AIR DISPERSION MODELING REPORT

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Plug Power Innovation Center, NY

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1. INTRODUCTION

On behalf of Plug Power Inc. (Plug Power), Trinity Consultants, Inc. (Trinity) is submitting this modeling report to the New York State Department of Environmental Conservation (NYSDEC) for Plug Power's proposed new fuel cell manufacturing line at 1025 John Street in West Henrietta, New York (Plug Power Innovation Center or facility). On January 5, 2022, Trinity submitted an Air State Facility Permit application for the Plug Power Innovation Center to the NYSDEC on behalf of Plug Power.

1.1 Project Description

Plug Power is proposing to construct the Plug Power Innovation Center at a currently vacant building, which has no existing operations apart from heating, ventilation, and air conditioning (HVAC) equipment and a cooling tower. The new fuel cell manufacturing line will consist of a catalyst ink/coating preparation (ink process), cleaning activities (CIP), a research and development (R&D) material laboratory (MDEV lab), and coating operations which will be controlled by a regenerative thermal oxidizer (RTO). There are also other small natural gas-fired combustion equipment including heaters, boilers, air handling units, soak heaters, and makeup-air units that are exempt from permitting.

As part of the State Facility Permit application, Plug Power evaluated the applicable compliance requirements with respect to Title 6 of the Codes, Rules and Regulations of New York (6 CRR-NY) Part 212 related to Process Operations. As part of that analysis, Plug Power must demonstrate compliance with the applicable guideline concentrations for propanol and ethyl alcohol (ethanol) listed in New York State Division of Air Resources (DAR) DAR-1, *Guidelines for the Evaluation and Control of Ambient Air Contaminants Under 6NYCRR Part 212*.[1]

On February 4, 2022, Trinity submitted an air dispersion modeling protocol on behalf of Plug Power to the NYSDEC. This protocol was conditionally approved by the NYSDEC via email on February 11, 2022, provided that Plug Power addressed comments in the email. This modeling report discusses those comments and any changes made to the submitted protocol. In addition, point by point response to the comments received from the NYSDEC is also included in Appendix D to this report. Notably, the NYSDEC requested that air dispersion modeling is completed for carbon black[2] to verify compliance with the DAR-1 guideline concentrations and confirm the initial Environmental Rating. Therefore, in addition to ethanol and propanol, carbon black is also included in this modeling report.

The air dispersion modeling is completed in a manner that conforms to the applicable rules, guidance, and requirements in the following guidance documents:

- The United States Environmental Protection Agency's (U.S. EPA's) Guideline on Air Quality Models, 40 CFR Part 51 - Appendix W (latest rule update, effective May 2017),
- The U.S. EPA's AERMOD Implementation Guide (Updated July 2021),
- The U.S. EPA's User's Guide for the AMS/EPA Regulatory Model – AERMOD (April 2021), and
- NYSDEC Guidelines on Dispersion Modeling Procedures for Air Quality Impact Analysis (DAR-10) (September 2020).

[1] https://www.dec.ny.gov/docs/air_pdf/dar1.pdf

[2] Since carbon black is a B rated contaminant, compliance with Part 212 is demonstrated by 0.05 grains per dry cubic foot standard for solid particulate matter as a family group with environmental rating of B.

The remainder of this modeling report is organized as follows:

- Section 1 provides a brief description of the facility and the site;
- Section 2 discusses standards that apply to the facility related to air dispersion modeling;
- Section 3 describes the air dispersion modeling methodology;
- Section 4 discusses the representation of emission sources and source parameters; and,
- Section 5 includes the results of the air dispersion modeling.

1.2 Site Description

The proposed facility will be located at 1025 John Street, West Henrietta, New York. Figure 1-1 presents an aerial view of the facility location. A detailed plot plan is provided in Appendix A.

Figure 1-1. Aerial View of the Plug Power Innovation Center

2. REGULATORY STANDARDS

Trinity has prepared this modeling report to describe the modeling methodologies and data resources that are used to demonstrate the facility's compliance with appropriate DAR-1 guideline concentrations for propanol, ethanol, and carbon black.

2.1 Applicable Standards

Plug Power modeled propanol, ethanol, and carbon black from the stationary sources associated with the proposed new facility.

Information related to the determination of which process emission sources, and which compounds are required to be included in air dispersion modeling were included in Section 3.3.3 of the state permit application that was submitted to the NYSDEC on January 5, 2022, and in Appendix C of the approved modeling protocol. Sections 2 (Emission Calculation Methodology) and Section 3.3 (State Regulatory Requirements) of that submittal is reproduced in their entirety in Appendix B and Appendix C, respectively, to this air dispersion modeling report as a reference for the NYSDEC modeling group. It is Plug Power's understanding that the NYSDEC has started its technical review of the permit application and the permitting engineer will review and comment on the emission calculations and Part 212 analysis if any.

The evaluation of Part 212 applicability and requirements has illustrated that the following listed process emission sources are subject to modeling for propanol, carbon black, and ethanol emissions. Details of the determination are provided in Sections 2 and 3.3.3 of the permit application excerpts that are included in Appendix B and C. A more detailed list of emission points, their coordinates, and elevations is provided in Section 4 of this modeling report.

- Catalyst ink/coating preparation (ink process),
- Coating operations which will be controlled by an RTO,
- Cleaning activities (CIP), and
- R&D MDEV lab.

None of the pollutants modeled have a short-term guideline concentration (SGC). The annual guideline concentrations (AGC) for propanol, carbon black, and ethanol are listed in Table 2-1.

Table 2-1. NYSDEC's AGC for Modeled Pollutants

Pollutant	AGC[a] ($\mu g/m^3$)
Propanol	590
Ethanol	45,000
Carbon Black	7

a. Based on DAR-1 AGC/SGC Tables dated February 12, 2021.

3. AIR DISPERSION MODELING METHODOLOGY

This section of the modeling report presents the procedures that are utilized in the air dispersion modeling analysis. The techniques in this air dispersion modeling analysis are consistent with the current U.S. EPA, NYSDEC guidance, and approved modeling protocol.

3.1 Dispersion Model Selection and Building Downwash Analysis

Dispersion models predict ambient pollutant concentrations by simulating the evolution of the pollutant plume over time and space given data inputs including the quantity of emissions, stack exhaust parameters (e.g., velocity, flow rate, and temperature), and weather data. Building structures that obstruct wind flow near emission points may cause stack discharges to become caught in the turbulent wakes of these structures leading to downwash of the plumes. Wind blowing around a building creates zones of turbulence that are greater than if the building were absent. These effects generally cause higher ground-level pollutant concentrations since building downwash inhibits dispersion from elevated stack discharges. For this reason, building downwash algorithms are considered an integral component of the selected air dispersion model.

The latest version of the AERMOD model, v21112, is used to estimate maximum ground-level concentrations in the air pollutant analysis conducted. AERMOD is a refined, steady-state, multiple source dispersion model that was promulgated in December 2005 as the EPA-preferred model to use for industrial sources in this type of air dispersion modeling analysis. The AERMOD modeling is performed using regulatory default options except as otherwise noted in this report. The AERMOD model has the Plume Rise Modeling Enhancements (PRIME) incorporated in the regulatory version, so the direction-specific building downwash dimensions used as input is determined by the Building Profile Input Program, PRIME version (BPIP PRIME), version 04274. BPIP PRIME is designed to incorporate the concepts and procedures expressed in the Good Engineering Practice (GEP) Technical Support document, the Building Downwash Guidance document, and other related documents, while incorporating the PRIME enhancements to improve prediction of ambient impacts in building cavities and wake regions.

Table 3-1 below is a list of the buildings included in the downwash analysis. There is only one main building which is modeled as a rectangular building in AERMOD. A visual is also presented in Appendix A.

Plug Power only included the onsite building in the downwash analysis, as nearby offsite structures do not encompass the stacks within the GEP 5L area of influence.[3] The GEP 5L area of influence for each structure is determined by measuring a distance of five times 'L' from each edge of the structure, where 'L' is the lesser of the building height or projected building width. Only those stacks within the area of influence are affected by building wake effects. For example, the building to the immediate northeast of the facility is shorter than it is wide, so 'L' is defined as the height (i.e., approximately 30 feet [ft]) and 5L equals 150 ft. The closest distance to any modeled stack location is approximately 300 ft. Since the shortest distance to any stack is greater than the GEP 5L area of influence, the building does not need to be included in the downwash analysis. All other buildings are of similar height and located further away from the point sources. As such, the other nearby buildings do not need to be included in the downwash analysis.

[3] EPA-454/R-93-038. User's Guide to the Building Profile Input Program. February 8, 1995. https://gaftp.epa.gov/Air/aqmg/SCRAM/models/related/bpip/bpipd.pdf

Table 3-1. Building Dimensions

AERMOD ID	Description	Coordinate		Base Elevation		Height	
		X (m)	Y (m)	(m)	(ft)	(m)	(ft)
BLDG1	Main Building	282611.7	4771812.6	169.46	555.97	9.19	30.17

3.2 Meteorological Data

Site-specific dispersion models require a sequential hourly record of dispersion meteorology representative of the region within which the source is located. In the absence of site-specific measurements, readily available data from the closest and most representative National Weather Service (NWS) station are commonly used. Regulatory air dispersion modeling using AERMOD requires five years of quality-assured meteorological data that includes hourly records of the following parameters:

- Wind speed;
- Wind direction;
- Air temperature;
- Micrometeorological parameters (e.g., friction velocity, Monin-Obukhov length);
- Mechanical mixing height; and
- Convective mixing height.

The first three of these parameters, wind speed, wind direction, and air temperature, are directly measured by monitoring equipment located at typical surface observation stations. The friction velocity, Monin-Obukhov length, and mixing heights are derived from characteristic micrometeorological parameters and from observed and correlated values of cloud cover, solar insulation, time of day and year, and latitude of the surface observation station. Surface observation stations form a relatively dense network, are almost always found at airports, and are typically operated by the NWS. Upper air stations are fewer in number than surface observing points since the upper atmosphere is less vulnerable to local effects caused by terrain or other land influences and is, therefore, less variable. The NWS operates virtually all available upper air measurement stations in the United States.

Plug Power utilized the most recent five years (2016 to 2020) of meteorological data from the Greater Rochester International Airport (KROC) surface station (WBAN – 14768), located roughly 6 km north of the Plug Power Innovation Center, for the modeling analysis. The meteorological data was processed by the NYSDEC using AERMET version 19191 and AERMINUTE[4] version 15272 and includes upper air measurements from the Buffalo, NY BUF site (upper air station ID No. 14733). The surface parameters were determined using AERSURFACE version 20060 using the 2016 National Land Cover Dataset along with the 2016 Tree Canopy and Impervious Surface data. The AERMOD-ready meteorological data files were provided by the NYSDEC.[5]

3.3 Urban/Rural Option

Per NYSDEC Modeling Guidance, as the Plug Power facility is not located in the New York City metro area, the rural regulatory default option is utilized within AERMOD.

[4] 5-min meteorological data were substituted for any missing 1-min data.

[5] Meteorological data provided by John Kent (NYSDEC) on July 26, 2021 via email to Sarah Davis (Trinity).

