Biofuel Feasibility Study at an Eco-Industrial Park

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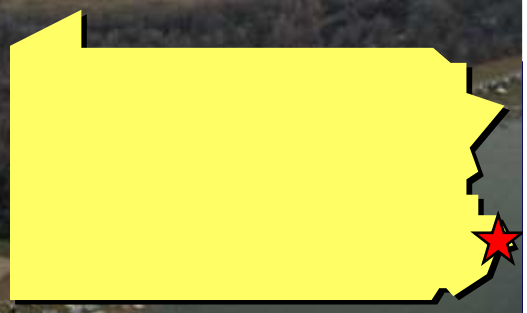
Outline

- Background on Keystone Industrial Port Complex (KIPC)
- Purpose of Study
- Methodology
  - Identify assumptions
  - Estimate fuel consumption
  - Calculate emissions (baseline & biodiesel blend)
- Next Steps

Keystone Industrial Port Complex

- 2,600-acre former steel mill operation
- RCRA cleanup in Region 3
- Developing as an eco-industrial park
- Working with EPA on sustainability issues



Purpose of the Study

- Algae-based biofuel manufacturer moving on-site…
- Industrial park with industrial vehicles…

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Purpose of the Study

WHAT IF….

There was an on-site biodiesel fueling station?

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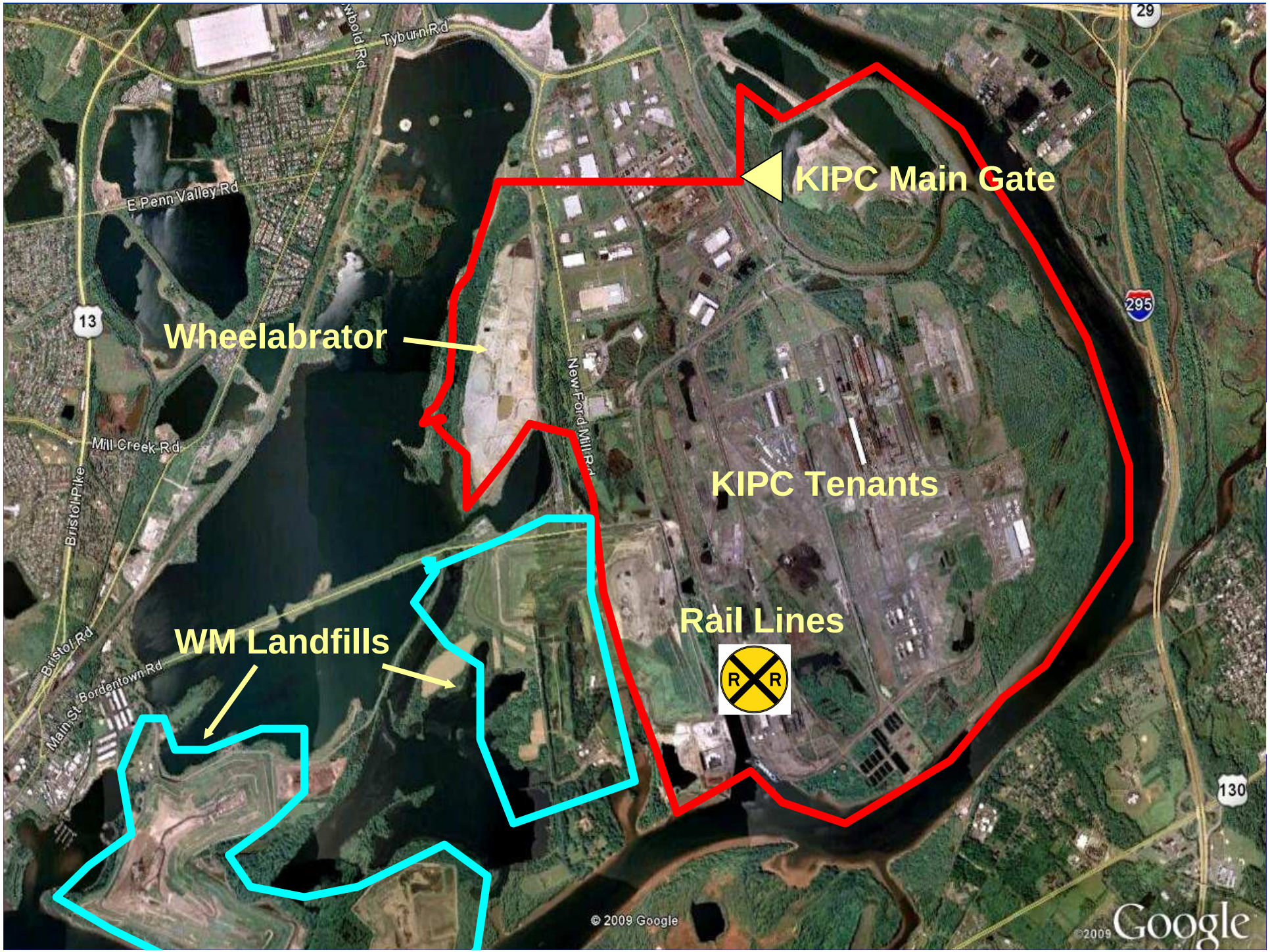
General Data Assumptions

