HYDRAGEN™ REEFER TESTING 2017

dynaCERT Inc.

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Table of Contents

Table of Figures

Table of Tables

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Executive Summary

With the support of Loblaw Cos, dynaCERT conducted testing of its proprietary carbon emission reduction technology. The plan is to develop a new *HydraGEN™* unit specifically sized to be used on smaller diesel engines with a focus on the refrigerated trailer (Reefer) market.

The testing was conducted to evaluate the use of *HydraGEN™* Technology to reduce carbon emissions and improve fuel economy of a diesel–powered reefer trailer that is used to haul perishable goods in a cold climate environment. These trailers are used around the world in both truck-hauled units and container units moved by large ocean-going ships.

A summary of the most significant findings can be found in Table 1 below. Please note that the temperatures were recorded per the trailer control system in Fahrenheit degrees.

Three months of testing and data collection were performed to date on a reefer trailer as provided by Loblaw Cos. This trailer was equipped with a Thermo-King 4-cylinder, 2.1L engine operating an air conditioning chiller system. The engine controller had two operational levels, a low speed to maintain the set temperature and a high speed to reach the set temperature. Engine properties can be found in Table 2 below. The test location was the outdoor parking lot at 501 Alliance Avenue Toronto ON Canada with uncontrolled environmental conditions that ranged from low temperatures and rain to cloudless sky and high temperatures.

As the engine operated in the different climatic conditions and for different operating set points, the changes to the fuel consumption, reefer temperature, and exhaust properties: temperature, excess air, burn efficiency and losses, and gas composition (oxygen, carbon dioxide, carbon monoxide, nitric oxide, nitrous oxide, total NOx, and sulphur dioxide content) were monitored on an hourly basis for 8hr periods per day.

Table 1: Summary of average and maximum savings calculated for each phase and separate set of conditions.

Conditions	Property	Trial Max Savings	Trial Average Savings
Phase 1.1 Set Temp 32°F 15A current Doors closed	Fuel Consumption	28%	26%
	Carbon Dioxide (CO2)	49%	44%
	Carbon Monoxide (CO)	55%	51%
	NOx	35%	30%
Phase 1.2 Set Temp 0°F 15A current Doors closed	Fuel Consumption	15%	13%
	Carbon Dioxide (CO2)	31%	24%
	Carbon Monoxide (CO)	45%	41%
	NOx	14%	11%
Phase 1.3 Set Temp -15°F 15A current Doors closed	Fuel Consumption	17%	13%
	Carbon Dioxide (CO2)	34%	24%
	Carbon Monoxide (CO)	36%	29%
	NOx	22%	12%
Phase 2.1 Set Temp 0°F 15A current Doors open	Fuel Consumption	17%	16%

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Test Plan

1.1 Purpose

- To determine the impact of the *HydraGEN™* unit producing approximately 2 L/min of H2/O2 gas on fuel consumption and economy, as well as exhaust properties including temperature, diesel burn efficiency, and carbon dioxide, carbon monoxide, nitric oxide, and nitrous oxide exhaust content.
- To determine the extent of engine cleaning because of *HydraGEN™* usage.
- To determine the effect of changing the operating current and gas output of the *HydraGEN™* unit.
- To verify that the design will meet the operational requirements for a reefer engine.
- To improve the design, performance, and understanding of the *HydraGEN™* units and applications.

Table 2: Reefer engine properties.

Engine Property	Value
Manufacturer	Ingersoll Rand – Yanmar
Family	8Y7XL209K4N
Model	TK 486V
Displacement	2.091L
Fuel Rate	27.2 mm^3/stroke at 253kW/2200 rpm
Year	2004
Engine operating setting	High Speed, Low speed
Engine automatic set temperatures	32F, 0F, -15F

1.2 Test Plan Summary

To verify and gauge any performance changes made by the *HydraGEN™* system, a baseline of the reefer units' (RU) normal operation will need to be established. For the baseline and operational performance, testing will monitor the fuel consumption, reefer temperature, and exhaust properties: temperature, excess air, burn efficiency and losses, and gas composition (oxygen, carbon dioxide, carbon monoxide, nitric oxide, nitrous oxide, total NOx, and sulphur dioxide content).

Figure 1: Reefer testing set-up, with reefer unit, trailer, HydraGEN™ *unit, ladder, and ECOM emissions analyzer.*

Figure 2: Rear doors of reefer trailer with reefer temperature sensor indicated in red.

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The test will consist of 2 phases. Phase 1 takes place with the doors of the trailer closed, ensuring that the reefer can reach and maintain the set temperature; the first hour of testing was allotted for this. Trials were conducted at three different set point temperatures: 32, 0 and -15°F, repeated three times at each condition to ensure consistency of results. Trials were also conducted at different *HydraGEN™* unit current set points. Data was collected each day at once per hour or eight readings per trial. A baseline performance was established by running the reefer for three complete trials at each temperature set point without a *HydraGEN™* unit attached. To ensure accurate results, all baseline data must be collected on a 'dirty engine' before the unit is installed. Table 3 below summarizes all scheduled trial condition.

Table 3: Phase 1 testing plan – doors closed. Each trial was repeated three times.

Set Temperature (°F)	*HydraGEN™* Maximum Current (A)	
	0A – no unit (baseline)	15A
32°F	3 baseline trials at 32F	3 trials at 32F, 15A
0°F	3 baseline trials at 0F	3 trials at 0F, 15A
-15°F	3 baseline trials at -15F	3 trials at -15F, 15A

Phase 2 takes place with the trailer doors open; this prevents the reefer temperature from reaching the set point and keeps it running at maximum load (high speed) throughout the trial. It will be performed at 0°F, first for 3 trials without the *HydraGEN™* unit (baseline), then 3 trials each at 15A and 12A.

Figure 3: Rear view of reefer trailer, doors open (as in Phase 2 trials).

Performance changes will be determined by comparing the baseline data over against the test data. This testing is to prove that the *HydraGEN™* system can be applied in a steady state mode to improve the performance of a diesel engine that is also operating in a steady state mode.

1.2.1 Replication of Results

To reduce external variables and ensure that the improvement in engine performance is a direct result of the *HydraGEN™* unit, the unit was removed once a completed set of results had been acquired (over four or five full days for each trial). The reefer trailer engine was then run for several days until fuel consumption and emissions levels returned to baseline. The *HydraGEN™* unit was then reinstalled, and the trials were repeated. It was found that the engine performance again improved with time, reaching the levels of the initial trials in 3-5 days.

