

WCDEF Yonkers Joint WWTP  
NYSDEC ID #3-5518-00342  
Title V Air Permit Renewal #3  
Supplemental Information  
February 22, 2023

## Section C

Narrative Addressing CLCPA  
(Climate Leadership and Community Protection Plan)  
Greenhouse Gas (GHG) Emission Tables

Evaluation of Greenhouse Gas (GHG) Emissions - WCDEF Yonkers Joint WWTP  
NYSDEC ID #3-5518-00342  
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**Addressing the New York State  
Climate Leadership and Community Protection Plan**

**Background**

Yonkers Joint WWTP (YJ) is a major urban municipal wastewater treatment plant serving Westchester County, NY that combusts predominantly and almost exclusively in-house produced anaerobic digester gas (ADG) in small boilers and engines, with minimal natural gas (NG) use. As shown in the NAAQS and organics parts of the Supplemental Information Package, this permit renewal introduces self-imposed caps on liquid fuel for small boilers; distillate will be used for periodic maintenance & testing, and rare occasions where ADG and NG are not available.

The facility's Title V permit is being modified during its present renewal to include two new engines [that will function as one in terms of PTE]. As the old Enterprise DGSG-38-CB engines (EU1-ENGIN installed in 1978) undergo decommissioning, the new engines will be installed (anticipated spring 2024). Technical specifications of the new MWM engines are provided in Section A of this Supplemental Information package.

The average of 2020 and 2021 facility fuel use and operating hours from monthly monitoring was used to generate emissions of the combustion-related greenhouse gases (GHG) carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O).

Table 1 shows 2017-2021 source-specific gas use, the latter three years showing significantly less gas consumption than the first two. Table 2A shows GHG emissions for ADG (only). Table 2B shows direct and upstream GHG for natural gas (note: ADG does not come from out-of-state and has no upstream component). Table 3 shows distillate use and corresponding GHG emissions. Table 4 calculates GHG emissions from the new proposed engines, and Table 5 presents a facility GHG summary.

EPA provides GHG emission factors for natural gas, landfill gas and 'other biomass gases'. The 'other biomass gases' factors were chosen based on: 1) the heat content of ADG (~610 Btu/ft<sup>3</sup>) is closer to that of the 'biomass gas'; and 2) the chemistry of landfill gas is different than that of ADG. Combustion GHG mass and CO<sub>2</sub> equivalents are calculated for the facility using 20-year global warming potentials (methane, 84; nitrous oxide, 264) found in:

*Appendix 8.A: Lifetimes, Radiative Efficiencies and Metric Values of Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (pp. 731-740).*

Municipal wastewater treatment plants are specifically exempt from EPA's Mandatory Greenhouse Gas Reporting Program (MGGRP; 40 CFR Part 98 Subpart II Industrial Wastewater Treatment).

The existing MWM engine fires ADG and natural gas; each new engine will be 400 horsepower less than the existing similar MWM engine and will also fire both gaseous (only) fuels. The new engines will function in island mode and will not run in parallel with the local electric utility grid. The engines will be redundant and will run at 1.0 engine equivalent in terms of PTE, to help power blowers and switch operations between blowers.

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More efficient production and use of in-house produced ADG is constantly evolving, and the past several years have seen extensive upgrades to air moving systems, emergency engine power, sewage handling, boiler burner replacements, and improving ADG quality and quantity. The engines continue to remove flaring load with a continuing profile of more efficient energy use and production.

### **Discussion**

Facilities are adapting a new unit of measurement for comparison and conversation about GHG. YJ's ADG baseline of 4046 metric tons (mass) CO<sub>2</sub> annually picked up 34 metric tons under the new convention accounting for global warming potential (GWP) of methane and nitrous oxide, and the new ADG GHG baseline is 4080 CO<sub>2</sub> equivalents (CO<sub>2</sub>eq), Table 2A.

Table 2B shows NG direct and upstream GHG adds 390 metric tons of CO<sub>2</sub>eq; Table 3 showing distillate use adds another 190 metric tons, bringing the new baseline to 4660 metric tons CO<sub>2</sub>eq, with a PTE of 10,326 metric tons CO<sub>2</sub>eq.

The new engines are anticipated to run 90% ADG and 10% NG and will add almost 6500 metric tons CO<sub>2</sub>eq based on 8760 hours of operation (actual=PTE).

