Response to Request for Information Regarding the Volkswagen Consent Decree Environmental Mitigation Trust Project Ideas

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Summary of Proposed Concepts to be Incorporated into the Mitigation Plan

The following is a summary of Blue Gas Marine's (BGM) response to the Request for Information (RFI) regarding the VW Consent Decree (VW Settlement) Environmental Mitigation Trust Project Ideas. BGM proposes the following concepts be integrated into the final plan:

- Priority should be given as follows:
    1) What projects will reduce the most emissions for the money. This "Bang for the Buck" approach should ensure that the projects that can most efficiently achieve the goals of the settlement will get funded.
    2) Cost-efficient projects that benefit taxpayers by providing savings in state operating costs.
    3) Projects in non-attainment areas as a way of addressing the most pressing emissions issues.

- Due to the fact that marine vessels account for a disproportionately large percentage of emissions, marine applications should be as broadly eligible as possible for VW Settlement:
    - Marine vessel can burn more than 10x the amount of fuel per mile as even large trucks;
    - Marine vessels, especially commercial diesels, emit much larger quantities of pollutants per gallon burned than on road, due to less stringent mitigation requirements, the burning of dirty diesel and gasoline fuel blends and the average age of marine engines (especially diesel) vs. on-road engines.

- Infrastructure to be eligible to receive funding.
    - The availability of Compressed Natural Gas and electricity will be critical to adoption of natural gas as an on-water fuel and electric vehicles (EV).
    - As with EV charging stations, available on-water natural gas stations will increase awareness and demand for natural gas fueling systems, creating a "snowball" effect that will help to further reduce emissions because of the cost savings of natural gas vs. liquid fuels
    - It will grow the overall availability of natural gas, benefiting local natural gas utilities, increasing the overall availability of natural gas to all industries.

- It should be ensured that retro-fitting of existing engines, as well as new build or repowers, is eligible for funding. Having said that, where it states in Appendix D-2 to the Partial Consent Decree in paragraph 4(c) *"Eligible Ferries and/or Tugs may be Repowered with any new Tier 3 or Tier 4 diesel or Alternate Fueled engines, or with All-Electric engines, or may be upgraded with an EPA Certified Remanufacture System or an EPA Verified Engine Upgrade.",* BGM believes "*upgraded*" includes retrofitting of existing engine. This is the most economical way of installing natural gas fueling and it would not make sense for it to be deemed ineligible due merely to wording in the drafting of the legislation.

- Should require that the new technologies reduce emissions, instead of bringing vessels up to Tier 4 status.

    - Marine engines have a long operating life. If they had to be brought up to Tier 4 status, fewer would be up-fitted to improve emissions and thus these long-lived assets will remain in operations as higher polluting engines.
    - If the focus is on the cost-efficiency of emissions reduction when evaluating the proposals, this should not be an issue.
- The requirement of EPA certification should be prior to distribution of funds and not prior to the award.
    - Marine engines are far more varied than on road engines, and thus, seeking out EPA certification for engine modification technologies generally only happens once an order is received, and the engine type has been identified. To require this to prior to just the award being made, vs. prior to actual distribution of funds, would place a significant burden on the makers of add-on engine technologies.
        - As an example, to perform EPA certification testing will require not only the cost of the testing, but the acquisition of an engine. All in this could be upwards of $250,000 before even knowing if the buyer was going to be able to purchase it. Considering some operators can have 4-5 or more different types of engines in their fleet, in order to propose a project to up-fit the engines on an entire fleet, the add-on equipment manufacturer could incur over $1 million in costs.
    - If the technology had to be EPA approved prior to awarding of the funds, it would likely result in the only option being the installation of new engines that are EPA approved. Engine manufacturers don't have the same issue, due to the fact they only need to go through EPA approval one time and they know they will have to do this before any sales are made. This would be at a huge additional cost vs the addon technologies. As an example, a new dedicated natural gas engine for a large tug could be as much as $4-5 million.

Summary of Natural Gas as a Marine Fuel

When compared with on-road vehicles, marine vessels are extremely large consumers of fuel. A typical recreational boat may get 1-2 miles per gallon, while large work boats and tugs can burn through hundreds of gallons an hour. Emissions requirements for boats are also not as stringent as on-road, resulting in significantly more emissions per mile traveled as on-road. In addition, some vessels, such as commercial tugs, burn a low grade dirtier form of diesel, which results in even more emissions per gallon consumed than on-road diesel trucks.

As such, finding a solution to reduce or eliminate emissions from marine vessels would have an outsized benefit to the environment and operating costs, when compared with typical on-road vehicles. Natural gas as a fuel represents an excellent solution to this problem for the following reasons:

- Replacing diesel commercial marine vessels with natural gas offer the yearly emissions reduction benefit of replacing 275x buses and/or trucks with all electric vehicles at less than 0.5% of the cost.
- Burning natural gas can reduce fuel costs per mile by as much as 70%, and reduce emissions by as much as 90% vs. conventional marine fuels.
- Natural gas can reduce the maintenance costs and downtime for operators because it is cleaner burning and, therefore, results in less carbon deposits in the engine.