1.3 Equipment

- Trailer with Reefer unit (RU) and internal thermocouple
- *HydraGEN™* system
- Mass Flow Meter
- Ladder
- Workbench
- Multi-meter
- Weight Scale
- ECOM Emissions Analyzer (Figure 4)

Figure 4: ECOM Emissions Analyzer

1.4 Milestones

- Test preparations to the trailer complete (isolate fuel system for measuring)
- Phase 1 baseline complete
- Phase 2 baseline complete
- Phase 1 testing complete
- Phase 2 testing complete
- Trailer ready for normal operation (fuel tank re-filled and re-secured)
- Data analysis performed on results

1.5 Procedure

1. Set up testing and fuel weighing equipment. Record initial fuel weight.
2. Set up *HydraGEN™* unit, unless performing a baseline test.
3. Turn on reefer. Set desired temperature. If performing a Phase 2 test, open the trailer door.

4. Perform an emissions analysis. Record emissions data and reefer temperature.
5. Record emissions data, fuel weight, and reefer temperature each hour for a total of 7 hours (8 readings).
6. After 8 readings over 7 hours, turn off reefer engine.
7. Put away all equipment.

1.6 Expected Results

The expected results are a reduction of carbon emission of 10% and a fuel savings of at least 5% for the reefer unit's general operation from day to day. The results are to show an improvement in the fuel efficiency of the reefer when the trailer temp is being maintained below the ambient temperature outside. Phase 1 and 2 results will be from an equilibrium (as best possible) environment and will reflect the bulk of the RU's operational life cycle, either at steady state or maintained at full load.

1.7 Costs

- Diesel Fuel - $1,000
- Weight Scale - $200
- Worker Wages - $10,000
- Gas tanks - $200
- Trailer Rental – N/A

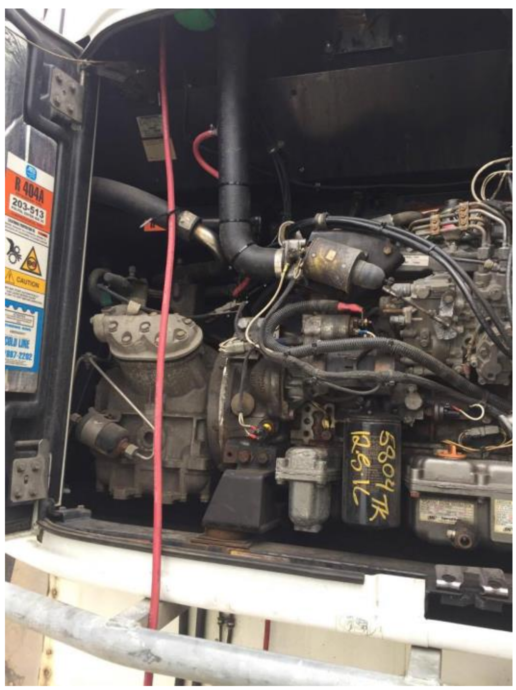

Figure 5: Reefer unit engine exposed with HydraGEN™ *unit connection hose (gas inlet to engine) visible.*

Results

The following results provide an analysis and discussion of the results of each phase of testing. The change in engine performance from baseline is quantified by the following factors: fuel consumption, reefer temperature, and exhaust properties: temperature, excess air, burn efficiency and losses, and gas composition (oxygen, carbon dioxide, carbon monoxide, nitric oxide, nitrous oxide, total NOx, and sulphur dioxide content). The most significant findings are documented in the following sections. It should also be noted that the ambient temperature on each day of testing is included as this has a **direct impact** on the engine load.

Figure 6: Open-door view of reefer engine with HydraGEN™ *unit connection hose.*

1.8 Phase 1 Test Results: Steady State

Phase 1 tests the engine performance at steady state with and without the *HydraGEN™* unit. By keeping the trailer doors closed, the engine can reach steady state at the set temperature, at which point the engine load is reduced and engine load reduces.

Each of the Phase 1 trials were compared to a baseline test performed at 32°F with no *HydraGEN™* unit attached and the doors closed. Ambient temperature on the day of the baseline was 23°C with a high of 26°C.

1.8.1 32°F Set point

Removal of the *HydraGEN™* unit and consistency of results

In order to verify the consistency of results, the *HydraGEN™* was removed after day 4 and the reefer was run sans unit until emissions and fuel consumption values returned to the baseline. Then, the unit was reinstalled on day 5. Over days 5-9, the levels gradually decreased to duplicate the excellent results seen on days 1-4. This further corroborate the beneficial results of *HydraGEN™* technology.

Table 4 below summarizes ambient temperature on each test day.

Table 4: Ambient maximum, minimum, and mean temperature on each day of Phase 1 testing at 32F.

Test Day	Temperature High (°C)	Temperature Low (°C)	Temperature Average (°C)
Baseline	26	20	23
Day 1	23	21	23
Day 2	20	11	17
Day 3	22	11	16
Day 4	21	10	16
Day 5	27	20	24
Day 6	27	20	24
Day 7	28	17	22
Day 8	18	13	16
Day 9	19	11	15

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Fuel Consumption

Improved fuel economy means significant financial savings and a better return on investment for the *HydraGEN™.*

Figure 7 below shows the plot of the fuel consumption (measured in fuel lb/hr) over time. The black line represents the baseline values. On average, throughout the course of the trials fuel consumption was reduced by **25%**. The highest fuel consumption savings were seen on day 2, which showed 28% average savings. The lowest savings were seen on days 1, 4 and 9, at 22% savings from baseline as would be expected with a low ambient temperature (see Table 4). It is clear from the graph that *HydraGEN™* stabilizes the engine operation and resulting readings. Days 5-7 show a high fuel consumption close to that of baseline, but days 8-9 return to the levels seen on days 1 through 4. This suggests that *HydraGEN™* technology may help to clean out the engine and improves fuel consumption over time.

These are significant savings.