- Only diesel vehicles are included in this analysis
- Study evaluates emissions at combustion stage, not full life cycle analysis
- At the consumption stage, makeup of algae-based biodiesel is similar to plant or soybean-based biodiesel (NREL 1998)

National Renewable Energy Laboratories. A Look Back at the U.S. Department of Energy's Aquatic Species Program: Biodiesel from Algae. NREL/TP-580-24190, 1998

Overview of Methodology

- Estimate fuel consumption
  - » 4 fleets
  - » vehicle types, distance traveled
  - » accessibility to site
- Calculate emissions
  - » baseline fuel
  - » biodiesel blend


KIPC Main Gate
Wheelabrator
KIPC Tenants
Rail Lines
WM Landfills
E Penn Valley Rd
Tyburn Rd
New Ford Mill Rd
Mill Creek Rd
Bristol Pike
Bristol Rd
Main St
Bordentown Rd
13
29
295
130
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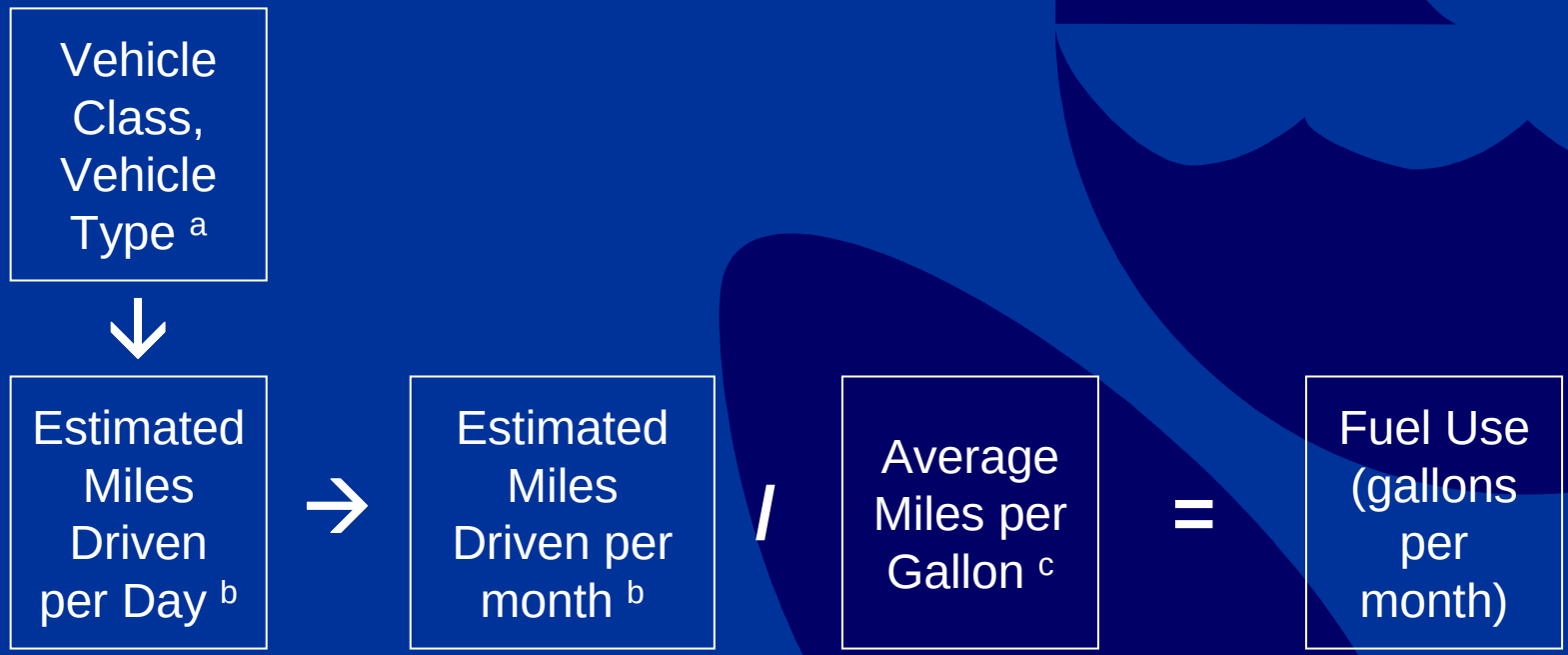
Current Status

