Emissions testing of a 110kVA, Stage IIIA Power Generator.
Analysis of Data measurements carried out by Emissions Analytics.
Comparison of Emissions with Diesel, HVO and Green D+ fuels

Introduction

Emissions Analytics carried out emissions studies in January and February 2021 on a diesel-powered generator. The results obtained on the Stage IIIA engine were compiled in a report (EA report 20210222v2.0). This report is an analysis of the data supplied by EA.

Experimental details

Three fuels were tested. Each was tested in triplicate.

Engine: ElectropaK, 1104D-E44TAG2, Stage IIIA engine.

Measuring Equipment: PEMS testing equipment used by EA was a SEMTECH-LDV gas analyser. The analyser measured CO, CO_2, NO, NO_2. A Sensors Condensate Particle Number was used to quantify particle number.

Calibration was carried out with Zero and Span gas measurements at the start and end of each cycle.

Test cycle: from a cold start, the engine was run up the power output to 100% over 10 minutes. The five modes were run in sequence. The 10-minute stabilisation period was followed by 10 minutes measurement.
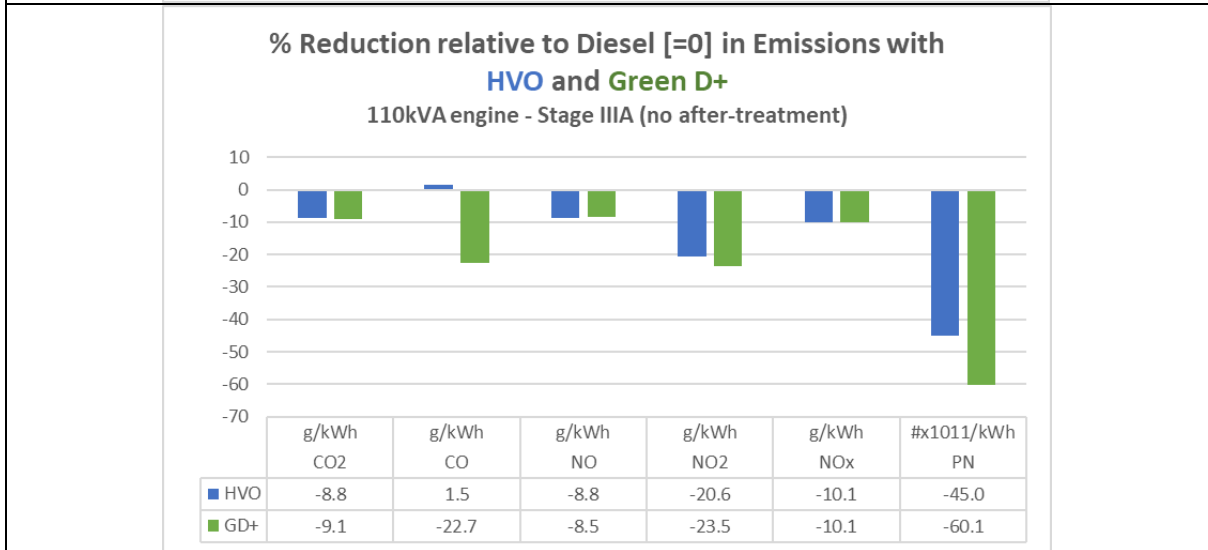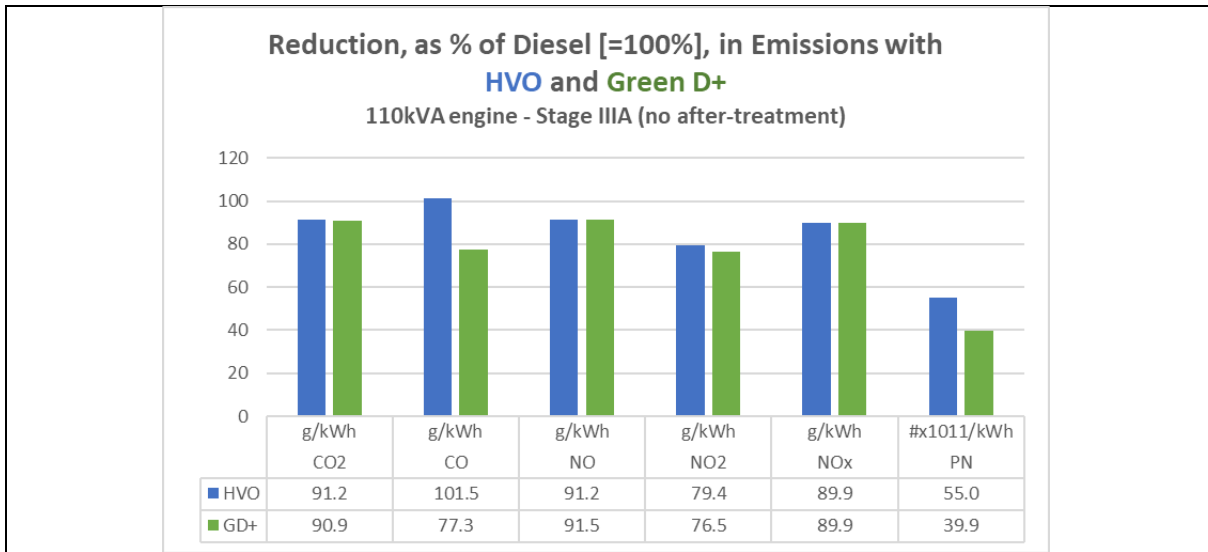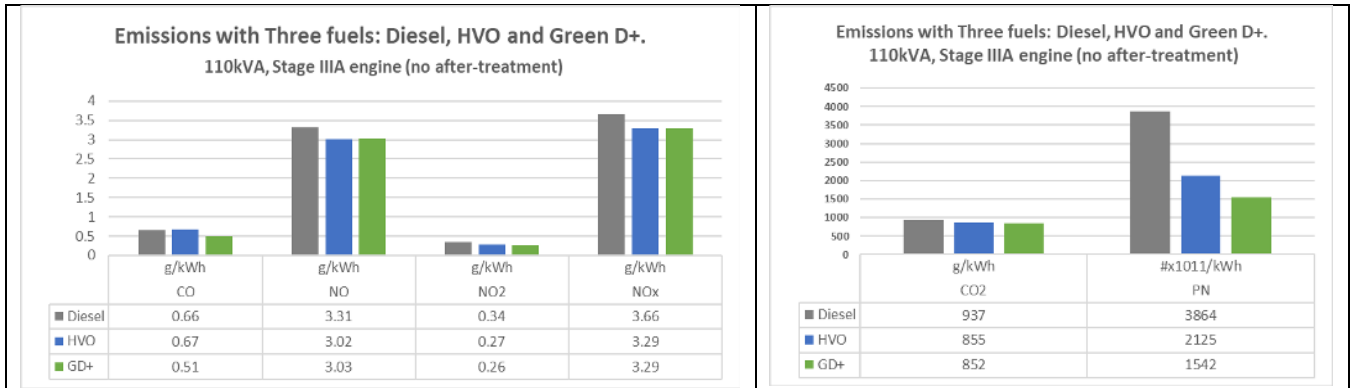
Results