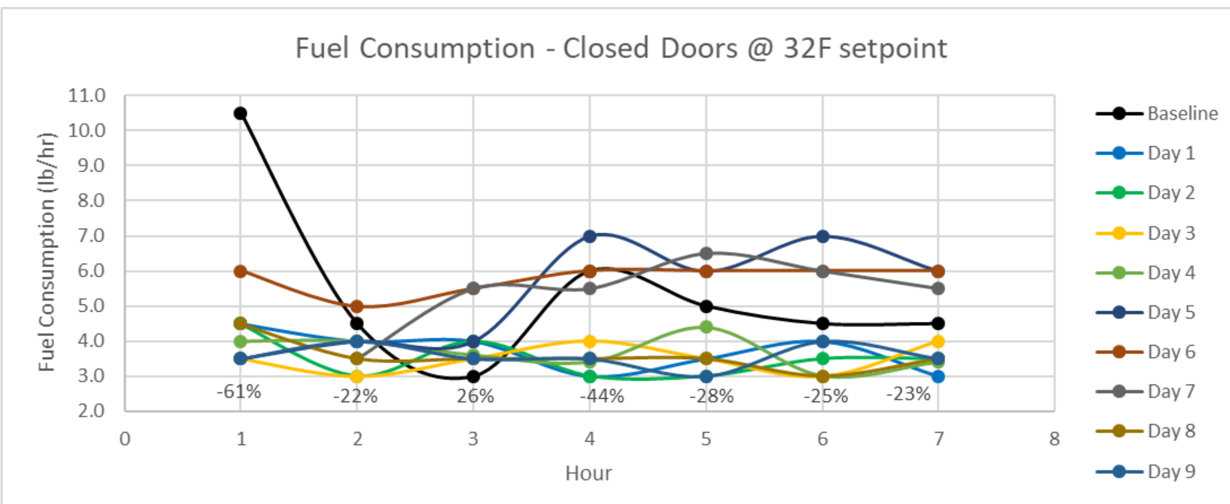

Figure 7: Fuel Consumption (pounds per hour) over time for nine Phase 1 trials at 32F, compared to the baseline data (black) It should be noted that after day 4, the HydraGEN™ *unit was removed until fuel consumption levels returned to the baseline levels. It was reinstalled on day 5, and by days 8 and 9, levels returned to the previous low levels seen on days 1-4. Average percent change from baseline is shown labelled in percentages.*

Carbon Dioxide (CO2) Emissions

Reducing CO2 emissions is part of reducing air pollution and environmental impact which is a priority for most governments and employers.

Figure 8 below shows the plot of the fraction of CO2 (g/hr) in the exhaust over time. The black line represents the baseline values (without the *HydraGEN™* unit). This is a representation of the total mass of carbon dioxide emitted in the exhaust over time (g/hr).

On average, throughout the course of the trials the carbon dioxide content of the exhaust was reduced by **44%**. The highest CO2 reduction was seen on day 3, which showed 49% average savings. The lowest savings were seen on day 1, at 39% savings from baseline. Days 5-7 show high levels of CO2 emissions close to those of baseline as expected after several weeks without the *HydraGEN™* unit, but days 8-9 return to the levels seen on days 1 through 4. This suggests that *HydraGEN™* Technology helps to clean out carbon deposits from the engine and decrease emissions over time.

These are significant savings.

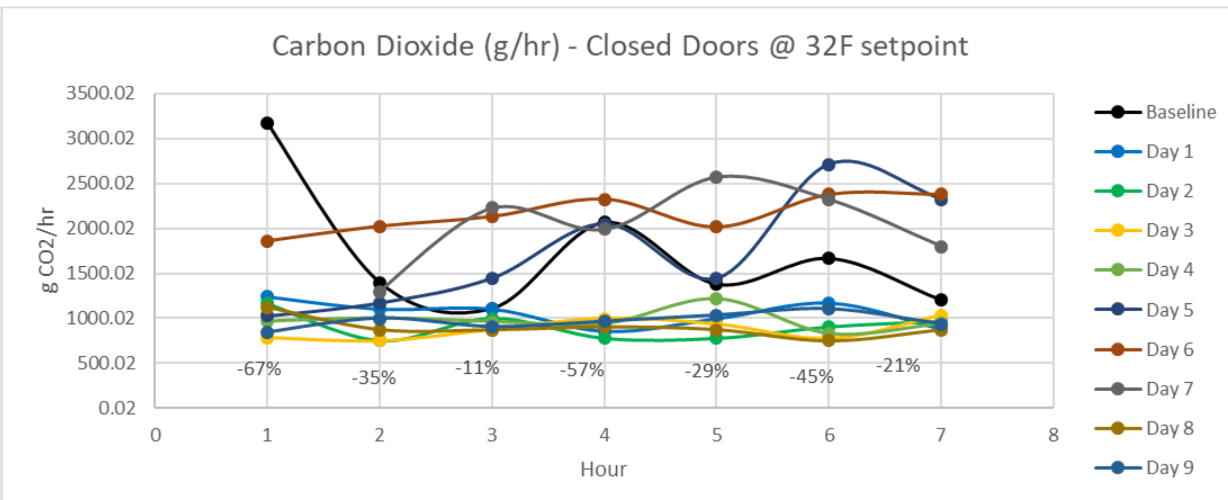

Figure 8: CO2 Emissions (grams per hour) over time for nine Phase 1 trials at 32F, compared to the baseline data (black). After day 4, the HydraGEN™ *unit was removed until emissions levels returned to the baseline. It was reinstalled on day 5, and by days 8 and 9, emissions returned to the previous low levels seen on days 1-4. Average percent change from baseline is shown labelled in percentages.*

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Carbon Monoxide (CO) Emissions

Reducing CO emissions is part of reducing air pollution and environmental impact, a priority for most governments and employers.

Figure 9 below shows the plot of the fraction of CO (g/hr) in the exhaust over time. The black line represents the baseline values. This is a representation of the total mass of carbon monoxide emitted in the exhaust over time.

On average, throughout the course of the nine trials the carbon monoxide content of the exhaust was reduced by **51%.** The highest CO reduction was seen on day 3, at 55% average savings. The lowest savings were seen on day 8, at 43% savings from baseline both days. Days 5-7 show high levels of CO2 emissions close to those of baseline as expected after several weeks without the *HydraGEN™* unit, but days 8-9 return to the levels seen on days 1 through 4, which suggests that *HydraGEN™* may help to clean out carbon deposits from the engine and decrease emissions over time.

These are significant savings.

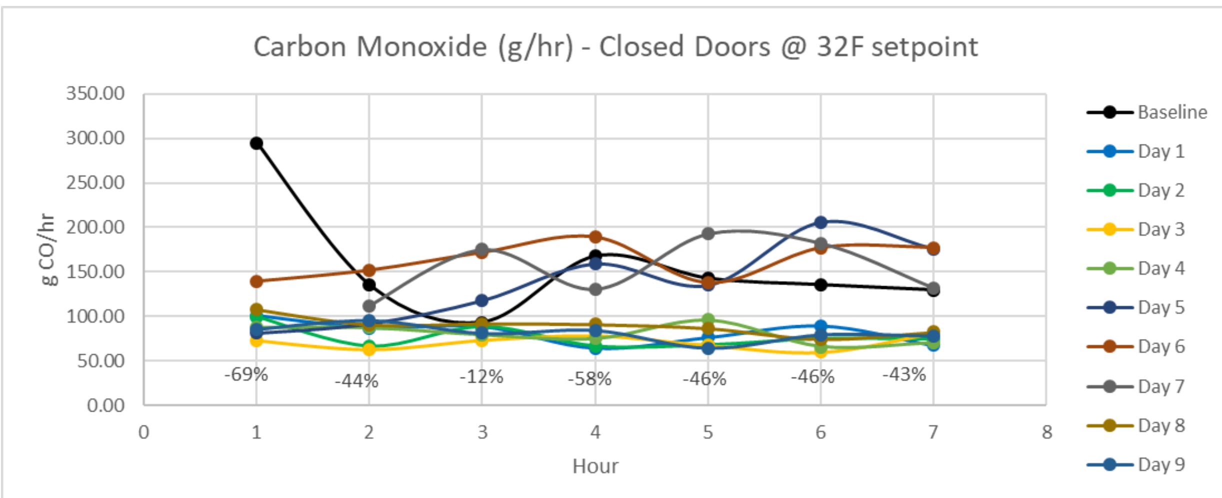

Figure 9: CO Emissions (grams per hour) over time for nine Phase 1 trials at 32F, compared to the baseline data (black). After day 4, the HydraGEN™ unit was removed until emissions levels returned to the baseline. It was reinstalled on day 5, and by days 8 and 9, emissions returned to the previous low levels seen on days 1-4. Average percent change from baseline is shown labelled in percentages.