A new facility anticipated actual future baseline including the new engines will generate about 11,000 metric tons CO<sub>2</sub>eq. with a PTE of 16,863 tons. For comparison, EPA's MGGRP has a 25,000 metric ton threshold under which reporting is not required.

The Yonkers Joint WWTP receives round-the-clock non-stop wastes of a large urban residential, commercial and industrial population. There is no option to ever 'slow production' (when business is 'slow' like manufacturing or other markets or economic drivers). The waste input characteristic and chemistry sometimes do not produce sufficient quality or quantity of ADG to fire in the boilers and engines. Adding a small amount of natural gas complements the efficiency of the gas fuel system that is integral in providing more reliable treatment of sewage and wastewater that is vital to public health. POTWs reduce conventional and toxic pollutants discharged by industry and domestic wastewater sources into municipal sewer systems and subsequently into the environment. Using the primary waste gas of a POTW - which can be explosive and must be dealt with - for the very control of the system which produces it is a productive loop that reduces flaring.

The Westchester County Department of Environmental Facilities continuously balances air and water quality issues to affect the best treatment for each, and feels that use of slightly supplemented in-house produced ADG with NG will not impact NYS from meeting its overall goals of the Climate Leadership and Community Protection Act. This energy approach to optimize plant operations is neither inconsistent with, nor will interfere with, statewide GHG policy. If the project is deemed inconsistent, the state agency will provide a detailed justification.

Yonkers Joint WWTP	Average	Cubic Feet Consumed					Average
Gaseous Fuel Source	2017 & 2018	2017	2018	2019	2020	2021	2020 & 2021
EU 1-ENGIN ((ADG)	255,601	154,518	356,684	16,482	262,109	17,903	140,006
EU 2-ENGIN (ADG)*	103,710,135	106,795,669	100,624,601	14,336,024	16,494,507	118,148,332	67,321,420
EU 2-ENGIN (NG)	0	0	0	0	0	898,214	449,107
EU 1-FLARE (ADG)	112,845,104	110,154,801	115,535,406	122,343,247	150,223,495	53,616,166	101,919,831
EU 1-SDBLR (ADG)	37,340,563	44,136,308	30,544,818	39,767,469	37,848,796	20,839,809	29,344,303
EU 2-SDBLR (Exempt, ADG)	21,452,662	18,346,368	24,558,955	24,314,841	24,429,718	19,237,296	21,833,507
EU 1-CSOBL (Exempt, NG)	4,597,000	3,612,000	5,582,000	6,385,200	5,815,999	3,896,000	4,856,000
<b>TOTAL, MMScf</b>	<b>280</b>	<b>283</b>	<b>277</b>	<b>207</b>	<b>235</b>	<b>217</b>	<b>226</b>

235	<b>5-Year</b>	244
Median		Average

**CLCPA TABLE 2A**  
**Source-Specific Anaerobic Digester Gas GHG**  
**Baseline Actual Emissions & PTE**

*emission factors in kg; results in mass, pounds.*

	<b>mmBtu/scf</b>	<b>kg CO2/scf</b>	<b>gm CH4/scf</b>	<b>gm N2O/scf</b>
Natural Gas	0.001026	0.054440	0.001030	0.000100
Landfill Gas	0.000485	0.025254	0.001552	0.000306
<b>Other Biomass Gases</b>	<b>0.000655</b>	<b>0.034106</b>	<b>0.002096</b>	<b>0.000413</b>

<b>GWP* 20:</b>	
<b>84</b>	<b>264</b>
<b>CH4</b>	<b>N2O</b>
<b>kg, CO2 eq.</b>	<b>kg, CO2 eq.</b>
5,166	3,199
3,844	2,381
25	15
11,853	7,340
20,888	12,935
<b>21</b>	<b>13</b>

<b>Gaseous Fuel Source</b>	<b>Cu. Ft .Burned^^</b>	<b>Mass Weight^</b>		
		<b>kg CO2</b>	<b>kg CH4</b>	<b>kg N2O</b>
EU 1-SDBLR (ADG)	29,344,303	1,000,817	62	12
EU 2-SDBLR (ADG)	21,833,507	744,654	46	9
EU 1-FLARE (ADG)	140,006	4,775	0.3	0.1
EU 2-ENGIN (ADG)*	67,321,420	2,296,064	141	28
Total, kg:		4,046,310	249	49
<b>Total, Metric tons:</b>		<b>4,046</b>	<b>0.2</b>	<b>0.0</b>