Table 1: Gaseous emissions with three fuels on Stage IIIA engine

ISO 8178 - D2 values - No SCR

	CO_2	CO	NO	NO_2	NOx	PN
	g/s	g/s	mg/s	mg/s	mg/s	$\#x10^{11}/s$
Diesel	8.9	4.2	34.7	2.8	37.5	25.9
HVO	8.3	4.5	31.6	2.3	33.9	14.7
GD+	8.2	3.2	31.7	2.2	33.9	10.3
	CO_2	CO	NO	NO_2	NOx	PN
	g/kWh	g/kWh	g/kWh	g/kWh	g/kWh	$tx10^{11}/kWh$
Diesel	937	0.66	3.31	0.34	3.66	3864
HVO	855	0.67	3.02	0.27	3.29	2125
GD+	852	0.51	3.03	0.26	3.29	1542
%	CO_2	CO	NO	NO_2	NOx	PN
Diesel	100	100	100	100	100	100
HVO	91.2	101.5	91.2	79.4	89.9	55.0
GD+	90.9	77.3	91.5	76.5	89.9	39.9
%	CO_2	CO	NO	NO_2	NOx	PN
Diesel	0	0	0	0	0	0
HVO	-8.8	1.5	-8.8	-20.6	-10.1	-45.0
GD+	-9.1	-22.7	-8.5	-23.5	-10.1	-60.1

Figure 1: Emissions with three fuels and % reduction relative to diesel

Emissions with Three fuels: Diesel, HVO and Green D+.
110kVA, Stage IIIA engine (no after-treatment)

	g/kWh CO	g/kWh NO	g/kWh NO2	g/kWh NOx
Diesel	0.66	3.31	0.34	3.66
HVO	0.67	3.02	0.27	3.29
GD+	0.51	3.03	0.26	3.29

Emissions with Three fuels: Diesel, HVO and Green D+.
110kVA, Stage IIIA engine (no after-treatment)

	g/kWh CO2	#x1011/kWh PN
Diesel	937	3864
HVO	855	2125
GD+	852	1542

Reduction, as % of Diesel [=100%], in Emissions with HVO and Green D+
110kVA engine - Stage IIIA (no after-treatment)

	g/kWh CO2	g/kWh CO	g/kWh NO	g/kWh NO2	g/kWh NOx	#x1011/kWh PN
HVO	91.2	101.5	91.2	79.4	89.9	55.0
GD+	90.9	77.3	91.5	76.5	89.9	39.9

% Reduction relative to Diesel [=0] in Emissions with HVO and Green D+
110kVA engine - Stage IIIA (no after-treatment)

	g/kWh CO2	g/kWh CO	g/kWh NO	g/kWh NO2	g/kWh NOx	#x1011/kWh PN
HVO	-8.8	1.5	-8.8	-20.6	-10.1	-45.0
GD+	-9.1	-22.7	-8.5	-23.5	-10.1	-60.1

Discussion and Conclusions

- o CO_2 emissions are reduced by 8.8% and 9.1% with HVO and Green D+ respectively, relative to diesel. The expected decrease is ~3%. The greater reduction indicates a fuel efficiency improvement.

- o Incomplete combustion products, CO and PN show a significant reduction with Green D+ of 23% (for CO) and 60% (for PN), relative to diesel. HVO also shown significant reduction relative to diesel in PN of 45%. The indication is that Green D+ is out-performing HVO, which is itself significantly cleaner than diesel.

    Green D+ >> HVO >>> Diesel   - for reducing incomplete combustion emissions.

- o NOx emissions with both HVO and Green D+ are reduced by 10% relative to diesel.

    Green D+ ~ HVO >> Diesel - for reducing NOx emissions.

Note: These data were obtained and supplied by Emissions Analytical. The analysis of the data in this report are by GBF. All the data provided by EA have been included.

[AFP reference: AFP analysis of EA_StageIIIA_DvsHVOvsGD.xlsx]