NOx Emissions

NOx refers to a group of nitrogen oxides that contribute significantly to air pollution and depletion of the ozone layer. Reducing NOx emissions is a high priority for most governments and employers for these reasons.

Figure 10 below shows the plot of the mass of NOx emissions over time. The black line represents the baseline values. This is a representation of the total mass of NOx gases emitted in the exhaust over time (g/hr).

On average, the *HydraGEN™* reduced NOx emissions by **30%**. The highest reduction was seen on day 2, at 35% average savings. The lowest savings were seen on days 1 and 4, at 26% savings from baseline. Days 5-7 show high levels of CO2 emissions close to those of baseline as expected after several weeks without the *HydraGEN™* unit, but days 8-9 return to the levels seen on days 1 through 4, which suggests that *HydraGEN™* may help to decrease emissions over time.

These are significant savings.

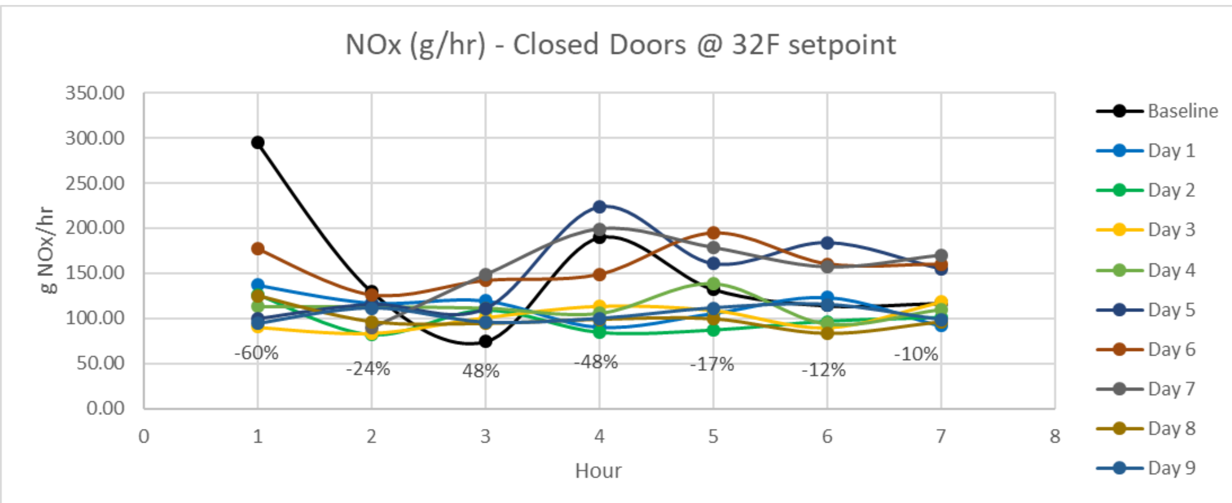

Figure 10: NOx Emissions (grams per hour) over time for nine Phase 1 trials at 32F, compared to the baseline data (black). After day 4, the HydraGEN™ unit was removed until emissions levels returned to the baseline. It was reinstalled on day 5, and by days 8 and 9, emissions returned to the previous low levels seen on days 1-4. Average percent change from baseline is shown labelled in percentages.

1.8.2 0°F Set point

The table below summarizes ambient temperature on each test day.

Test Day	Temperature High (°C)	Temperature Low (°C)	Temperature Average (°C)
Baseline	26	20	23
Day 1	23	16	20
Day 2	17	8	14
Day 3	21	14	16
Day 4	19	10	14
Day 5	18	11	14

Fuel Consumption

Improved fuel economy means significant financial savings and a better return on investment for the *HydraGEN™.*

Figure 11 below shows the plot of the fuel consumption (measured in lb/hr) over time. The black line represents the baseline values.

On average, the *HydraGEN™* reduced fuel consumption by **13%.** The highest fuel consumption savings were seen on day 2, which showed 15% average savings. The lowest savings were seen on day 3, at 11% savings from baseline. It is clear from the graph that *HydraGEN™* results in a more regular, constant fuel consumption.

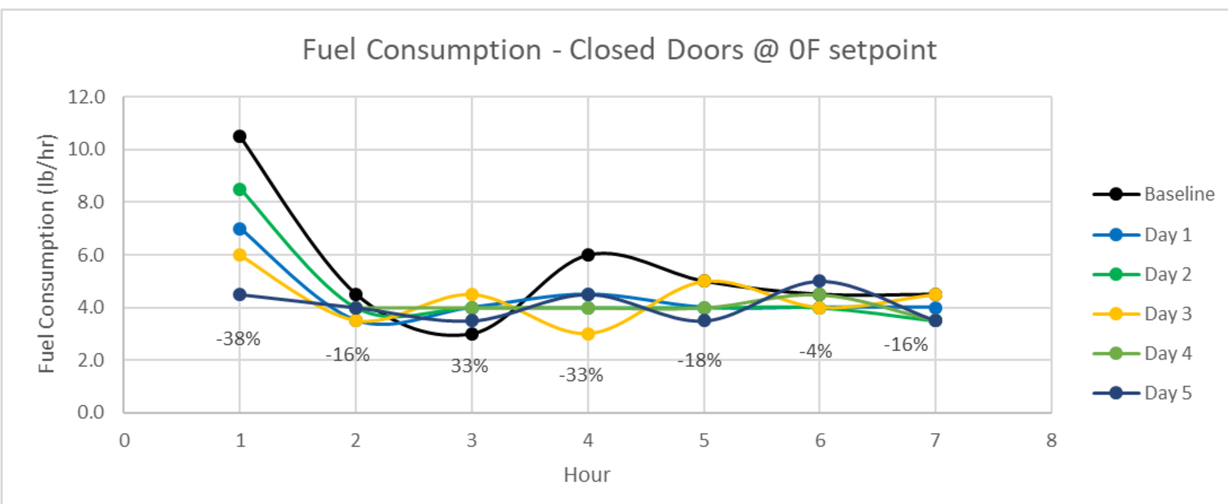

Figure 11: Fuel Consumption (pounds per hour) over time for five Phase 1 trials at 0F, compared to the baseline data (black). Average percent change from baseline is shown labelled in percentages.