There are also a number of reasons the marine environment is very well suited to take advantage of natural gas as a fuel:

1) frequently more systems are being run than just the propulsion system (e.g., larger boats often have critical onboard generators, which can run on natural gas);

2) boats use and take on much more fuel at a time, unlike on-road;

3) there are far fewer refueling locations to retrofit with natural gas due to vast majority of boats exhibit "fleet" behavior, characterized as departing and returning to the same location each night, as well as refueling at the same location;

5) boat construction often allows for excess storage space to store natural gas, which is less energy dense than liquid fuels; and

6) unlike on-road vehicles, converting to electricity is not an option due to the much greater loads placed on marine engines vs. on-road.

Emissions

The following table illustrates the emission differences between all cars and all boats (gasoline and diesel), total and on a per unit basis.

Table 1.

YE 2005	Marine Vessels*	HWY Vehicles*	
	Tons / yr	Tons / yr	
NOx	2,821,352	6,491,821	
CO	3,007,285	48,544,438	
PM	387,637	329,342	
VOC	990,625	4,112,147	
Registered	12,951,621	247,421,120	
	Tons / year per boat	**Tons / year per vehicle**	**% Difference**
NOx	0.2178	0.0262	730%
CO	0.2322	0.1962	18%
PM	0.0299	0.0254	18%
VOC	0.0765	0.3175	-76%

* Based on review of National Emissions Inventory provided by the EPA (ftp.epa.gov/pub/EmisInventory/nei_criteria_summaries/2005summaryfiles/) and Bureau of Transportation statistics (rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/html/table_01_11.html)

Due to the quantity of fuel and the reduced emissions mitigation requirements of boats vs. on-road vehicles, boats emit significantly greater quantities of pollutants per unit. This is even more true of work boats, especially diesel.

Overview of BGM

BGM has developed an end-to-end solution for fueling, storing and combusting natural gas for marine engines. The technology uses the latest supply and storage technology to minimize the space, as well as BGM's proprietary computerized combustion management system that ensures efficient combustion, even with multiple engines. The result is a technology that:

- Allows a boat owner to burn cheaper domestically-sourced natural gas;
- Increases the miles per gallon equivalent by up to 40% due to improved combustion efficiency;
- Reduces emissions by up to 90% vs conventional fuels;
- Dramatically reduces emission exposure for vessel passengers and workers, which are exposed to very elevated levels of pollutants given their proximity to the emissions source.
- Reduces engine wear;
- Can be installed on existing engines without major engine modifications;
- Reduces engine noise; and
- Allows for hybrid optionality, allowing the operator to burn natural gas, liquid fuels, or both, eliminating concerns about fuel availability.

The BGM technology can economically be installed in a new boat under construction, or in an existing boat as a retrofit. In the case of a hybrid solution, BGM works with the end-user to determine the usage patterns and refueling availability. This allows BGM to design a solution that can meet 99% of the users' needs, without having to duplicate the fuel storage capacity, thereby reducing cost and storage needs.

Because of the per unit emissions impact of boats vs. on-road vehicles, the BGM system is able to generate a very compelling cost of emission reduction. When compared with, for example, an electric bus, replacing gasoline or diesel/MGO with natural gas is clearly a better use of capital. The following table illustrates the cost of emission reduction for natural gas vs. electric, using the BGM system on commercial harbor tug boats.

Table 2.

Pollutant	Gasoline to BGM CNG	Diesel/MGO to BGM CNG	Diesel Bus to EV Bus
NOx	**$17/lb reduced**	**$15/lb reduced**	**$4,209/lb reduced**
PM		**$106/lb reduced**	**$252,994/lb reduced**
CO	**$2/lb reduced**		**$5,126/lb reduced**

To illustrate the table in another way, taking the Diesel/MGO example, in order to generate the NOx emissions reduction on one harbor tug using the BGM system, you would need to replace 275 city buses with all-electric bus at a cost of $82.5 million vs. $0.35 million for the tug. To generate the same PM emissions reduction, you would need to replace 2,339 city buses with all-electric bus at a cost of $716.6 million!

Conclusion

BGM encourages the inclusion of the proposed suggestion to the Mitigation Plan, which will facilitate the adoption of natural gas as a marine fuel. Not only does natural gas present the greatest "bang for its buck" from an emissions reduction standpoint, but natural gas in the marine environment also accomplishes the following:

- Is applicable to gasoline and diesel boats;
- Is the only real alternative fuel solution, as electric is not able to provide the horsepower needed;
- Lowers operating costs through reduce per gallon fuel costs, greater efficiency and reduced downtime and maintenance costs;
- Facilitates the adoption of natural gas by other private and recreational boat operators, further reducing emissions;
- Can have an immediate and significant impact on state-owned boats, benefiting all taxpayers;
- Impacts highly populated areas with greater emissions problems on average.