**Total CO2eq, metric tons:**  
**4,080**

<b>Gaseous Fuel Source</b>	<b>2-Year Average Hours^^</b>	<b>Potential to Emit, CO2eq</b>			
		<b>CO2</b>	<b>CH4</b>	<b>N2O</b>	<b>TOTAL</b>
EU 1-SDBLR (ADG)	9245	1,896,626	9,791	6,063	1,912,480
EU 2-SDBLR (ADG)	8202	1,590,628	8,211	5,085	1,603,924
EU 1-FLARE (ADG)	25411	6,584	34	21	6,639
EU 2-ENGIN (ADG)*	3347	6,009,418	31,022	2,073	6,042,513
<b>TOTAL PTE, kg</b>		<b>9,503,257</b>	<b>49,058</b>	<b>13,242</b>	<b>9,565,557</b>
<b>Total PTE, metric tons</b>		<b>9,503</b>	<b>49</b>	<b>13</b>	<b>9566</b>

^^ Average of 2020 and 2021 data.

Emission factors taken from: EPA Center for Climate Leadership - Emission Factors for Greenhouse Gas Inventories - Modified: April 1, 2022

\* The primary fossil fuel greenhouse gas combustion emissions are carbon dioxide, methane and nitrous oxide. The 20-year global warming potentials (GWP) for determining carbon dioxide equivalents are taken from: Appendix 8.A: Lifetimes, Radiative Efficiencies and Metric Values of Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (pp. 731-740). 20-Year CH4 GWP factor = 84; 20-Year N2O factor = 264.

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**CLCPA TABLE 2B**  
**Natural Gas GHG ^^**

EPA Emission Factors for Greenhouse Gas Inventories*		
kg CO2/scf	gm CH4/scf	gm N2O/scf
0.05444	0.00103	0.00010

Emission Rates for Out-of-State Sources***		
gm CO2/mmbtu^	gm CH4/mmbtu	gm N2O/mmbtu
12,131	357	0.14

Actual 2021 Direct Mass Emissions			
Natural Gas SCF^^	kg CO2	gram CH4	gram N2O
4,794,214	260,997	4,938	479

Upstream Emissions, grams:		
CO2	CH4	N2O
59,903,368	1,762,880	691

kg, mass :	260,997	4.9	0.5	
metric ton, mass:	261	0.005	0.0005	
<b>metric ton, CO2 eq**:</b>	<b>261</b>	<b>0.4</b>	<b>0.1</b>	<b>262</b>

59,903	1,763	1	
60	2	0	
<b>60</b>	<b>35</b>	<b>33</b>	<b>128</b>

Total Natural Gas CO2eq: **390**

Direct Mass PTE, metric tons CO2eq			
CO2	CH4	N2O	
388	0.6	0.2	<b>389</b>

Upstream Emissions PTE, metric tons CO2eq			
CO2	CH4	N2O	
89	52	50	<b>191</b>

Total Natural Gas CO2eq PTE: **579**

^ using 1030 Btu per cubic feet natural gas =

4,938 MMBtu

^^ 2021 natural gas from EU2-ENGIN and exempt EU1-CSOBL for actual emisisions. PTE is based only on source ENG01 from 2021 EU1-ENGIN (actual hours were 5891)

\* EPA Center for Corporate Climate Leadership/GHG Emission Factors Hub: 'www.epa.gov/sites/default/files/2021-04/documents/emission-factors\_apr2021.pdf

\*\*Using 20-year GWP global warming potential factr CH4 = 84

N2O = 264

\*\* Appendix 8.A: Lifetimes, Radiative Efficiencies and Metric Values of Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (pp. 731-740). 20-Year CH4 GWP factor = 84; 20-Year N2O factor = 264.