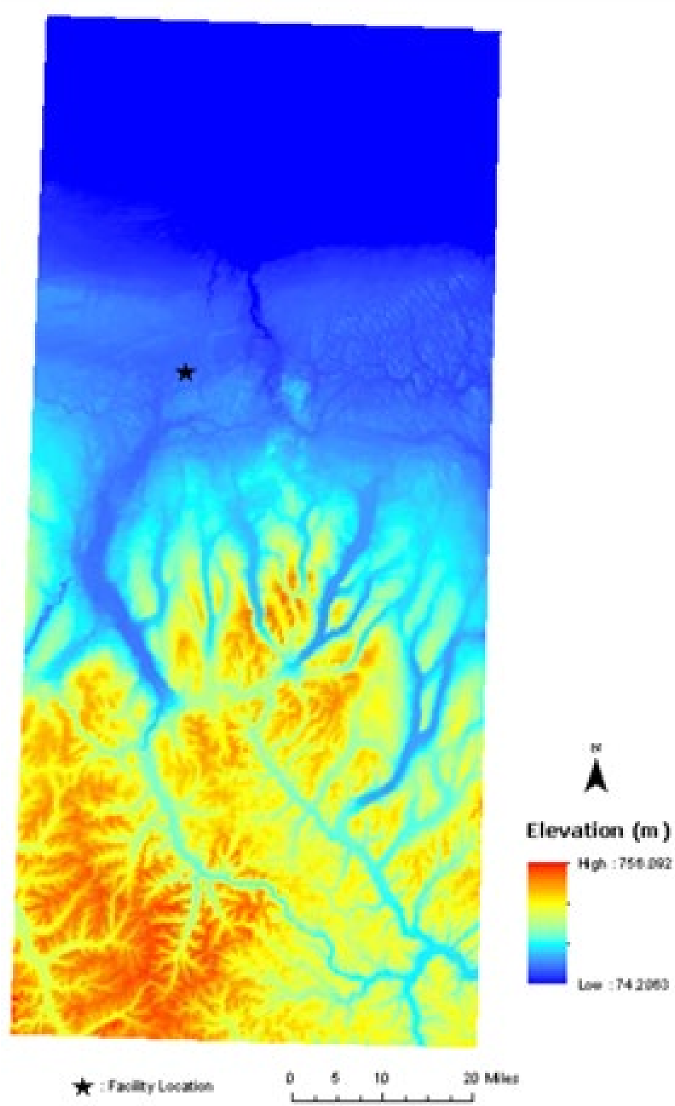
3.4 Treatment of Terrain

Through the use of the AERMOD terrain preprocessor (AERMAP, version 18081), AERMOD incorporates not only the receptor heights but also an effective height (hill height scale) that will represent the significant terrain features surrounding a given receptor that could lead to plume recirculation and other terrain interaction.

The source, building, and receptor terrain elevations input to the model were interpolated from 1/3 arc-second National Elevation Dataset (NED) data obtained from the U.S. Geological Survey (USGS) from datum year 1983. The array elevations were interpolated using AERMAP.

As requested in the February 11, 2022 modeling protocol approval letter from the NYSDEC, a terrain map of the area surrounding the facility is included in Figure 3-1.

Figure 3-1. Terrain Map



3.5 Coordinate System

In all modeling analysis data files, the location of emission sources, structures, and receptors were represented in the UTM coordinate system. The UTM grid divides the northern hemisphere into coordinates that are measured in north meters (measured from the equator) and east meters (measured from the central meridian of a particular zone, which is set at 500 km). The datum for this modeling analysis is based on North American Datum 1983 (NAD 83). UTM coordinates for this analysis all reside within UTM Zone 18.

3.6 Receptor Grids

For this air dispersion modeling analysis, ground-level concentrations were calculated within a Cartesian receptor grid. As per DAR-10 guidance, the air dispersion model should consider both simple and complex terrain receptor impacts. As such, Plug Power proposes a Cartesian receptor grid that is consistent with the suggested initial receptor grid in DAR-10. The Cartesian receptor grid consists of the following receptor spacing:

- 70 meter-spaced receptors from the center of the building out to 1 kilometer;
- 100 meter-spaced receptors from 1 to 2 kilometers;
- 250 meter-spaced receptors from 2 to 5 kilometers; and,
- 500 meter-spaced receptors from 5 to 10 kilometers.

The receptor grid is defined in Figure 3-2 and Figure 3-3 below. The maximum modeled impacts were reviewed to ensure they are located within the 70-m spaced receptors. Receptor elevations required by AERMOD were determined using the AERMAP terrain preprocessor (version 18081).

3.1.1 Sensitive Receptors

In evaluating the surrounding 2-km area of the facility in Google Earth™, there are schools, nursing homes, and residential areas located within this boundary. Trinity identified five locations within 2 km of the facility and placed sensitive receptors at those locations. These are listed in Table 3-2 and identified in Figure 3-4 below.

Table 3-2. Modeled Sensitive Receptors

Location	X Coordinate (m)	Y Coordinate (m)	Elevation (m)	Elevation (ft)
Care-a-lot of Henrietta Day Care Center	283353.6	4773455.3	158.56	520.21
Fyle Elementary School	283922.8	4771934.3	162.2	532.15
Margaret's House Day Care	282752.38	4773765.04	162.98	534.71
Adventure Learning Daycare	283840.73	4771546.9	161.33	529.30
Woodcrest Commons Senior Living Community	284225.58	4771269.27	188.98	620.01

3.1.2 Boundary Receptors

Plug Power is not installing a physical fence around the facility. Therefore, all the area outside the main building is considered ambient air and will be covered by the proposed 70 m Cartesian receptor grid.

Figure 3-2. Receptor Grid (Zoomed Out)

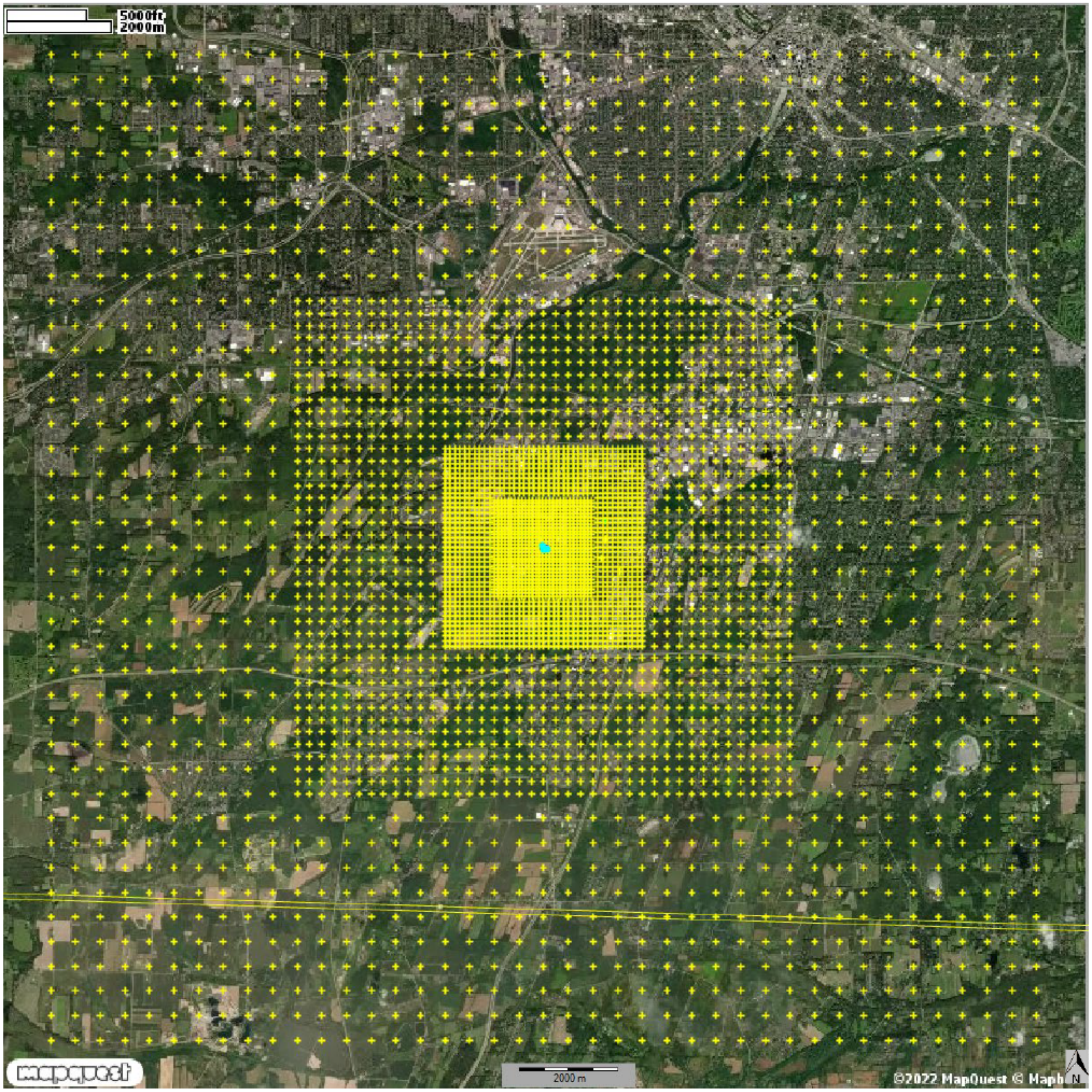
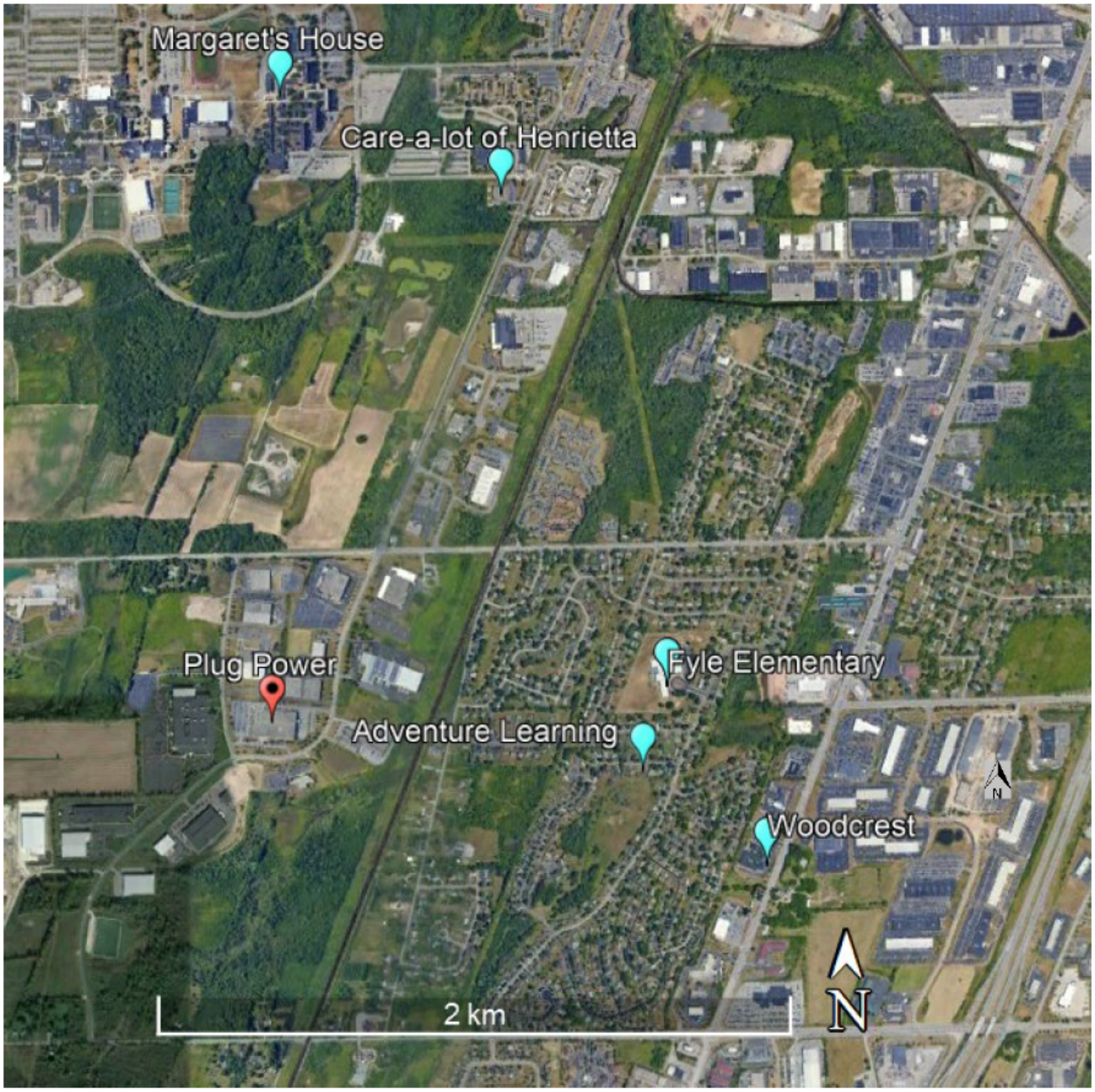


