage tanks
- Fleet Services: ~50% of vehicles warranted to B20 (primarily later model vehicles); remainder for B5
- TTC: approximately 80% of buses warranted up to B20; remainder for B5
  - Buses use 90% of diesel used by City
- No compatibility issues expected up to B20 even in absence of warranty

Conclusion

- We believe (backed by analysis of other jurisdictions) that biodiesel blends up to B20 can be used without engine issues or increased maintenance, provided biodiesel meets CGSB standards

Experience in Other Jurisdictions

- Biodiesel blends, from B4 – B20, have been successfully used in these other Ontario jurisdictions
  - Brampton
  - Guelph
  - Kingston
  - Kitchener/Waterloo
  - Mississauga
  - Oshawa
  - Ottawa
  - Thunder Bay
  - York Region

Fuel Cost Implications

- Historic wholesale biodiesel price in U.S. shows moderate premium over petroleum diesel

- In 2018, City of Toronto:
  - B5 cost same as petroleum diesel
  - B10 premium = 3 cents/L relative to petroleum diesel
  - B20 premium = 6 cents/L relative to petroleum diesel

- Based on available information, HDRD premium likely double the premium for biodiesel at same blend level

Greenhouse Gas Emissions Modeling

- Fuel supplier provides GHG (carbon) intensity value(s) to City based on Ontario Greener Diesel Regulation assumptions

- Typical life cycle GHG emissions reduction of **3.4-20%** (B5-B20) relative to petroleum diesel, and **3.5-16%** (B10-B20) relative to B5, depending on feedstock

- Example annual scenario (B5 winter, B10 spring/fall, B20 summer):
  - GHG reduction of **8-12%** relative to petroleum diesel, and **4-7%** relative to B5, depending on feedstock
  - Estimated reduction of ~30,000 - 40,000 tonnes CO_2e/y relative to petroleum diesel and ~15,000 - 25,000 tonnes CO_2e/y relative to B5

- HDRD – slightly higher GHG emissions (lesser reductions) than biodiesel at any given blend level

Air Quality Impacts: Literature Review

- Air quality likely to improve with biodiesel or HDRD
  - Larger benefits for older vehicles with less emission control technology
  - Greater impacts/benefits at higher blend levels

- Generally lower emissions of particulate matter, carbon monoxide and hydrocarbons

- Results for nitrogen oxides less consistent for biodiesel
  - Dependent on feedstock, engine and emission control technology

Final Recommendations

- Bio-based diesel expected to result in net benefits for air quality and GHG emissions
- From technical standpoint, City should be able to use B5 in winter, higher blends such as B10 in spring/fall, B20 in summer
  - Potential exception: Use in gensets dependent on fuel turnover
  - Expected annual premium of roughly $3 million/year for annual blends scenario
- Fuel should be delivered as blended fuel
- City should specify that:
  - Biodiesel meets CAN/CGSB-3.524;
  - B5 blends meet CAN/CGSB-3.520;
  - B10 or B20 blends meet CAN/CGSB-3.522 (including meeting cloud point specifications)

Thank you

Questions?