\*\*\* NYSDEC (2021) Summary Report 2021 NYS Statewide GHG Emissions Report; https://www.dec.ny.gov/energy/99223.html

Distillate Fuel Oil No. 2 * (gallons)				
Source	2020	2021	Average gallons	Average MMBtu
EU 1-SDBLR	1,190	15,568	8379	1,156
EU 2-SDBLR (Exempt)	88	12,760	6424	887
EU 1-ENGIN	445	110	277.5	38
EU3-ENGIN	23	109	66	9
IC001 (Exempt)	239	130	184.5	25

\*0.138 MMBtu/gallon

SOURCE	Average 2020/2021 hours	kg CO2/gallon	gm CH4/gallon	gm N2O/gallon	GWP* 20-Year:	GWP* 20-Year:
					CH4	N2O
		10.21	0.41	0.08	84	264
EU 1-SDBLR	466	85,550	3,435	670	288573	176,964
EU 2-SDBLR	347.5	65,589	2,634	514	221243	135,675
EU 1-ENGIN ^	^	2,833	114	22	9557	5,861
EU 3-ENGIN	2.85	674	27	5	2273	1,394
EU IC001	15.9	1,884	76	15	6354	3,897

Total:		kg CO2/gallon	gm CH4/gallon	gm N2O/gallon	GWP* 20-Year:	GWP* 20-Year:
Total, gms			6,286	1,226	528000	323,791
Total, kg		156,530	6.29	1.23	528	324
Total, metric tons CO2eq		156.5	0.006	0.001	0.5	0.3
						Total eq. 157.4

Potential to Emit	Average 2020 & 2021 hours	PTE, Direct Emissions, kg				PTE, Upstream Emissions, kg		
SOURCE		PTE Factors	CO2	CH4	N2O	CO2	CH4	N2O
EU 1-SDBLR^^	466	0.216	18475	62	38	3787	30.21	0.065
EU 2-SDBLR^^	347.5	0.393	25762	87	53	6105	6105	0.091
EU 1-ENGIN ^	^	---	---	---	---	---	---	---
EU 3-ENGIN^^^	2.85	175	118221	245	399	951	951	0.415
EU IC001^^^	15.9	31	59237	200	123	4.3	0.03	0.208
Units in Kg:			221695	593.58	612.82	10847.53	7086.88	0.779
Units in Metric Ton:			222	0.6	0.6	10.85	7.09	0.00

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Direct Emissions for Distillate No. 2 GHG						
emission factor:	Distillate EPA Emission Factors for Greenhouse Gas Inventories**			Distillate Emission Rates for Out-of-State Sources***		
	kg CO2/MMBtu	gm CH4/MMBtu	gm N2O/MMBtu	gm CO2/mmbtu	gm CH4/mmbtu	gm N2O/mmbtu
SOURCE	73.96	3.0	0.60	15,164	121	0.26
EU 1-SDBLR	85520	3.5	0.69	17,534	140	0.30
EU 2-SDBLR	65566	2.7	0.53	15,544	124	0.23
EU 1-ENGIN	2832	0.1	0.02	595	5	0.01
EU 3-ENGIN	674	0.0	0.01	5	0.043	0.00
EU IC001	1883	0.1	0.02	0,138	0,001	0,01
Units in Kg:	156476	6.3	1.27	33,679	269	0.55
Units in Metric Ton:	156	0.006	0.001	34	0.269	0.001

Total Direct & Upstream: 190

Note: Direct emissions are based on fuel volume/gallons used; upstream values are based on heat content, Btu.

\*\* The primary fossil fuel greenhouse gas combustion emissions are carbon dioxide, methane and nitrous oxide. The 20-year global warming potentials (GWP) for determining carbon dioxide equivalents are taken from: Appendix 8.A: Lifetimes, Radiative Efficiencies and Metric Values of Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (pp. 731-740). 20-Year CH4 GWP factor = 84; 20-Year N2O factor = 264.

\*\* EPA Center for Climate Leadership - Emission Factors for Greenhouse Gas Inventories - Last Modified: 26 March 2020  
<https://epa.gov/sites/production/files/2020-04/documents/ghg-emission-factors-hub.pdf>

\*\*\* NYSDEC (2021) Summary Report 2021 NYS Statewide GHG Emissions Report; <https://www.dec.ny.gov/energy/99223.html>

^ EU1-ENGIN will be decommissioned when the new engines are being installed. For the past few years 100% oil operation has been limited to single digit hours/year (maintenance only) so a PTE based on 8760 (or even 500 hours would be unrealistic and grossly exaggerated, and actual PTE is based on NYSDEC air dispersion modeling performed during consent order negotiations.