Figure 3-3. Receptor Grid (Zoomed In)

Figure 3-4. Sensitive Receptors



3.7 GEP Stack Height Analysis

Stack height regulations restrict the use of stack heights in excess of Good Engineering Practice (GEP) stack height in air dispersion modeling analyses. Under these regulations, that portion of a stack in excess of the GEP is generally not creditable when modeling to determine source impacts. This essentially prevents the use of excessively tall stacks to reduce ground-level pollutant concentrations. The minimum stack height not subject to the effects of downwash, called the GEP stack height, is defined by the following formula:

HGEP = H + 1.5L, where:

HGEP = minimum GEP stack height,
H = structure height, and

L = lesser dimension of the structure (height or projected width).

The wind direction-specific downwash dimensions and the dominant downwash structures used in this analysis will be determined using BPIP PRIME. In general, the lowest GEP stack height for any source is 65 meters by default. A source may construct a stack that exceeds GEP but is limited to the GEP stack height in the air quality analysis demonstration. All modeled source stacks at the Plug Power facility are less than 65 meters tall and therefore meet the requirements of GEP and credit for the entire actual height of each stack can be taken in this modeling analysis.

4. EMISSION SOURCES AND EMISSION RATES

This section presents the source types and stack parameters that are utilized for air dispersion modeling.

4.1 Sources and Stack Parameters

The AERMOD dispersion model allows for emission units to be represented as point, area, or volume sources.

4.1.1 Plug Power Facility Sources

All emission points proposed for modeling will exhaust from vertical, unobstructed stacks. As such, Plug Power utilized point sources using the POINT keyword for all modeled emission sources. There will be no area or volumes sources used in this modeling analysis.

Table 4-1, 4-2, and 4-3 list the sources of propanol, carbon black, and ethanol included in the air dispersion modeling. Model inputs for all point sources include stack parameters (i.e., height, diameter, exhaust gas temperature, and gas exit velocity). The site layout in Appendix A depicts the approximate location of the sources that are modeled.

Table 4-1. Point Source Parameters

AERMOD ID	Description	X Coord. (m)	Y Coord. (m)	Elevation (ft)	Elevation (m)
RTO	Regenerative Thermal Oxidizer	282747.3	4771711.5	542.55	165.37
CIP	Cleaning Process	282670.8	4771728.5	545.64	166.31
INK	Catalyst Ink/Coating Preparation	282685.4	4771727.7	544.72	166.03
LAB	MDEV R&D Laboratory	282650.7	4771787.4	549.51	167.49

Table 4-2. Point Source Stack Parameters (Imperial Units)

AERMOD ID	Description	Orientation	Stack Height (ft)	Stack Temp. (°F)	Stack Velocity (ft/s)	Stack Diameter (ft)
RTO	Regenerative Thermal Oxidizer	Vertical	35	161	28.14	3
CIP	Cleaning Process	Vertical	30.15	AMBIENT	2.55	1
INK	Catalyst Ink/Coating Preparation	Vertical	30.15	AMBIENT	47.75	0.33
LAB	MDEV R&D Laboratory	Vertical	30.15	AMBIENT	0.0033	0.33

Table 4-3. Point Source Stack Parameters (Metric Units)

AERMOD ID	Description	Orientation	Stack Height (m)	Stack Temp. (K) [a]	Stack Velocity (m/s)	Stack Diameter (m)
RTO	Regenerative Thermal Oxidizer	Vertical	10.67	344.82	8.58	0.91
CIP	Cleaning Process	Vertical	9.19	0	0.78	0.305

AERMOD ID	Description	Orientation	Stack Height (m)	Stack Temp. (K) [a]	Stack Velocity (m/s)	Stack Diameter (m)
INK	Catalyst Ink/Coating Preparation	Vertical	9.19	0	14.55	0.102
LAB	MDEV R&D Laboratory	Vertical	9.19	0	0.001	0.102

[a] If 0K is input for the stack exit temperature, AERMOD adjusts the hourly exit temperature to be equal to the ambient temperature.

4.2 Source Emission Rates

Table 4-4 represents the emission rates utilized in the AERMOD model for all modeled sources of propanol, ethanol, and carbon black. The relevant emission calculations are attached in Appendix B.

Table 4-4. Modeled Emission Rates

AERMOD ID	Description	Propanol (g/s)	Propanol (lb/hr)	Ethanol (g/s)	Ethanol (lb/hr)	Carbon Black (g/s)	Carbon Black (lb/hr)
RTO	Regenerative Thermal Oxidizer	5.81E-01	4.61	4.90E-03	3.89E-02	N/A	N/A
CIP	Cleaning Process	4.38E-02	0.35	N/A	N/A	N/A	N/A
INK	Catalyst Ink/Coating Preparation	3.40E-02	0.27	7.91E-04	6.28E-03	1.17E-02	9.29E-02
LAB	MDEV R&D Laboratory	1.96E-01	1.56	1.65E-03	1.31E-02	1.17E-02	9.29E-02

1. Conservatively modeled total PM emissions as carbon black emissions.

5. MODELING RESULTS

The modeling results are presented in Table 5-1 below. Modeled annual impacts for propanol, ethanol, and carbon black for all receptors, including sensitive receptors, are below their respective AGCs.

Electronic copies of the input and output files, along with the modeling report are being submitted to the NYSDEC through the NYSDEC's secure file transfer system.

Table 5-1. Modeling Results

Pollutants	Averaging Period	Rank	Highest Modeled Impact ($\mu g/m^3$)	AGC ($\mu g/m^3$)	Modeled Impact Below AGC?
Propanol	Annual	H1H	65.1	590	Yes
Ethanol	Annual	H1H	0.55	45,000	Yes
Carbon Black	Annual	H1H	3.82	7	Yes

APPENDIX A: FACILITY PLOT PLAN

Figure A-1. Facility Plot Plan and Buildings

APPENDIX B: EMISSION CALCULATIONS

Plug Power Innovation Center - West Henrietta, NY
New Fuel Cell Manufacturing Line
PTE Summary

Emission Source Description	Potential Annual Emissions (tpy)										
	NO_X	CO	PM	Total PM_{10}	Total $PM_{2.5}$	SO_2	VOC	Lead	Total HAP	CO_2e (100-yr)	CO_2e (20-yr)
[redacted]											
Hot Water Boiler	4.29	3.61	0.33	0.33	0.33	0.03	0.24	2.1E-05	0.08	5,129	5,134
Steam Boiler	6.87	5.77	0.52	0.52	0.52	0.04	0.38	3.4E-05	0.13	8 206	8 215
Emergency Generator	0.01	0.26	0.01	0.01	0.01	8.8E-04	0.07	--	0.11	175	175
Facility-Wide Total (tpy)	**16.45**	**14.07**	**2.08**	**2.08**	**2.08**	**0.10**	**31.01**	**8.22E-05**	**0.42**	**19,810**	**19,831**
Relevant Title V Major Source Threshold (MST)	**100**	**100**	**100**	**100**	**100**	**100**	**50**	**100**	**25**	**-**	**-**
Above Title V MST?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**-**	**-**

Reference Document: EPA Emission Inventory Improvement Program (EIIP) Document, Volume II, Chapter 8: Methods for Estimating Air Emissions from Paint, Ink, and Other Coating Manufacturing Facilities, Section 4.1

Method: EPA EIIP, Volume II, Chapter 8, Equation 8.4-1

$$E_{VOC} = 12.46 \times \frac{S \times P \times M \times Q}{T}$$

where

E_{VOC} = total VOC loading emissions (lb/yr)
S = saturation factor (dimensionless; see Table 5.2-1 in *AP-42*)
P = vapor pressure of the material loaded at temperature T (psia)
M = vapor molecular weight (lb/lb-mole)
Q = volume of material loaded (1,000 gal/yr)
T = temperature of liquid loaded (°R).

EPA EIIP, Volume II, Chapter 8, Equation 8.4-5

$$m_x = \frac{z_x/M_x}{\Sigma(z_x/M_x)}$$

where

m_x = liquid mole fraction of VOC species x (mole/mole)
z_x = liquid mass fraction of VOC species x (lb/lb)
M_x = molecular weight of VOC species x (lb/lb-mole).

EPA EIIP, Volume II, Chapter 8, Equation 8.4-3

$$P_x = m_x \times VP_x$$

where

P_x = partial vapor pressure of VOC species x (psia)
m_x = liquid mole fraction of VOC species x (mole/mole)
VP_x = true vapor pressure of VOC species x (psia).

EPA EIIP, Volume II, Chapter 8, Equation 8.4-2

$$P = \Sigma P_x$$

where

P = vapor pressure of material loaded (psia)
P_x = partial pressure of VOC species x (psia).

EPA EIIP, Volume II, Chapter 8, Equation 8.4-7

$$y_x = \frac{P_x}{P} \qquad (8.4\text{-}7)$$

where

y_x	=	vapor mole fraction of VOC species x (mole/mole)
P_x	=	partial pressure of VOC species x (calculated using Equation 8.4-3 or 8.4-4) (psia)
P	=	vapor pressure of the material loaded (calculated using Equation 8.4-2).