Carbon Dioxide (CO2) Emissions

Figure 12 below shows the plot of the fraction of CO2 (g/hr) in the exhaust over time for five trial days. The black line represents the baseline values. This is a representation of the total mass of carbon dioxide emitted in the exhaust over time (g/hr).

On average, throughout the course of the five trials the carbon dioxide content of the exhaust was reduced by **24%**. The highest CO2 reduction was seen on day 4, which showed 31% average savings. The lowest savings were seen on day 2, at 18% savings from baseline.

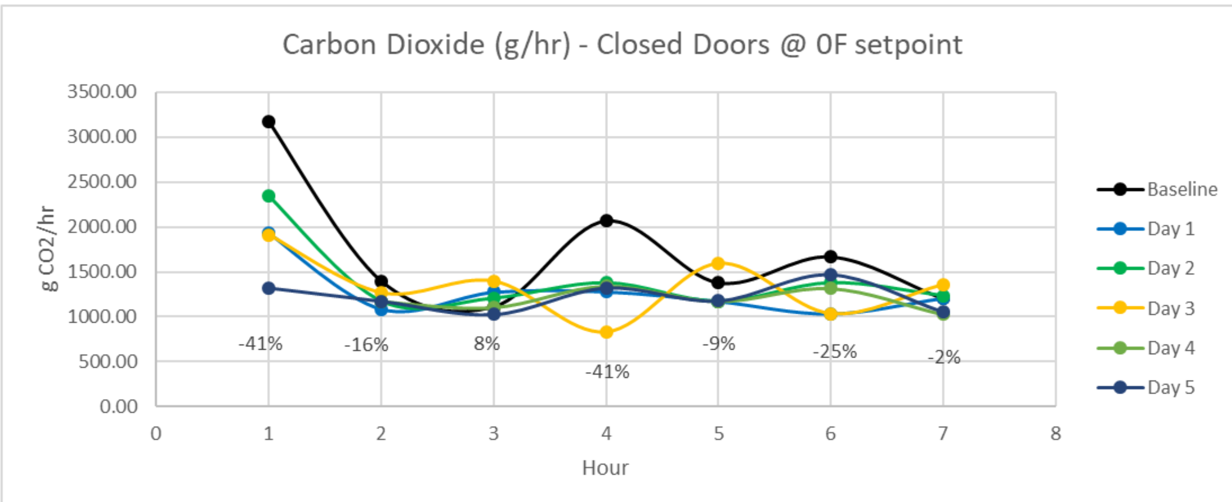

Figure 12: CO2 Emissions (grams per hour) over time for five Phase 1 trials at 0F, compared to the baseline data (black). Average percent change from baseline is shown labelled in percentages.

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Carbon Monoxide (CO) Emissions

Figure 13 below shows the plot of the fraction of CO (g/hr) in the exhaust over time for five test days. The black line represents the baseline values. This is a representation of the total mass of carbon monoxide emitted in the exhaust over time (g/hr).

On average, throughout the course of the three trials the carbon monoxide content of the exhaust was reduced by **41%**. The highest CO reduction was seen on day 1, at 45% average savings. The lowest savings were seen on day 3, at 38%. This suggests that *HydraGEN™* helps to burn diesel more completely, as CO is a product of incomplete combustion.

These are significant savings.

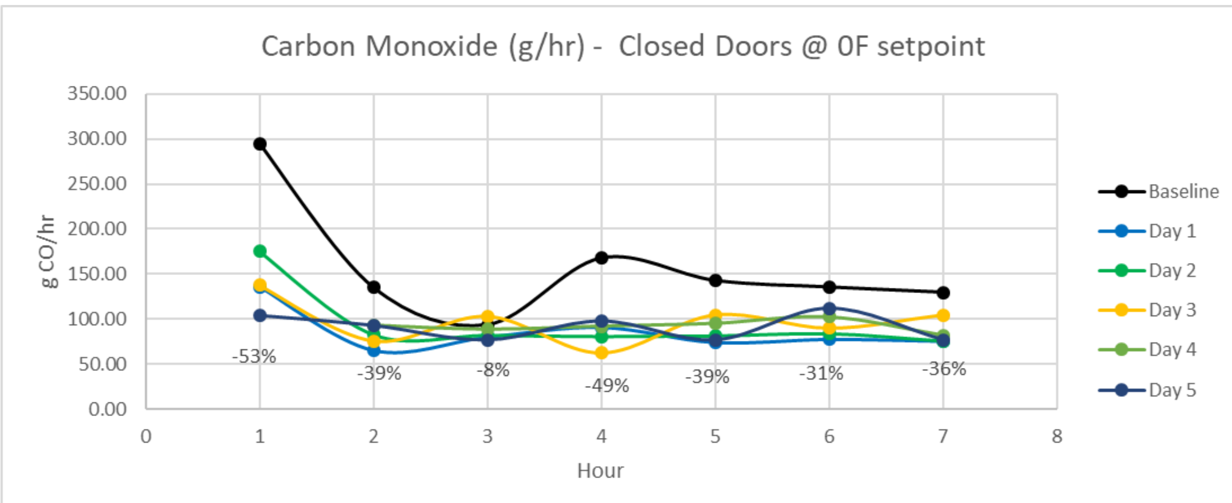

Figure 13: CO Emissions (grams per hour) over time for five Phase 1 trials at 0F, compared to the baseline data (black). Average percent change from baseline is shown labelled in percentages.

NOx Emissions

Figure 14 below shows the plot of the mass of NOx (g/hr) emissions over five test days. The black line represents the baseline values. This is a representation of the total mass of nitrogen oxides emitted in the exhaust over time (g/hr).

The baseline point at hour 3 is an outlier and should be disregarded. On average, accounting for this point, the *HydraGEN™* reduced NOx emissions by **11%**. The highest reduction was seen on day 4, at 14% average savings.