- Total annual number of vehicles in analysis:
  - KIPC Gate Access 4,619
  - KIPC Tenants 2,120
  - Waste Management & Wheelabrator 1,948
  - Rail Fleet 2 locomotives

TOTAL = 8, 689 Vehicles

Total Fuel Consumption

Waste Management & Wheelabrator



a. Waste Management/Wheelabrator
b. Waste Management/Wheelabrator
c. Waste Management/Wheelabrator, 2002 Economic Census Vehicle Use Survey

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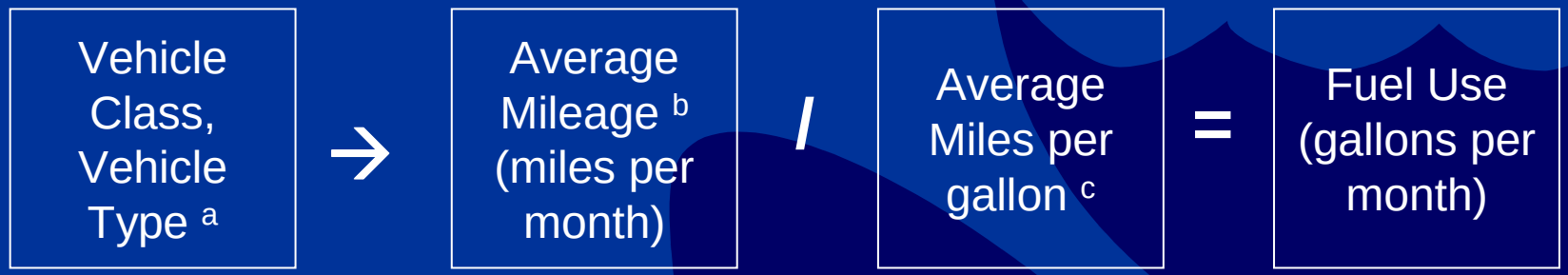
Total Fuel Consumption

KIPC Tenant Vehicles



a. KIPC, KIPC Tenants
b. 2002 Economic Census Vehicle Use Survey, U.S. Average
c. 2002 Economic Census Vehicle Use Survey