EPA EIIP, Volume II, Chapter 8, Equation 8.4-6

$$M = \Sigma(y_x \times M_x)$$

where

M	=	vapor molecular weight (lb/lb-mole)
y_x	=	vapor mole fraction of VOC species x (mole/mole)
M_x	=	molecular weight of VOC species x (lb/lb-mole).

EPA EIIP, Volume II, Chapter 8, Equation 8.4-9

$$x_x = \frac{y_x \times M_x}{M} \qquad (8.4\text{-}9)$$

where

x_x	=	vapor mass fraction of VOC species x (lb/lb)
y_x	=	vapor mole fraction of VOC species x, calculated using Equation 8.4-7 (mole/mole)
M_x	=	molecular weight of VOC species x (lb/lb-mole)
M	=	vapor molecular weight, calculated using Equation 8.4-6 (lb/lb-mole).

AP-42, Section 7.1, Eq 1-26 (Antoine's Equation)

$$\log P = A - \left(\frac{B}{T_{LA} + C}\right)$$

where:

log	=	log 10
A	=	constant in vapor pressure equation, dimensionless
B	=	constant in vapor pressure equation, °C
C	=	constant in vapor pressure equation, °C
T_{LA}	=	average daily liquid surface temperature, °C
P	=	vapor pressure at average liquid surface temperature, mm Hg

[redacted]

Method: EPA EIIP, Volume II, Chapter 8, Equation 8.5-15

$$E_{PM} = EF_{PM} \times \Sigma Q_x \qquad (8.5\text{-}15)$$

where

E_{PM}	=	total PM emissions (lb/yr)
EF_{PM}	=	PM emission factor (lb PM/ton pigment)
ΣQ_x	=	total pigment (ton/yr).

[redacted]

[redacted]rietta, NY

Reference Document: EPA Emission Inventory Improvement Program (EIIP) Document, Volume II, Chapter 8: Methods for Estimating Air Emissions from Paint, Ink, and Other Coating Manufacturing Facilities, Section 4.2

Method: EPA EIIP, Volume II, Chapter 8, Equation 8.4-15

$$N_{x,out} = N_{avg} \ln\left(\frac{Pa_1}{Pa_2}\right) - (n_{x,2} - n_{x,1})_{vessel} \qquad ($$

where

$N_{x,out}$	=	moles of volatile component x leaving the vessel per batch
N_{avg}	=	average gas space molar volume during the heating process
Pa_1	=	partial pressure of noncondensable in the vessel headspace at initial temperature
Pa_2	=	partial pressure of noncondensable in the vessel headspace at final temperature
$n_{x,2}$	=	moles of volatile component x in the vessel headspace at the final temperature
$n_{x,1}$	=	moles of volatile component x in the vessel headspace at the initial temperature.

EPA EIIP, Volume II, Chapter 8, Equations 8.4-17 & 18

$$n_1 = \frac{P_1 V}{RT_1}$$

$$n_2 = \frac{P_2 V}{RT_2}$$

where

P_1	=	total system pressure at initial temperature
P_2	=	total system pressure at final temperature
V	=	volume of gas space in the vessel
R	=	gas constant
T_1	=	initial temperature of vessel contents
T_2	=	final temperature of vessel contents.

Method: EPA EIIP, Volume II, Chapter 8, Equation 8.4-16

$$N_{avg} = \frac{1}{2}(n_1 + n_2) \qquad (8.4\text{-}16)$$

where

n_1	=	total moles of gas in the vessel headspace at the initial temperature
n_2	=	total moles of gas in the vessel headspace at the final temperature.

EPA EIIP, Volume II, Chapter 8, Equations 8.4-12 & 13

$$\mathbf{Pa_1 = 14.7 - \Sigma(P_x)_{T1}} \qquad (8.4\text{-}12)$$

$$\mathbf{Pa_2 = 14.7 - \Sigma(P_x)_{T2}} \qquad (8.4\text{-}13)$$

where

Pa_1	=	initial gas pressure in vessel (psia)
Pa_2	=	final gas pressure in vessel (psia)
$(P_x)_{T1}$	=	partial pressure of each VOC_x in the vessel headspace (psia) at the initial temperature T1; see Equations 8.4-3 and 8.4-4
$(P_x)_{T2}$	=	partial pressure of each VOC_x in the vessel headspace (psia) at the final temperature T2; see Equations 8.4-3 and 8.4-4.

AP-42, Section 7.1, Eq 1-26 (Antoine's Eq)

$$\log P = A - \left(\frac{B}{T_{LA} + C}\right)$$

where:

log	=	log 10
A	=	constant in vapor pressure equation, dimensionless
B	=	constant in vapor pressure equation, °C
C	=	constant in vapor pressure equation, °C
T_{LA}	=	average daily liquid surface temperature, °C
P	=	vapor pressure at average liquid surface temperature, mm Hg

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Reference Document: EPA Emission Inventory Improvement Program (EIIP) Document, Volume II, Chapter 8: Methods for Estimating Air Emissions from Paint, Ink, and Other Coating Manufacturing Facilities, Section 4.2

Method: **EPA EIIP, Volume II, Chapter 8, Equation 8.4-22**

$$E_x = \frac{M_x \times K_x \times A \times P_x \times 3600 \times H}{R \times T} \times B \qquad (8.4\text{-}22)$$

where

E_x	=	emissions of VOC species x (lb/yr)
M_x	=	molecular weight of VOC species x (lb/lb-mole)
K_x	=	gas-phase mass transfer coefficient for VOC species x (ft/sec)
A	=	surface area of exposure or opening of tank (ft^2)
P_x	=	true vapor pressure of VOC x (if a pure chemical is used) or the partial pressure of chemical x (if a mixture of VOCs is used) at temperature T (psia)^2
3600	=	3600 sec/hr
H	=	batch time (hr/batch)
R	=	universal gas constant at 1 atmosphere of pressure, 10.73 psia-ft^3/°R-lb mole;
T	=	temperature of the liquid, °R (°F+460)
B	=	number of batches per year (batches/yr).

EPA EIIP, Volume II, Chapter 8, Equation 8.4-21

$$K_x = 0.00438 \times U^{0.78} \times \left(\frac{18}{M_x}\right)^{1/3} \qquad (8.4\text{-}21)$$

where

K_x	=	gas-phase mass transfer coefficient for VOC species x (ft/sec)
U	=	wind speed (mile/hr)
M_x	=	molecular weight of VOC species x (lb/lb-mole).

[redacted]

[redacted]

Reference Document: EPA Emission Inventory Improvement Program (EIIP) Document, Volume II, Chapter 8: Methods for Estimating Air Emissions from Paint, Ink, and Other Coating Manufacturing Facilities, Section 4.5

Method: EPA EIIP, Volume II, Chapter 8, Equation 8.4-23

$$E_x = \frac{P_x \times F_{ac} \times M_x \times 60 \times OH}{R \times T} \times \frac{P_T}{P_T - \Sigma P_x}$$

where

E_x	=	emissions of VOC species x, lb/yr
P_x	=	partial pressure of VOC species x, psia
F_{ac}	=	flow rate into the vessel, ft^3/min
M_x	=	molecular weight of VOC species x, lb/lbmole
60	=	60 min/hr
OH	=	hours that the gas sweep or purge operates, hr/yr
R	=	universal gas constant (10.73 psia ft^3/lbmole °R)
T	=	temperature of the exhaust gas, °R
P_T	=	total system pressure, psia.

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[redacted]

VOC Emission Method: **Material Balance for VOC Emissions**

[redacted]

Reference Document: EPA Emission Inventory Improvement Program (EIIP) Document, Volume II, Chapter 8: Methods for Estimating Air Emissions from Paint, Ink, and Other Coating Manufacturing Facilities, Section 4.1

Method: **EPA EIIP, Volume II, Chapter 8, Equation 8.4-1**

$$E_{VOC} = 12.46 \times \frac{S \times P \times M \times Q}{T}$$

where

E_{VOC} = total VOC loading emissions (lb/yr)
S = saturation factor (dimensionless; see Table 5.2-1 in *AP-42*)
P = vapor pressure of the material loaded at temperature T (psia)
M = vapor molecular weight (lb/lb-mole)
Q = volume of material loaded (1,000 gal/yr)
T = temperature of liquid loaded (°R).

EPA EIIP, Volume II, Chapter 8, Equation 8.4-5

$$m_x = \frac{z_x/M_x}{\Sigma(z_x/M_x)}$$

where

m_x = liquid mole fraction of VOC species x (mole/mole)
z_x = liquid mass fraction of VOC species x (lb/lb)
M_x = molecular weight of VOC species x (lb/lb-mole).

EPA EIIP, Volume II, Chapter 8, Equation 8.4-3

$$P_x = m_x \times VP_x$$

where

P_x = partial vapor pressure of VOC species x (psia)
m_x = liquid mole fraction of VOC species x (mole/mole)
VP_x = true vapor pressure of VOC species x (psia).

EPA EIIP, Volume II, Chapter 8, Equation 8.4-2

$$P = \Sigma P_x$$

where

P = vapor pressure of material loaded (psia)
P_x = partial pressure of VOC species x (psia).

EPA EIIP, Volume II, Chapter 8, Equation 8.4-7

$$y_x = \frac{P_x}{P} \qquad (8.4\text{-}7)$$

where

y_x = vapor mole fraction of VOC species x (mole/mole)
P_x = partial pressure of VOC species x (calculated using Equation 8.4-3 or 8.4-4) (psia)
P = vapor pressure of the material loaded (calculated using Equation 8.4-2).

EPA EIIP, Volume II, Chapter 8, Equation 8.4-6

$$M = \Sigma(y_x \times M_x)$$

where

M = vapor molecular weight (lb/lb-mole)
y_x = vapor mole fraction of VOC species x (mole/mole)
M_x = molecular weight of VOC species x (lb/lb-mole).

EPA EIIP, Volume II, Chapter 8, Equation 8.4-9

$$x_x = \frac{y_x \times M_x}{M} \qquad (8.4\text{-}9)$$

where

x_x = vapor mass fraction of VOC species x (lb/lb)
y_x = vapor mole fraction of VOC species x, calculated using Equation 8.4-7 (mole/mole)
M_x = molecular weight of VOC species x (lb/lb-mole)
M = vapor molecular weight, calculated using Equation 8.4-6 (lb/lb-mole).