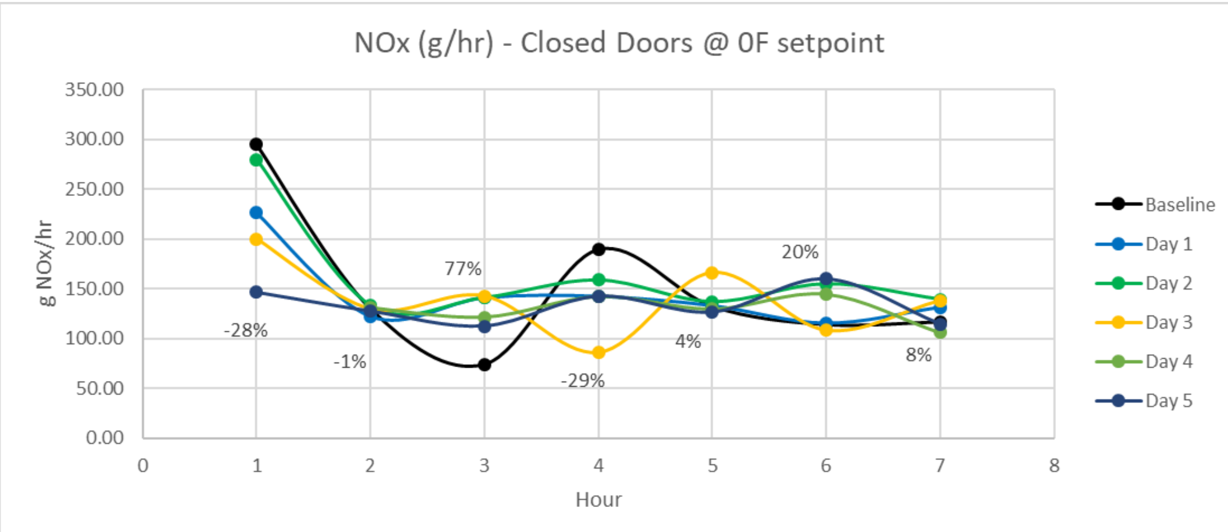

Figure 14: NOx Emissions (grams per hour) over time for five Phase 1 trials at 0F compared to the baseline data (black). Average percent change from baseline is shown labelled in percentages.

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1.8.3 -15°F Setpoint

The table below summarizes ambient temperature on each test day.

Test Day	Temperature High (°C)	Temperature Low (°C)	Temperature Average (°C)
Baseline	26	20	23
Day 1	21	11	16
Day 2	20	10	15
Day 3	18	11	14
Day 4	22	12	17
Day 5	21	13	17
Day 6	14	8	11

Fuel Consumption

Improved fuel economy means significant financial savings and a better return on investment for the *HydraGEN™.*

Figure 15 below shows the plot of the fuel consumption (measured in lb/hr) over time. The black line represents the baseline values.

On average, the *HydraGEN™* reduced fuel consumption by **13%**. The highest fuel consumption savings were seen on day 6, which showed **17%** average savings. The lowest savings were seen on day 1, at 8% savings from baseline.

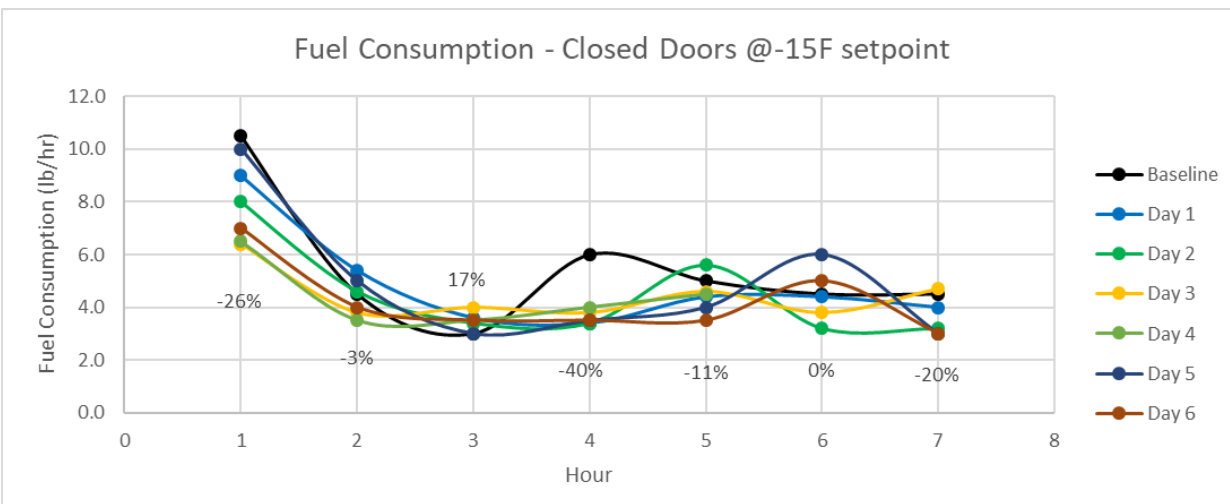

Figure 15: Fuel Consumption (pounds per hour) over time for six Phase 1 trials at -15F, compared to the baseline data (black). Average percent change from baseline is shown labelled in percentages.

Carbon Dioxide (CO2) Emissions

Figure 16 below shows the plot of the fraction of CO2 (g/hr) in the exhaust over six days. The black line represents the baseline values. This is a representation of the total mass of carbon dioxide emitted in the exhaust over time (g/hr).

On average, throughout the course of the six trials the carbon dioxide content of the exhaust was reduced by **24%** for all six trials. The highest CO2 savings were seen on day 6, which showed **34%** average savings. The lowest savings were seen on day 1, at 12% savings from baseline. This suggests that *HydraGEN™* technology may help to clean carbon buildup from the engine and further reduce emissions over time.

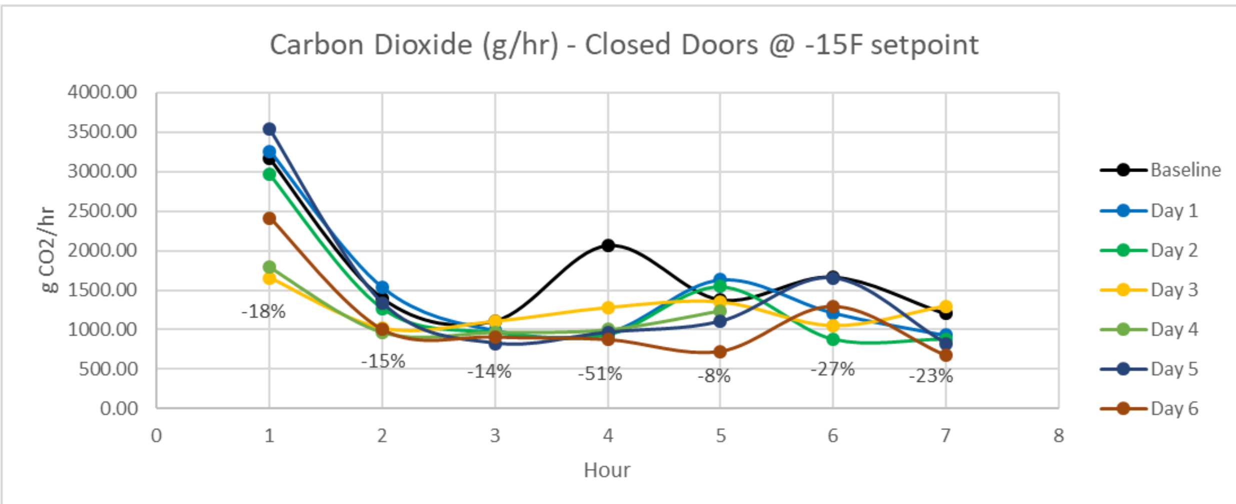

Figure 16: CO2 Emissions (grams per hour) over time for six Phase 1 trials at -15F, compared to the baseline data (black). Average percent change from baseline is shown labelled in percentages.