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Total Fuel Consumption

KIPC Gate Access Vehicles

Vehicle License Plate Number/State		VA HYW-3087	MD K98-KI00
Frequency of Visits to KIPC *Add number of trips and time period*		2	10
		Per week (Per month)	(Per week) Per month
Average Fuel Use per Week *Gallons*		100	45
Distance from Trip Origin to KIPC *Miles, one-way*		60	10
Passenger Car (diesel)			
Class 1-4 Truck/ Van < 16,000 lbs			
Class 5 Truck 16,000-19,500 lbs			X
Class 6 Truck 19,501-26,000 lbs			
Class 7 Truck 26,001-33,000 lbs			
Class 8a Truck 33,001-60,000 lbs		Short Haul (Long Haul)	Short Haul Long Haul

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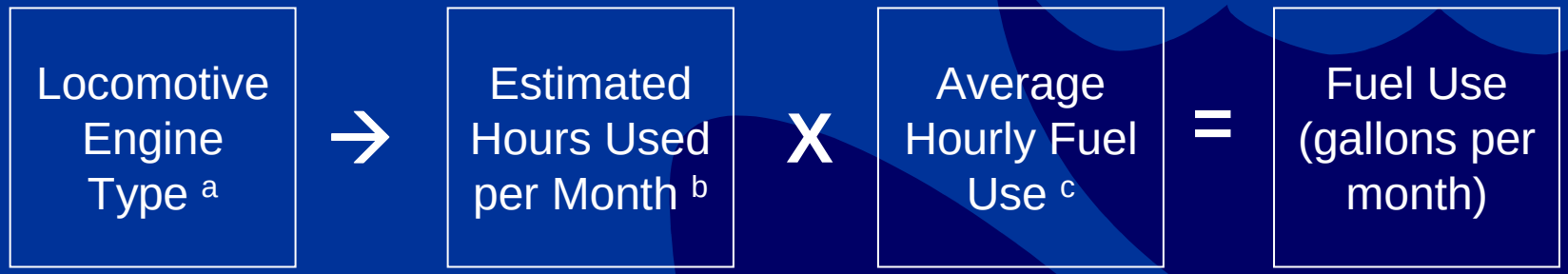
Total Fuel Consumption

Rail



a. KIPC, USS, Kinder Morgan
b. KIPC, USS Galvanized, Kinder Morgan, EPA OTAQ MOBILE6 Nonroad Model
c. EPA OTAQ MOBILE6 Nonroad Model

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How Much Fuel Can be Replaced by Biodiesel Acquired at KIPC?

Function of how often vehicles access the site

- 100% of fuel → at KIPC daily or weekly
  - **KIPC Tenant Vehicles**
  - **Waste Management and Wheelabrator**
  - **Rail**

- <100% of fuel → visit KIPC less frequently
  - **KIPC Gate Access Vehicles**

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KIPC Gate Access Vehicles

What portion of fuel can be replaced?

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Current Status

- Total annual diesel fuel consumption:
  - KIPC Gate Access — 11.1 mil gal/year
  - KIPC Tenants — 16.7 million gallons
  - Waste Management & Wheelabrator — 20.1 million gallons
  - Rail Fleet — 0.7 million gallons

TOTAL = ~49 Million gallons per year

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Establishing Baseline Emissions

- In Pennsylvania:
  - Ultra Low-Sulfur Diesel (ULSD S15)
  - Minimum 2% biodiesel blend in 2010

→ **Baseline fuel = B2**
2% soybean/plant biodiesel
98% ultra-low sulfur diesel

EPA OTAQ MOBILE6 Model: http://www.epa.gov/OMS/m6.htm; NREL GREET 1.6 Developed by Argonne National Laboratory; Clean Diesel Fuel Alliance ULSD Implementation Schedule for Highway Diesel http://www.clean-diesel.org

Emissions Considered

- EPA Office of Transportation and Air Quality (OTAQ) vehicle emissions data used to estimate emissions per gallon of fuel combusted

- Two categories of emission impacts:
  - Air quality impacts: HCs, CO, NO_x, PM
  - Greenhouse gas (GHG) impacts: CO_2, CH_4