AP-42, Section 7.1, Eq 1-26 (Antoine's Equation)

$$\log P = A - \left(\frac{B}{T_{LA} + C}\right)$$

where:

log = log 10
A = constant in vapor pressure equation, dimensionless
B = constant in vapor pressure equation, °C
C = constant in vapor pressure equation, °C
T_{LA} = average daily liquid surface temperature, °C
P = vapor pressure at average liquid surface temperature, mm Hg

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Cooling Tower

Reference Document: EPA AP-42: Compilation of Air Emissions Factors, Chapter 13.4: Wet Cooling Towers; Reisman and Frisbie (July 2002), Calculating Realistic PM10 Emissions from

Cooling Tower Emissions

EP Description	Water Flow Rate	Drift Loss	Cycles of Concentration[1]	TDS[2]	Hourly Emissions (lbs/hr)			Annual Emissions[3] (tpy)		
	(gpm)	(%)		(ppmw)	PM	PM_{10}	$PM_{2.5}$	PM	PM_{10}	$PM_{2.5}$
Cooling Tower	33	0.005%	5	800	6.61E-04	5.62E-04	2.45E-06	2.9E-03	2.5E-03	1.1E-05

[1] *Per cooling tower manufacturer specifications.*

[2] *TDS for water source: Lake Hemlock Lake (one of the main source of water in Henrietta) from 2020 Water Quality Report by Monroe County Water Authority. (https://mcwa-wordpress-media.s3.amazonaws.com/wp-content/uploads/2020-Data-Summary.pdf).*

160 PPM

[3] *Assumes equipment operates 24 hours per day, 365 days per year.*

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Existing Natural Gas Combustion Equipment

Total Maxmimum Heat Input Rate:	5.73	MMBtu/hr	
Number of Units:	13		
Maximum Unit Size:	1.12	MMBtu/hr	
Fuel:	Natural Gas		
Natural Gas Higher Heating Value:	1020	Btu/scf	AP-42, Table 1.4-1, footnote a
Proposed Hours of Operation:	8760	hrs/yr	

Criteria Air Pollutant Emissions

Pollutant	Emission Factor	Emission Factor Units	Maximum Emissions (lbs/hr)	Potential Emissions (tpy)	Emission Factor Source
NO_X	100	lb/MMscf	0.56	2.46	AP-42, Table 1.4-1 (07/98)
CO	84	lb/MMscf	0.47	2.07	
Total PM	7.60	lb/MMscf	0.04	0.19	AP-42, Table 1.4-2 (07/98)
Total PM_{10}	7.60	lb/MMscf	0.04	0.19	
Total $PM_{2.5}$	7.60	lb/MMscf	0.04	0.19	
SO_2	0.60	lb/MMscf	3.37E-03	0.01	
VOC	5.50	lb/MMscf	0.03	0.14	

Greenhouse Gas Emissions

Pollutant	Emission Factor	Emission Factor Units	Maximum Emissions (lbs/hr)	Potential Emissions (tpy)	Emission Factor Source
CO_2	53.06	kg/MMBtu	670.68	2,937.57	40 CFR Appendix Table C-1 to Subpart C of Part 98
CH_4	1.00E-03	kg/MMBtu	1.26E-02	5.54E-02	40 CFR Appendix Table C-2 to Subpart C of Part 98
N_2O	1.00E-04	kg/MMBtu	1.26E-03	5.54E-03	
CO_2e (100-yr horizon)[1,2]	53.11	kg/MMBtu	671	2,941	See footnote 1
CO_2e (20-yr horizon)[2,3]	53.17	kg/MMBtu	672	2,944	See footnote 3
CO_2e (Upstream Emissions)	44.21	kg/MMBtu	559	2,447	Preliminary Interim Draft Emission Factors for Use by State Agencies and Project Proponents Table 1 (02/2021)

[1] *CO_2e emissions calculated based on Global Warming Potentials for 100-yr horizon per 40 CFR 98 Table A-1 to Subpart A. Units are in kg/MMBtu.*

CO_2	1
CH_4	25
N_2O	298

[2] *Annual CO_2e Emissions (tpy) = [GWP x Annual CO_2 emissions (tpy)] + [GWP x Annual CH_4 emissions (tpy)] + [GWP x Annual N_2O emissions (tpy)]*

[3] *CO_2e emissions calculated based on Global Warming Potentials for 20-yr horizon per 6 CRR-NY 496.5.*

CO_2	1
CH_4	84
N_2O	264

Hazardous and Other Air Pollutant Emissions

Pollutant	HAP?	Emission Factor	Emission Factor Units	Maximum Emissions (lbs/hr)	Potential Emissions (tpy)	Emission Factor Source
Lead	Yes	5.00E-04	lb/MMscf	2.81E-06	1.23E-05	AP-42, Table 1.4-2 (07/98)
2-Methylnaphthalene	Yes	2.40E-05	lb/MMscf	1.35E-07	5.91E-07	AP-42, Table 1.4-3 (07/98)
3-Methylcholanthrene	Yes	1.80E-06	lb/MMscf	1.01E-08	4.43E-08	
7,12-Dimethylbenz(a)anthracene	Yes	1.60E-05	lb/MMscf	8.99E-08	3.94E-07	
Acenaphthene	Yes	1.80E-06	lb/MMscf	1.01E-08	4.43E-08	
Acenaphthylene	Yes	1.80E-06	lb/MMscf	1.01E-08	4.43E-08	
Anthracene	Yes	2.40E-06	lb/MMscf	1.35E-08	5.91E-08	
Benz(a)anthracene	Yes	1.80E-06	lb/MMscf	1.01E-08	4.43E-08	
Benzene	Yes	2.10E-03	lb/MMscf	1.18E-05	5.17E-05	
Benzo(a)pyrene	Yes	1.20E-06	lb/MMscf	6.75E-09	2.95E-08	
Benzo(b)fluoranthene	Yes	1.80E-06	lb/MMscf	1.01E-08	4.43E-08	
Benzo(g,h,i)perylene	Yes	1.20E-06	lb/MMscf	6.75E-09	2.95E-08	
Benzo(k)fluoranthene	Yes	1.80E-06	lb/MMscf	1.01E-08	4.43E-08	
Butane	No	2.10E+00	lb/MMscf	1.18E-02	5.17E-02	
Chrysene	Yes	1.80E-06	lb/MMscf	1.01E-08	4.43E-08	
Dibenzo(a,h)anthracene	Yes	1.20E-06	lb/MMscf	6.75E-09	2.95E-08	
Dichlorobenzene	No	1.20E-03	lb/MMscf	6.75E-06	2.95E-05	
Ethane	No	3.10E+00	lb/MMscf	1.74E-02	7.63E-02	
Fluoranthene	Yes	3.00E-06	lb/MMscf	1.69E-08	7.39E-08	
Fluorene	Yes	2.80E-06	lb/MMscf	1.57E-08	6.89E-08	
Formaldehyde	Yes	7.50E-02	lb/MMscf	4.22E-04	1.85E-03	
Hexane	Yes	1.80E+00	lb/MMscf	1.01E-02	4.43E-02	
Indeno(1,2,3-cd)pyrene	Yes	1.80E-06	lb/MMscf	1.01E-08	4.43E-08	
Naphthalene	Yes	6.10E-04	lb/MMscf	3.43E-06	1.50E-05	
Pentane	No	2.60E+00	lb/MMscf	1.46E-02	6.40E-02	
Phenanathrene	Yes	1.70E-05	lb/MMscf	9.56E-08	4.19E-07	
Propane	No	1.60E+00	lb/MMscf	8.99E-03	3.94E-02	
Pyrene	Yes	5.00E-06	lb/MMscf	2.81E-08	1.23E-07	
Toluene	Yes	3.40E-03	lb/MMscf	1.91E-05	8.37E-05	
Arsenic	Yes	2.00E-04	lb/MMscf	1.12E-06	4.92E-06	AP-42, Table 1.4-4 (07/98)
Barium	No	4.40E-03	lb/MMscf	2.47E-05	1.08E-04	
Beryllium	Yes	1.20E-05	lb/MMscf	6.75E-08	2.95E-07	
Cadmium	Yes	1.10E-03	lb/MMscf	6.18E-06	2.71E-05	
Chromium	Yes	1.40E-03	lb/MMscf	7.87E-06	3.45E-05	
Cobalt	Yes	8.40E-05	lb/MMscf	4.72E-07	2.07E-06	
Copper	No	8.50E-04	lb/MMscf	4.78E-06	2.09E-05	
Manganese	Yes	3.80E-04	lb/MMscf	2.14E-06	9.36E-06	
Mercury	Yes	2.60E-04	lb/MMscf	1.46E-06	6.40E-06	
Molybdenum	No	1.10E-03	lb/MMscf	6.18E-06	2.71E-05	
Nickel	Yes	2.10E-03	lb/MMscf	1.18E-05	5.17E-05	
Selenium	Yes	2.40E-05	lb/MMscf	1.35E-07	5.91E-07	
Vanadium	No	2.30E-03	lb/MMscf	1.29E-05	5.66E-05	
Zinc	No	2.90E-02	lb/MMscf	1.63E-04	7.14E-04	
			Total HAPs	**1.06E-02**	**4.65E-02**	
			Max HAP	**1.01E-02**	**4.43E-02**	

Plug Power Innovation Center - West Henrietta, NY
[redacted] RTO Combustion Emissions

Emission Point ID:	EC-05		
Emission Point Description:	Electrode Coating (RTO)		
Total Maxmimum Heat Input Rate:	5.50	MMBtu/hr	
Fuel:	Natural Gas		
Natural Gas Higher Heating Value:	1020	Btu/scf	AP-42, Table 1.4-1, footnote a
Proposed Hours of Operation:	8760	hrs/yr	

Criteria Air Pollutant Emissions

Pollutant	Emission Factor	Emission Factor Units	Maximum Emissions (lbs/hr)	Potential Emissions (tpy)	Emission Factor Source
NO_X	100	lb/MMscf	0.54	2.36	AP-42, Table 1.4-1 (07/98)
CO	84	lb/MMscf	0.45	1.98	
Total PM	7.60	lb/MMscf	0.04	0.18	AP-42, Table 1.4-2 (07/98)
Total PM_{10}	7.60	lb/MMscf	0.04	0.18	
Total $PM_{2.5}$	7.60	lb/MMscf	0.04	0.18	
SO_2	0.60	lb/MMscf	3.24E-03	0.01	
VOC	5.50	lb/MMscf	0.03	0.13	

Greenhouse Gas Emissions

Pollutant	Emission Factor	Emission Factor Units	Maximum Emissions (lbs/hr)	Potential Emissions (tpy)	Emission Factor Source
CO_2	53.06	kg/MMBtu	643.38	2,817.98	40 CFR Appendix Table C-1 to Subpart C of Part 98
CH_4	1.00E-03	kg/MMBtu	1.21E-02	5.31E-02	40 CFR Appendix Table C-2 to Subpart C of Part 98
N_2O	1.00E-04	kg/MMBtu	1.21E-03	5.31E-03	
CO_2e (100-yr horizon)[1,2]	53.11	kg/MMBtu	644	2,821	See footnote 1
CO_2e (20-yr horizon)[2,3]	53.17	kg/MMBtu	645	2,824	See footnote 3
CO_2e (Upstream Emissions)	44.21	kg/MMBtu	536	2,348	Preliminary Interim Draft Emission Factors for Use by State Agencies and Project Proponents Table 1 (02/2021)

[1] *CO_2e emissions calculated based on Global Warming Potentials for 100-yr horizon per 40 CFR 98 Table A-1 to Subpart A. Units are in kg/MMBtu.*

CO_2	1
CH_4	25
N_2O	298

[2] *Annual CO_2e Emissions (tpy) = [GWP x Annual CO_2 emissions (tpy)] + [GWP x Annual CH_4 emissions (tpy)] + [GWP x Annual N_2O emissions (tpy)]*