Carbon Monoxide (CO) Emissions

Figure 17 below shows the plot of the fraction of CO (g/hr) in the exhaust over time. The black line represents the baseline values. This is a representation of the total mass of carbon monoxide emitted in the exhaust over time (g/hr).

On average, throughout the course of the three trials the carbon monoxide content of the exhaust was reduced by **29%.** The highest CO reduction was seen on day 3, at 36% average savings. The lowest savings were seen on day 5 at 16%. This suggests that *HydraGEN™* helps to clean out carbon deposits from the engine and decrease emissions over time.

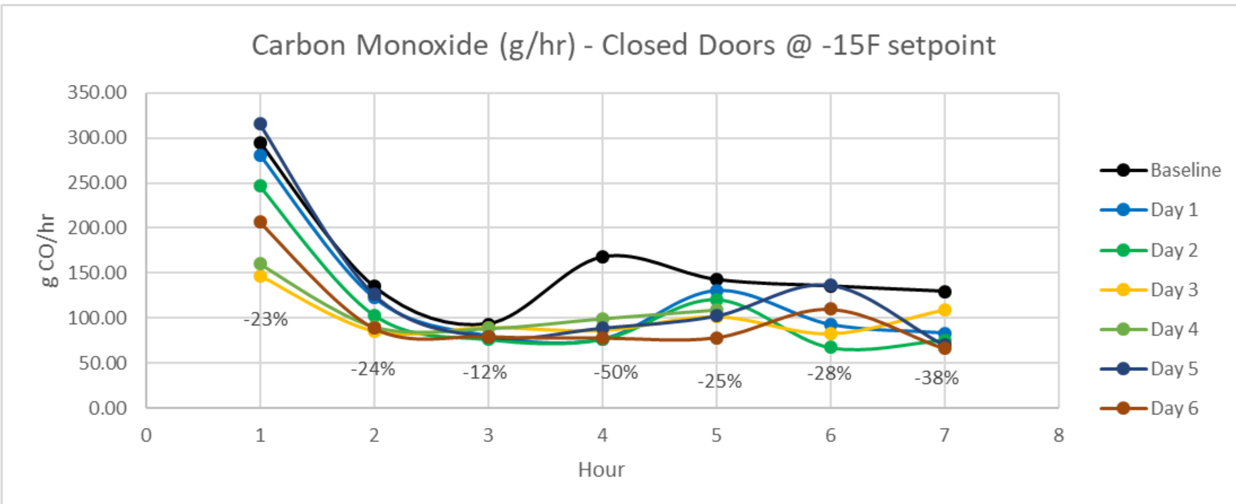

Figure 17: CO Emissions (grams per hour) over time for six Phase 1 trials at -15F, compared to the baseline data (black). Average percent change from baseline is shown labelled in percentages.

NOx Emissions

Figure 18 below shows the plot of NOx emissions by mass over time. The term NOx represents a group of nitrogen oxides including NO and NO2. The black line represents the baseline values.

On average, the *HydraGEN™* reduced NOx emissions by **12%**. The highest reduction was seen on day 6, at **22**% average savings. The lowest savings were seen on day 1, at 5% savings from baseline. This suggests that *HydraGEN™* helps to clean out the engine and improve engine performance over time.

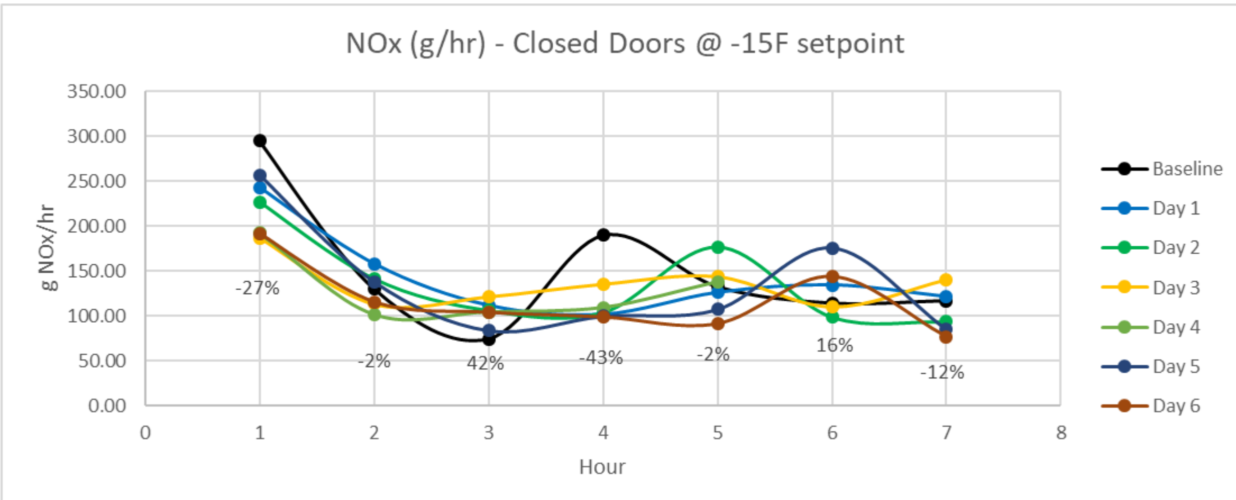

Figure 18: NOx Emissions (grams per hour) over time for six Phase 1 trials at -15F, compared to the baseline data (black). Average percent change from baseline is shown labelled in percentages.

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1.9 Phase 2 Test Results: Full Load

Phase 2 tests the engine performance at full load with and without the *HydraGEN™* unit. By keeping the trailer doors open, the engine is prevented from ever reaching the set temperature of 0°F, so it stays at maximum load for the duration of the trial.

Each of the Phase 2 trials was compared to a baseline test performed at 0°F with no unit attached and the doors open. Ambient temperature on the day of the baseline was 22°C with a high of 27°C.

1.9.1 0°F Set point

The table below summarizes ambient temperature on each test day.

Test Day	Temperature High (°C)	Temperature Low (°C)	Temperature Average (°C)
Baseline	26	20	23
Day 1	23	21	23
Day 2	20	11	17
Day 3	22	11	16

Fuel Consumption

Improved fuel economy means significant financial savings and a better return on investment for the *HydraGEN™.*

Figure 19 below shows the plot of the fuel consumption (measured in lb/hr) over time. The black line represents the baseline values.

On average, throughout the course of the three trials fuel consumption was reduced by **16%**. The highest fuel consumption savings were seen on day 2, which showed 17% average savings. The lowest savings were seen on day 3, at 10% savings from baseline. It is clear from the graph that *HydraGEN™* stabilizes the readings.

These are significant savings.