- Not considered: SO_x , Nitrous Oxide

EPA OTAQ MOBILE6 Vehicle Emissions Model; EPA Office of Air and Radiation Diesel Emissions Draft Estimated Impacts, 2008; EPA Comprehensive Analysis of Biodiesel Emissions Impacts, 2002; Sze et al, 2007. Impact of Test Cycle and Biodiesel Concentration on Emissions

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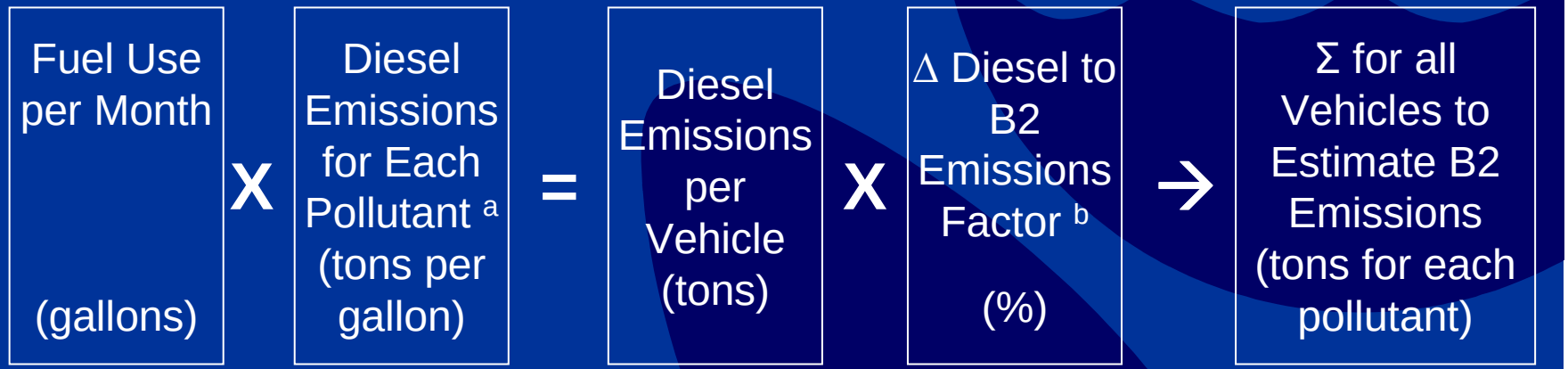
Calculating B2 Emissions

- For each vehicle type:



a. EPA OTAQ MOBILE6 Model
b: EPA Office of Air and Radiation Diesel Emissions Draft Estimated Impacts, 2008

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Emissions Using Biodiesel Blend

→**Biofuel blend = B20**

- Majority of emissions studies use B20
- Additional retrofitting costs with >B20
  - —Replacement of fuel line components
  - —Potential to void manufacturers' warranty

Effect of Biodiesel on Fuel Economy

- Fuel economy ↓ slightly as biodiesel blend ↑
- B20 vs. B2 – on average 1.8% lower fuel economy

Fuel Use per Month (gallons)	X	Diesel Emissions for Each Pollutant [a] (tons per gallon)

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Sze et al, 2007. Impact of Test Cycle and Biodiesel Concentration on Emissions

Accepted Emission Impact of Biodiesel Blends *(not our results)*

Reduce:

- Particulate matter (PM) - 7%
- Carbon monoxide (CO) - 8%
- Hydrocarbons (HC) - 12%
- Methane (CH_4) - 12%
- Carbon dioxide (CO_2) - not significant

Increase:

- Nitrogen Oxide (NOx) - 2%
- Fuel Use - 1.8%

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EPA Office of Air and Radiation Diesel Emissions Draft Estimated Impacts, 2008; EPA Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance Direct Emissions from Mobile Combustion Sources, 2008.

Next Steps

- Cost analysis
- Algae based biofuel specific emission impacts
- Life cycle analysis
- Provide data to KIPC & local community

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Acknowledgments

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- SRA for providing contractor support
- KIPC for conducting the vehicle assessment
- Waste Management and KIPC for providing vehicle data

Thank you