^^ These two emission units are each taking a future cap on oil use that is based on 1500 lbs. NOx per year. The PTE factors above are derived from applying the ratio of 1500 lb/year to the PTE lbs that were based on 8760 hours.

^^^ Emergency combustion sources capped at 500 hours per year even though EUIC001 is exempt.

Yonkers Joint WWTP

Westchester County Department of Environmental Facilities

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Prepared for Permit Renewal #3 and the CLCPA

## CLCPA TABLE 4 New Engine GHG

mmBtu/scf	emission factors-			
	kg CO2/scf	g CH4/scf	g N2O/scf	
0.001026	0.054440	0.001030	0.000100	Natural Gas
0.000485	0.025254	0.001552	0.000306	Landfill Gas
0.000655	0.034106	0.002096	0.000413	Other Biomass Gases

	Mass Weight^		
	kg CO2	kg CH4	kg N2O
<b>ADG</b>	5,423,247	333	66
<b>Total, Metric tons:</b>	<b>5,423</b>	<b>0.3</b>	<b>0.07</b>

Cubic feet either gas^^ = 159,011,520 annual consumption

NATURAL GAS	kg CO2	kg CH4	kg N2O
	8,656,587	164	16
<b>Total, Metric tons:</b>	<b>8,657</b>	<b>0.2</b>	<b>0.02</b>

	Anticipated New Engine PTE		
	Direct CO2eq	Upstream CO2eq produced in-house	Total CO2eq
<b>ADG @ 90% operations =</b>	4922		4922
<b>Natural Gas @ 10% operations =</b>	867	688	1555
	<b>5789</b>	<b>688</b>	<b>6477</b>

units in metric tons

grams:  
kg, mass :  
metric ton, mass:  
metric ton, CO2 e\*\*:

20-Year GWP*: 84	20-Year GWP*: 264
CH4 kg, CO2 eq.	N2O kg, CO2 eq.
27,996	17,337
<b>28</b>	<b>17</b>
<b>Total CO2eq, metric tons: 5,469</b>	

kg CH4	kg N2O
13,758	4,198
<b>13.8</b>	<b>4.2</b>
<b>Total CO2eq, metric tons: 8,675</b>	

Natural Gas MMBtu = 163,146		
<b>Natural Gas Emission Rates for Out-of-State Sources***</b>		
gm CO2/mmbtu	gm CH4/mmbtu	gm N2O/mmbtu
12,131	357	0.14

Upstream Natural Gas Maximum Emissions		
CO2	CH4	N2O
1,979,121,937	58,243,058	22,840
1,979,122	58,243	23
1,979	58	0.02
<b>1,979</b>	<b>4892</b>	<b>6</b>
		<b>6,878</b>

^Results in mass, kg and metric ton

^^ Based on manufacturer representative specifications: gas consumption = 514.0 cubic meter/hour @ 35.315 cubic feet per cubic meter = 18,152 cubic feet per hour. Assume 8760 hours for each fuel.

- Emission factors taken from: EPA Center for Climate Leadership - Emission Factors for Greenhouse Gas Inventories - Modified: April 1, 2022

\* The primary fossil fuel greenhouse gas combustion emissions are carbon dioxide, methane and nitrous oxide. The 20-year global warming potentials (GWP) for determining carbon dioxide equivalents are taken from: Appendix 8.A: Lifetimes, Radiative Efficiencies and Metric Values of Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (pp. 731-740).

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**CLCPA TABLE 5  
 GHG Summary**

Units in metric tons CO<sub>2</sub>eq

Source	Actual Emissions	Existing Source PTE*	New Source Actual = PTE	Facility Future PTE	Reference
Existing ADG Combustion	4,080	9,566	---	9,566	Table 2A
Existing NG Combustion	390	579	---	579	Table 2A
Existing Distillate Combustion	190	241	---	241	Table 3
New Engines (ADG & NG)	---		6,477	6477	Table 4
<b>TOTAL</b>	<b>4,660</b>	<b>10,386</b>	<b>6,477</b>	<b>16,863</b>	

\* Based on PTE factor 8760 hours divided by actual baseline hours, applied to actual emissions