[3] *CO_2e emissions calculated based on Global Warming Potentials for 20-yr horizon per 6 CRR-NY 496.5.*

CO_2	1
CH_4	84
N_2O	264

Hazardous and Other Air Pollutant Emissions

Pollutant	HAP?	Emission Factor	Emission Factor Units	Maximum Emissions (lbs/hr)	Potential Emissions (tpy)	Emission Factor Source
Lead	Yes	5.00E-04	lb/MMscf	2.70E-06	1.18E-05	AP-42, Table 1.4-2 (07/98)
2-Methylnaphthalene	Yes	2.40E-05	lb/MMscf	1.29E-07	5.67E-07	AP-42, Table 1.4-3 (07/98)
3-Methylcholanthrene	Yes	1.80E-06	lb/MMscf	9.71E-09	4.25E-08	
7,12-Dimethylbenz(a)anthracene	Yes	1.60E-05	lb/MMscf	8.63E-08	3.78E-07	
Acenaphthene	Yes	1.80E-06	lb/MMscf	9.71E-09	4.25E-08	
Acenaphthylene	Yes	1.80E-06	lb/MMscf	9.71E-09	4.25E-08	
Anthracene	Yes	2.40E-06	lb/MMscf	1.29E-08	5.67E-08	
Benz(a)anthracene	Yes	1.80E-06	lb/MMscf	9.71E-09	4.25E-08	
Benzene	Yes	2.10E-03	lb/MMscf	1.13E-05	4.96E-05	
Benzo(a)pyrene	Yes	1.20E-06	lb/MMscf	6.47E-09	2.83E-08	
Benzo(b)fluoranthene	Yes	1.80E-06	lb/MMscf	9.71E-09	4.25E-08	
Benzo(g,h,i)perylene	Yes	1.20E-06	lb/MMscf	6.47E-09	2.83E-08	
Benzo(k)fluoranthene	Yes	1.80E-06	lb/MMscf	9.71E-09	4.25E-08	
Butane	No	2.10E+00	lb/MMscf	1.13E-02	4.96E-02	
Chrysene	Yes	1.80E-06	lb/MMscf	9.71E-09	4.25E-08	
Dibenzo(a,h)anthracene	Yes	1.20E-06	lb/MMscf	6.47E-09	2.83E-08	
Dichlorobenzene	No	1.20E-03	lb/MMscf	6.47E-06	2.83E-05	
Ethane	No	3.10E+00	lb/MMscf	1.67E-02	7.32E-02	
Fluoranthene	Yes	3.00E-06	lb/MMscf	1.62E-08	7.09E-08	
Fluorene	Yes	2.80E-06	lb/MMscf	1.51E-08	6.61E-08	
Formaldehyde	Yes	7.50E-02	lb/MMscf	4.04E-04	1.77E-03	
Hexane	Yes	1.80E+00	lb/MMscf	9.71E-03	4.25E-02	
Indeno(1,2,3-cd)pyrene	Yes	1.80E-06	lb/MMscf	9.71E-09	4.25E-08	
Naphthalene	Yes	6.10E-04	lb/MMscf	3.29E-06	1.44E-05	
Pentane	No	2.60E+00	lb/MMscf	1.40E-02	6.14E-02	
Phenanathrene	Yes	1.70E-05	lb/MMscf	9.17E-08	4.02E-07	
Propane	No	1.60E+00	lb/MMscf	8.63E-03	3.78E-02	
Pyrene	Yes	5.00E-06	lb/MMscf	2.70E-08	1.18E-07	
Toluene	Yes	3.40E-03	lb/MMscf	1.83E-05	8.03E-05	
Arsenic	Yes	2.00E-04	lb/MMscf	1.08E-06	4.72E-06	AP-42, Table 1.4-4 (07/98)
Barium	No	4.40E-03	lb/MMscf	2.37E-05	1.04E-04	
Beryllium	Yes	1.20E-05	lb/MMscf	6.47E-08	2.83E-07	
Cadmium	Yes	1.10E-03	lb/MMscf	5.93E-06	2.60E-05	
Chromium	Yes	1.40E-03	lb/MMscf	7.55E-06	3.31E-05	
Cobalt	Yes	8.40E-05	lb/MMscf	4.53E-07	1.98E-06	
Copper	No	8.50E-04	lb/MMscf	4.58E-06	2.01E-05	
Manganese	Yes	3.80E-04	lb/MMscf	2.05E-06	8.97E-06	
Mercury	Yes	2.60E-04	lb/MMscf	1.40E-06	6.14E-06	
Molybdenum	No	1.10E-03	lb/MMscf	5.93E-06	2.60E-05	
Nickel	Yes	2.10E-03	lb/MMscf	1.13E-05	4.96E-05	
Selenium	Yes	2.40E-05	lb/MMscf	1.29E-07	5.67E-07	
Vanadium	No	2.30E-03	lb/MMscf	1.24E-05	5.43E-05	
Zinc	No	2.90E-02	lb/MMscf	1.56E-04	6.85E-04	
			Total HAPs	**1.02E-02**	**4.46E-02**	
			Max HAP	**9.71E-03**	**4.25E-02**	

Plug Power Innovation Center - West Henrietta, NY

[redacted] **Combustion Emissions**

Emission Point IDs:	ELX-06, ELX-10, ELX-11		
Emission Point Description:	Soak Heater		
Total Maxmimum Heat Input Rate:	1.05	MMBtu/hr	
Number of Units:	3		
Maximum Unit Size:	0.35	MMBtu/hr	
Fuel:	Natural Gas		
Natural Gas Higher Heating Value:	1020	Btu/scf	AP-42, Table 1.4-1, footnote a
Proposed Hours of Operation:	8760	hrs/yr	

Criteria Air Pollutant Emissions

Pollutant	Emission Factor	Emission Factor Units	Maximum Emissions (lbs/hr)	Potential Emissions (tpy)	Emission Factor Source
NO_X	100	lb/MMscf	0.10	0.45	AP-42, Table 1.4-1 (07/98)
CO	84	lb/MMscf	0.09	0.38	
Total PM	7.60	lb/MMscf	0.01	0.03	AP-42, Table 1.4-2 (07/98)
Total PM_{10}	7.60	lb/MMscf	0.01	0.03	
Total $PM_{2.5}$	7.60	lb/MMscf	0.01	0.03	
SO_2	0.60	lb/MMscf	6.18E-04	0.00	
VOC	5.50	lb/MMscf	0.01	0.02	

Greenhouse Gas Emissions

Pollutant	Emission Factor	Emission Factor Units	Maximum Emissions (lbs/hr)	Potential Emissions (tpy)	Emission Factor Source
CO_2	53.06	kg/MMBtu	122.83	537.98	40 CFR Appendix Table C-1 to Subpart C of Part 98
CH_4	1.00E-03	kg/MMBtu	2.31E-03	1.01E-02	40 CFR Appendix Table C-2 to Subpart C of Part 98
N_2O	1.00E-04	kg/MMBtu	2.31E-04	1.01E-03	
CO_2e (100-yr horizon)[1,2]	53.11	kg/MMBtu	123	539	See footnote 1
CO_2e (20-yr horizon)[2,3]	53.17	kg/MMBtu	123	539	See footnote 3
CO_2e (Upstream Emissions)	44.21	kg/MMBtu	102	448	Preliminary Interim Draft Emission Factors for Use by State Agencies and Project Proponents Table 1 (02/2021)

[1] *CO_2e emissions calculated based on Global Warming Potentials for 100-yr horizon per 40 CFR 98 Table A-1 to Subpart A. Units are in kg/MMBtu.*

CO_2	1
CH_4	25
N_2O	298

[2] *Annual CO_2e Emissions (tpy) = [GWP x Annual CO_2 emissions (tpy)] + [GWP x Annual CH_4 emissions (tpy)] + [GWP x Annual N_2O emissions (tpy)]*

[3] *CO_2e emissions calculated based on Global Warming Potentials for 20-yr horizon per 6 CRR-NY 496.5.*

CO_2	1
CH_4	84
N_2O	264

Hazardous and Other Air Pollutant Emissions

Pollutant	HAP?	Emission Factor	Emission Factor Units	Maximum Emissions (lbs/hr)	Potential Emissions (tpy)	Emission Factor Source
Lead	Yes	5.00E-04	lb/MMscf	5.15E-07	2.25E-06	AP-42, Table 1.4-2 (07/98)
2-Methylnaphthalene	Yes	2.40E-05	lb/MMscf	2.47E-08	1.08E-07	AP-42, Table 1.4-3 (07/98)
3-Methylcholanthrene	Yes	1.80E-06	lb/MMscf	1.85E-09	8.12E-09	
7,12-Dimethylbenz(a)anthracene	Yes	1.60E-05	lb/MMscf	1.65E-08	7.21E-08	
Acenaphthene	Yes	1.80E-06	lb/MMscf	1.85E-09	8.12E-09	
Acenaphthylene	Yes	1.80E-06	lb/MMscf	1.85E-09	8.12E-09	
Anthracene	Yes	2.40E-06	lb/MMscf	2.47E-09	1.08E-08	
Benz(a)anthracene	Yes	1.80E-06	lb/MMscf	1.85E-09	8.12E-09	
Benzene	Yes	2.10E-03	lb/MMscf	2.16E-06	9.47E-06	
Benzo(a)pyrene	Yes	1.20E-06	lb/MMscf	1.24E-09	5.41E-09	
Benzo(b)fluoranthene	Yes	1.80E-06	lb/MMscf	1.85E-09	8.12E-09	
Benzo(g,h,i)perylene	Yes	1.20E-06	lb/MMscf	1.24E-09	5.41E-09	
Benzo(k)fluoranthene	Yes	1.80E-06	lb/MMscf	1.85E-09	8.12E-09	
Butane	No	2.10E+00	lb/MMscf	2.16E-03	9.47E-03	
Chrysene	Yes	1.80E-06	lb/MMscf	1.85E-09	8.12E-09	
Dibenzo(a,h)anthracene	Yes	1.20E-06	lb/MMscf	1.24E-09	5.41E-09	
Dichlorobenzene	No	1.20E-03	lb/MMscf	1.24E-06	5.41E-06	
Ethane	No	3.10E+00	lb/MMscf	3.19E-03	1.40E-02	
Fluoranthene	Yes	3.00E-06	lb/MMscf	3.09E-09	1.35E-08	
Fluorene	Yes	2.80E-06	lb/MMscf	2.88E-09	1.26E-08	
Formaldehyde	Yes	7.50E-02	lb/MMscf	7.72E-05	3.38E-04	
Hexane	Yes	1.80E+00	lb/MMscf	1.85E-03	8.12E-03	
Indeno(1,2,3-cd)pyrene	Yes	1.80E-06	lb/MMscf	1.85E-09	8.12E-09	
Naphthalene	Yes	6.10E-04	lb/MMscf	6.28E-07	2.75E-06	
Pentane	No	2.60E+00	lb/MMscf	2.68E-03	1.17E-02	
Phenanathrene	Yes	1.70E-05	lb/MMscf	1.75E-08	7.67E-08	
Propane	No	1.60E+00	lb/MMscf	1.65E-03	7.21E-03	
Pyrene	Yes	5.00E-06	lb/MMscf	5.15E-09	2.25E-08	
Toluene	Yes	3.40E-03	lb/MMscf	3.50E-06	1.53E-05	
Arsenic	Yes	2.00E-04	lb/MMscf	2.06E-07	9.02E-07	AP-42, Table 1.4-4 (07/98)
Barium	No	4.40E-03	lb/MMscf	4.53E-06	1.98E-05	
Beryllium	Yes	1.20E-05	lb/MMscf	1.24E-08	5.41E-08	
Cadmium	Yes	1.10E-03	lb/MMscf	1.13E-06	4.96E-06	
Chromium	Yes	1.40E-03	lb/MMscf	1.44E-06	6.31E-06	
Cobalt	Yes	8.40E-05	lb/MMscf	8.65E-08	3.79E-07	
Copper	No	8.50E-04	lb/MMscf	8.75E-07	3.83E-06	
Manganese	Yes	3.80E-04	lb/MMscf	3.91E-07	1.71E-06	
Mercury	Yes	2.60E-04	lb/MMscf	2.68E-07	1.17E-06	
Molybdenum	No	1.10E-03	lb/MMscf	1.13E-06	4.96E-06	
Nickel	Yes	2.10E-03	lb/MMscf	2.16E-06	9.47E-06	
Selenium	Yes	2.40E-05	lb/MMscf	2.47E-08	1.08E-07	
Vanadium	No	2.30E-03	lb/MMscf	2.37E-06	1.04E-05	
Zinc	No	2.90E-02	lb/MMscf	2.99E-05	1.31E-04	
			Total HAPs	**1.94E-03**	**8.51E-03**	
			Max HAP	**1.85E-03**	**8.12E-03**	