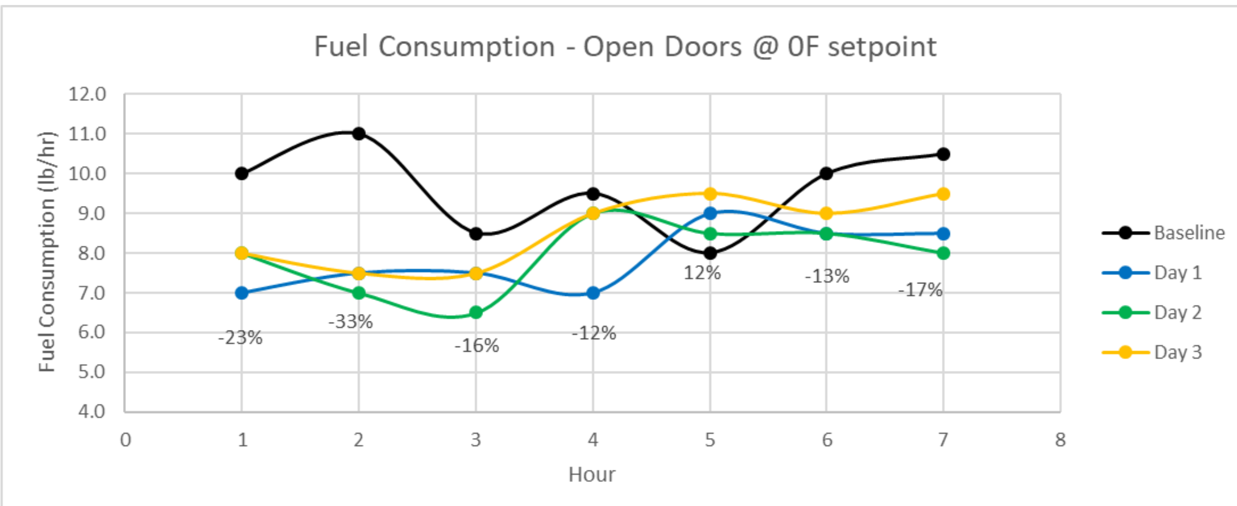

Figure 19: Fuel Consumption (lb/hr) over time for three Phase 2 trials at 0F, compared to the baseline data (black). Average percent change from baseline is shown labelled in percentages.

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1.9.2 HydraGEN™ Unit Removed

After running the reefer unit for 3 days with the HydraGEN™ unit, the unit was removed and the reefer was run again for 3 days to evaluate change in performance.

The table below summarizes ambient temperature on each test day.

Test Day	Temperature High (°C)	Temperature Low (°C)	Temperature Average (°C)
Baseline	26	20	23
Day 1	24	19	22
Day 2	24	16	20
Day 3	24	19	22

Fuel Consumption

Figure 20 below shows the black line representing the original baseline used to evaluate the unit performance in Phase 2.1. The red line represents the average fuel consumption over the course of all 3 trial days in Phase 2.1. It is clear from the red line that HydraGEN™ technology improves the fuel economy significantly.

The blue, green, and yellow lines represent each day the reefer was run after removing the HydraGEN™ unit. **There is a clear increase in fuel consumption over time without the HydraGEN™ unit**, where the average daily fuel consumption of day 3 is higher than day 2, which is an increase over day 1. This suggests that not only does HydraGEN™ technology decrease fuel consumption, but that it cleans out the engine so that fuel consumption does not immediately return to the original baseline value. The peak value seen at hour 5 is likely due to the ambient temperature peaking around this time (between 1:00PM and 2:00PM daily).

These results suggest that fuel consumption will continue to increase, eventually returning to the values seen during the baseline testing given sufficient time for the engine to become dirty again.

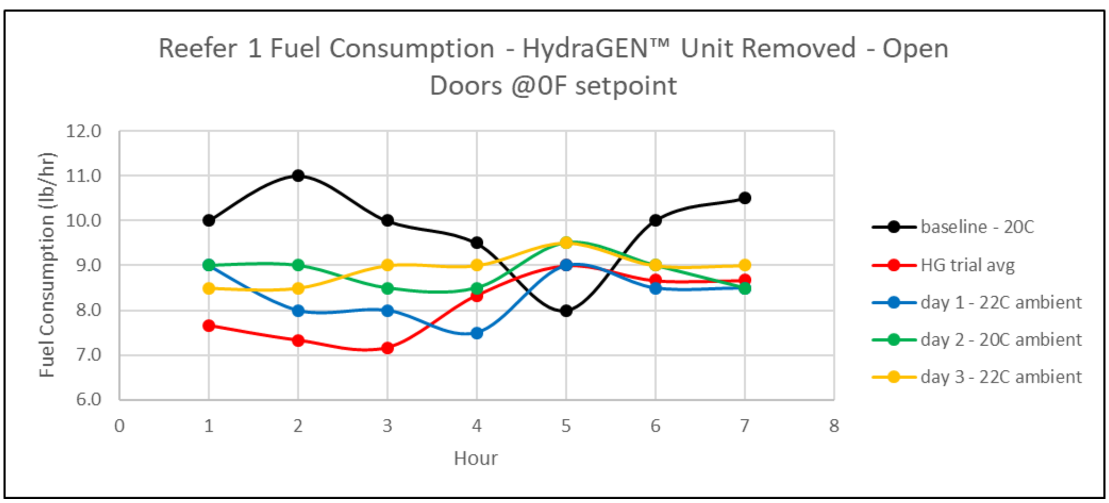

Figure 20: Fuel Consumption (lb/hr) over time for three Phase 2 trials with the HydraGEN™ unit removed at 0F (blue, green, yellow), compared to the baseline data (black) and to the Phase 2 trial average with the HydraGEN™ unit (red).

4.0 Conclusions

The results of the reefer testing indicate that the *HydraGEN™* unit has a significantly positive effect on engine performance, improving fuel economy and lowering NOx, CO, and CO2 emissions.

The most significant and promising findings are summarized in the table below.

Conditions	Property	Trial Max Savings	Trial Average Savings
Phase 1.1 Set Temp 32°F 15A current Doors closed	Fuel Consumption	28%	26%
	Carbon Dioxide (CO2)	49%	44%
	Carbon Monoxide (CO)	55%	51%
	NOx	35%	30%
Phase 1.2 Set Temp 0°F 15A current Doors closed	Fuel Consumption	15%	13%
	Carbon Dioxide (CO2)	31%	24%
	Carbon Monoxide (CO)	45%	41%
	NOx	14%	11%
Phase 1.3 Set Temp -15°F 15A current Doors closed	Fuel Consumption	17%	13%
	Carbon Dioxide (CO2)	34%	24%
	Carbon Monoxide (CO)	36%	29%
	NOx	22%	12%
Phase 2.1 Set Temp 0°F 15A current Doors open	Fuel Consumption	17%	16%

Figure 21: Reefer testing set-up.