Plug Power Innovation Center - West Henrietta, NY

[redacted]

Hot Water Boiler Combustion Emissions

Emission Point ID:	BOIL-HW		
Emission Point Description:	HW Boiler		
Total Maxmimum Heat Input Rate:	10.0	MMBtu/hr	
Fuel:	Natural Gas		
Natural Gas Higher Heating Value:	1020	Btu/scf	AP-42, Table 1.4-1, footnote a
Proposed Hours of Operation:	8760	hrs/yr	

Criteria Air Pollutant Emissions

Pollutant	Emission Factor	Emission Factor Units	Maximum Emissions	Potential Emissions	Emission Factor Source
			(lbs/hr)	(tpy)	
NO_X	100	lb/MMscf	0.98	4.29	AP-42, Table 1.4-1 (07/98)
CO	84	lb/MMscf	0.82	3.61	
Total PM	7.60	lb/MMscf	0.07	0.33	AP-42, Table 1.4-2 (07/98)
Total PM_{10}	7.60	lb/MMscf	0.07	0.33	
Total $PM_{2.5}$	7.60	lb/MMscf	0.07	0.33	
SO_2	0.60	lb/MMscf	5.88E-03	0.03	
VOC	5.50	lb/MMscf	0.05	0.24	

Greenhouse Gas Emissions

Pollutant	Emission Factor	Emission Factor Units	Maximum Emissions	Potential Emissions	Emission Factor Source
			(lbs/hr)	(tpy)	
CO_2	53.06	kg/MMBtu	1,169.77	5,123.60	40 CFR Appendix Table C-1 to Subpart C of Part 98
CH_4	1.00E-03	kg/MMBtu	2.20E-02	9.66E-02	40 CFR Appendix Table C-2 to Subpart C of Part 98
N_2O	1.00E-04	kg/MMBtu	2.20E-03	9.66E-03	
CO_2e (100-yr horizon)[1,2]	53.11	kg/MMBtu	1,171	5,129	See footnote 1
CO_2e (20-yr horizon)[2,3]	53.17	kg/MMBtu	1,172	5,134	See footnote 3
CO_2e (Upstream Emissions)	44.21	kg/MMBtu	975	4,269	Preliminary Interim Draft Emission Factors for Use by State Agencies and Project Proponents Table 1 (02/2021)

[1] *CO_2e emissions calculated based on Global Warming Potentials for 100-yr horizon per 40 CFR 98 Table A-1 to Subpart A. Units are in kg/MMBtu.*

CO_2	1
CH_4	25
N_2O	298

[2] *Annual CO_2e Emissions (tpy) = [GWP x Annual CO_2 emissions (tpy)] + [GWP x Annual CH_4 emissions (tpy)] + [GWP x Annual N_2O emissions (tpy)]*

[3] *CO_2e emissions calculated based on Global Warming Potentials for 20-yr horizon per 6 CRR-NY 496.5.*

CO_2	1
CH_4	84
N_2O	264

Hazardous and Other Air Pollutant Emissions

Pollutant	HAP?	Emission Factor	Emission Factor Units	Maximum Emissions (lbs/hr)	Potential Emissions (tpy)	Emission Factor Source
Lead	Yes	5.00E-04	lb/MMscf	4.90E-06	2.15E-05	AP-42, Table 1.4-2 (07/98)
2-Methylnaphthalene	Yes	2.40E-05	lb/MMscf	2.35E-07	1.03E-06	AP-42, Table 1.4-3 (07/98)
3-Methylcholanthrene	Yes	1.80E-06	lb/MMscf	1.76E-08	7.73E-08	
7,12-Dimethylbenz(a)anthracene	Yes	1.60E-05	lb/MMscf	1.57E-07	6.87E-07	
Acenaphthene	Yes	1.80E-06	lb/MMscf	1.76E-08	7.73E-08	
Acenaphthylene	Yes	1.80E-06	lb/MMscf	1.76E-08	7.73E-08	
Anthracene	Yes	2.40E-06	lb/MMscf	2.35E-08	1.03E-07	
Benz(a)anthracene	Yes	1.80E-06	lb/MMscf	1.76E-08	7.73E-08	
Benzene	Yes	2.10E-03	lb/MMscf	2.06E-05	9.02E-05	
Benzo(a)pyrene	Yes	1.20E-06	lb/MMscf	1.18E-08	5.15E-08	
Benzo(b)fluoranthene	Yes	1.80E-06	lb/MMscf	1.76E-08	7.73E-08	
Benzo(g,h,i)perylene	Yes	1.20E-06	lb/MMscf	1.18E-08	5.15E-08	
Benzo(k)fluoranthene	Yes	1.80E-06	lb/MMscf	1.76E-08	7.73E-08	
Butane	No	2.10E+00	lb/MMscf	2.06E-02	9.02E-02	
Chrysene	Yes	1.80E-06	lb/MMscf	1.76E-08	7.73E-08	
Dibenzo(a,h)anthracene	Yes	1.20E-06	lb/MMscf	1.18E-08	5.15E-08	
Dichlorobenzene	No	1.20E-03	lb/MMscf	1.18E-05	5.15E-05	
Ethane	No	3.10E+00	lb/MMscf	3.04E-02	1.33E-01	
Fluoranthene	Yes	3.00E-06	lb/MMscf	2.94E-08	1.29E-07	
Fluorene	Yes	2.80E-06	lb/MMscf	2.75E-08	1.20E-07	
Formaldehyde	Yes	7.50E-02	lb/MMscf	7.35E-04	3.22E-03	
Hexane	Yes	1.80E+00	lb/MMscf	1.76E-02	7.73E-02	
Indeno(1,2,3-cd)pyrene	Yes	1.80E-06	lb/MMscf	1.76E-08	7.73E-08	
Naphthalene	Yes	6.10E-04	lb/MMscf	5.98E-06	2.62E-05	
Pentane	No	2.60E+00	lb/MMscf	2.55E-02	1.12E-01	
Phenanathrene	Yes	1.70E-05	lb/MMscf	1.67E-07	7.30E-07	
Propane	No	1.60E+00	lb/MMscf	1.57E-02	6.87E-02	
Pyrene	Yes	5.00E-06	lb/MMscf	4.90E-08	2.15E-07	
Toluene	Yes	3.40E-03	lb/MMscf	3.33E-05	1.46E-04	
Arsenic	Yes	2.00E-04	lb/MMscf	1.96E-06	8.59E-06	AP-42, Table 1.4-4 (07/98)
Barium	No	4.40E-03	lb/MMscf	4.31E-05	1.89E-04	
Beryllium	Yes	1.20E-05	lb/MMscf	1.18E-07	5.15E-07	
Cadmium	Yes	1.10E-03	lb/MMscf	1.08E-05	4.72E-05	
Chromium	Yes	1.40E-03	lb/MMscf	1.37E-05	6.01E-05	
Cobalt	Yes	8.40E-05	lb/MMscf	8.24E-07	3.61E-06	
Copper	No	8.50E-04	lb/MMscf	8.33E-06	3.65E-05	
Manganese	Yes	3.80E-04	lb/MMscf	3.73E-06	1.63E-05	
Mercury	Yes	2.60E-04	lb/MMscf	2.55E-06	1.12E-05	
Molybdenum	No	1.10E-03	lb/MMscf	1.08E-05	4.72E-05	
Nickel	Yes	2.10E-03	lb/MMscf	2.06E-05	9.02E-05	
Selenium	Yes	2.40E-05	lb/MMscf	2.35E-07	1.03E-06	
Vanadium	No	2.30E-03	lb/MMscf	2.25E-05	9.88E-05	
Zinc	No	2.90E-02	lb/MMscf	2.84E-04	1.25E-03	
			Total HAPs	**1.85E-02**	**8.10E-02**	
			Max HAP	**1.76E-02**	**7.73E-02**	

Plug Power Innovation Center - West Henrietta, NY
[redacted]
Steam Boiler Combustion Emissions

Emission Point ID:	BOIL-STEAM		
Emission Point Description:	Steam Boiler		
Total Maxmimum Heat Input Rate:	16.00	MMBtu/hr	
Fuel:	Natural Gas		
Natural Gas Higher Heating Value:	1020	Btu/scf	AP-42, Table 1.4-1, footnote a
Proposed Hours of Operation:	8760	hrs/yr	

Criteria Air Pollutant Emissions

Pollutant	Emission Factor	Emission Factor Units	Maximum Emissions (lbs/hr)	Potential Emissions (tpy)	Emission Factor Source
NO_X	100	lb/MMscf	1.57	6.87	AP-42, Table 1.4-1 (07/98)
CO	84	lb/MMscf	1.32	5.77	
Total PM	7.60	lb/MMscf	0.12	0.52	AP-42, Table 1.4-2 (07/98)
Total PM_{10}	7.60	lb/MMscf	0.12	0.52	
Total $PM_{2.5}$	7.60	lb/MMscf	0.12	0.52	
SO_2	0.60	lb/MMscf	9.41E-03	0.04	
VOC	5.50	lb/MMscf	0.09	0.38	

Greenhouse Gas Emissions

Pollutant	Emission Factor	Emission Factor Units	Maximum Emissions (lbs/hr)	Potential Emissions (tpy)	Emission Factor Source
CO_2	53.06	kg/MMBtu	1,871.64	8,197.77	40 CFR Appendix Table C-1 to Subpart C of Part 98
CH_4	1.00E-03	kg/MMBtu	3.53E-02	1.54E-01	40 CFR Appendix Table C-2 to Subpart C of Part 98
N_2O	1.00E-04	kg/MMBtu	3.53E-03	1.54E-02	
CO_2e (100-yr horizon)[1,2]	53.11	kg/MMBtu	1,874	8,206	See footnote 1
CO_2e (20-yr horizon)[2,3]	53.17	kg/MMBtu	1,876	8,215	See footnote 3
CO_2e (Upstream Emissions)	44.21	kg/MMBtu	1,559	6,830	Preliminary Interim Draft Emission Factors for Use by State Agencies and Project Proponents Table 1 (02/2021)

[1] *CO_2e emissions calculated based on Global Warming Potentials for 100-yr horizon per 40 CFR 98 Table A-1 to Subpart A. Units are in kg/MMBtu.*

CO_2	1
CH_4	25
N_2O	298

[2] *Annual CO_2e Emissions (tpy) = [GWP x Annual CO_2 emissions (tpy)] + [GWP x Annual CH_4 emissions (tpy)] + [GWP x Annual N_2O emissions (tpy)]*

[3] *CO_2e emissions calculated based on Global Warming Potentials for 20-yr horizon per 6 CRR-NY 496.5.*

CO_2	1
CH_4	84
N_2O	264

Hazardous and Other Air Pollutant Emissions

Pollutant	HAP?	Emission Factor	Emission Factor Units	Maximum Emissions (lbs/hr)	Potential Emissions (tpy)	Emission Factor Source
Lead	Yes	5.00E-04	lb/MMscf	7.84E-06	3.44E-05	AP-42, Table 1.4-2 (07/98)
2-Methylnaphthalene	Yes	2.40E-05	lb/MMscf	3.76E-07	1.65E-06	AP-42, Table 1.4-3 (07/98)
3-Methylcholanthrene	Yes	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	
7,12-Dimethylbenz(a)anthracene	Yes	1.60E-05	lb/MMscf	2.51E-07	1.10E-06	
Acenaphthene	Yes	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	
Acenaphthylene	Yes	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	
Anthracene	Yes	2.40E-06	lb/MMscf	3.76E-08	1.65E-07	
Benz(a)anthracene	Yes	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	
Benzene	Yes	2.10E-03	lb/MMscf	3.29E-05	1.44E-04	
Benzo(a)pyrene	Yes	1.20E-06	lb/MMscf	1.88E-08	8.24E-08	
Benzo(b)fluoranthene	Yes	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	
Benzo(g,h,i)perylene	Yes	1.20E-06	lb/MMscf	1.88E-08	8.24E-08	
Benzo(k)fluoranthene	Yes	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	
Butane	No	2.10E+00	lb/MMscf	3.29E-02	1.44E-01	
Chrysene	Yes	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	
Dibenzo(a,h)anthracene	Yes	1.20E-06	lb/MMscf	1.88E-08	8.24E-08	
Dichlorobenzene	No	1.20E-03	lb/MMscf	1.88E-05	8.24E-05	
Ethane	No	3.10E+00	lb/MMscf	4.86E-02	2.13E-01	
Fluoranthene	Yes	3.00E-06	lb/MMscf	4.71E-08	2.06E-07	
Fluorene	Yes	2.80E-06	lb/MMscf	4.39E-08	1.92E-07	
Formaldehyde	Yes	7.50E-02	lb/MMscf	1.18E-03	5.15E-03	
Hexane	Yes	1.80E+00	lb/MMscf	2.82E-02	1.24E-01	
Indeno(1,2,3-cd)pyrene	Yes	1.80E-06	lb/MMscf	2.82E-08	1.24E-07	
Naphthalene	Yes	6.10E-04	lb/MMscf	9.57E-06	4.19E-05	
Pentane	No	2.60E+00	lb/MMscf	4.08E-02	1.79E-01	
Phenanathrene	Yes	1.70E-05	lb/MMscf	2.67E-07	1.17E-06	
Propane	No	1.60E+00	lb/MMscf	2.51E-02	1.10E-01	
Pyrene	Yes	5.00E-06	lb/MMscf	7.84E-08	3.44E-07	
Toluene	Yes	3.40E-03	lb/MMscf	5.33E-05	2.34E-04	
Arsenic	Yes	2.00E-04	lb/MMscf	3.14E-06	1.37E-05	AP-42, Table 1.4-4 (07/98)
Barium	No	4.40E-03	lb/MMscf	6.90E-05	3.02E-04	
Beryllium	Yes	1.20E-05	lb/MMscf	1.88E-07	8.24E-07	
Cadmium	Yes	1.10E-03	lb/MMscf	1.73E-05	7.56E-05	
Chromium	Yes	1.40E-03	lb/MMscf	2.20E-05	9.62E-05	
Cobalt	Yes	8.40E-05	lb/MMscf	1.32E-06	5.77E-06	
Copper	No	8.50E-04	lb/MMscf	1.33E-05	5.84E-05	
Manganese	Yes	3.80E-04	lb/MMscf	5.96E-06	2.61E-05	
Mercury	Yes	2.60E-04	lb/MMscf	4.08E-06	1.79E-05	
Molybdenum	No	1.10E-03	lb/MMscf	1.73E-05	7.56E-05	
Nickel	Yes	2.10E-03	lb/MMscf	3.29E-05	1.44E-04	
Selenium	Yes	2.40E-05	lb/MMscf	3.76E-07	1.65E-06	
Vanadium	No	2.30E-03	lb/MMscf	3.61E-05	1.58E-04	
Zinc	No	2.90E-02	lb/MMscf	4.55E-04	1.99E-03	
			Total HAPs	**2.96E-02**	**1.30E-01**	
			Max HAP	**2.82E-02**	**1.24E-01**	

Plug Power Innovation Center - West Henrietta, NY
Emergency Generator

Generator Make:	Generac		Manufacturer Data
Generator Model:	SG500		Manufacturer Data
Engine Power:	777	BHP	Manufacturer Data
Fuel Consumption Rate (at 100% load in demand response):	5862	scf/hr	Manufacturer Data
Fuel:	Natural Gas		
Natural Gas Higher Heating Value:	1020	Btu/scf	AP-42, Table 3.2-2, footnote b
Heat Input Rate	5.98	MMBtu/hr	
Allowed Hours of Operation:	500	hrs/yr	6 CRR-NY 200.1(bl)

Criteria Air Pollutant Emissions

Pollutant	Emission Factor	Emission Factor Units	Maximum Emissions (lbs/hr)	Potential Emissions (tpy)	Emission Factor Source
NO_X	0.03	g/BHP-hr	0 05	0.01	Generac Statement of Exhaust Emissions
CO	0.60	g/BHP-hr	1 03	0.26	
Total PM	9.99E-03	lb/MMBtu	0 06	0.01	AP-42, Table 3.2-2 (08/00)
Total PM_{10}	9.99E-03	lb/MMBtu	0 06	0.01	
Total $PM_{2.5}$	9.99E-03	lb/MMBtu	0 06	0.01	
SO_2	5.88E-04	lb/MMBtu	3.52E-03	0.001	
VOC	0.16	g/BHP-hr	0 27	0.07	Generac Statement of Exhaust Emissions

Greenhouse Gas Emissions

Pollutant	Emission Factor	Emission Factor Units	Maximum Emissions (lbs/hr)	Potential Emissions (tpy)	Emission Factor Source
CO_2	53.06	kg/MMBtu	699.44	174.86	40 CFR Appendix Table C-1 to Subpart C of Part 98
CH_4	1.00E-03	kg/MMBtu	1.32E-02	0.00	40 CFR Appendix Table C-2 to Subpart C of Part 98
N_2O	1.00E-04	kg/MMBtu	1.32E-03	0.00	
CO_2e (100-yr horizon)[1,2]	53.11	kg/MMBtu	700	175	See footnote 1
CO_2e (20-yr horizon)[2,3]	53.17	kg/MMBtu	701	175	See footnote 3
CO_2e (Upstream Emissions)	44.21	kg/MMBtu	583	146	Preliminary Interim Draft Emission Factors for Use by State Agencies and Project Proponents Table 1 (02/2021)

[1] *CO_2e emissions calculated based on Global Warming Potentials for 100-yr horizon per 40 CFR 98 Table A-1 to Subpart A Units are in kg/MMBtu*

CO_2	1
CH_4	25
N_2O	298

[2] *Annual CO_2e Emissions (tpy) = [GWP x Annual CO_2 emissions (tpy)] + [GWP x Annual CH_4 emissions (tpy)] + [GWP x Annual N_2O emissions (tpy)]*

[3] *CO_2e emissions calculated based on Global Warming Potentials for 20-yr horizon per 6 CRR-NY 496 5*

CO_2	1
CH_4	84
N_2O	264

Hazardous and Other Air Pollutant Emissions

Pollutant	HAP?	Emission Factor	Emission Factor Units	Maximum Emissions (lbs/hr)	Potential Emissions (tpy)	Emission Factor Source
1,1,2,2-Tetrachloroethane	Yes	4.00E-05	lb/MMBtu	2.39E-04	5.98E-05	AP-42, Table 3.2-2 (08/00)
1,1,2-Trichloroethane	Yes	3.18E-05	lb/MMBtu	1.90E-04	4.75E-05	
1,1-Dichloroethane	No	2.36E-05	lb/MMBtu	1.41E-04	3.53E-05	
1,2,3-Trimethylbenzene	No	2.30E-05	lb/MMBtu	1.38E-04	3.44E-05	
1,2,4-Trimethylbenzene	No	1.43E-05	lb/MMBtu	8.55E-05	2.14E-05	
1,2-Dichloroethane	No	2.36E-05	lb/MMBtu	1.41E-04	3.53E-05	
1,2-Dichloropropane	No	2.69E-05	lb/MMBtu	1.61E-04	4.02E-05	
1,3,5-Trimethylbenzene	No	3.38E-05	lb/MMBtu	2.02E-04	5.05E-05	
1,3-Butadiene	Yes	2.67E-04	lb/MMBtu	1.60E-03	3.99E-04	
1,3-Dichloropropene	Yes	2.64E-05	lb/MMBtu	1.58E-04	3.95E-05	
2-Methylnaphthalene	Yes	3.32E-05	lb/MMBtu	1.99E-04	4.96E-05	
2 2 4-Trimethylpentane	Yes	2.50E-04	lb/MMBtu	1.49E-03	3.74E-04	
Acenaphthene	Yes	1.25E-06	lb/MMBtu	7.47E-06	1.87E-06	
Acenaphthylene	Yes	5.53E-06	lb/MMBtu	3.31E-05	8.27E-06	
Acetaldehyde	Yes	8.36E-03	lb/MMBtu	5.00E-02	1.25E-02	
Acrolein	Yes	5.14E-03	lb/MMBtu	3.07E-02	7.68E-03	
Benzene	Yes	4.40E-04	lb/MMBtu	2.63E-03	6.58E-04	
Benzo(b)fluoranthene	Yes	1.66E-07	lb/MMBtu	9.93E-07	2.48E-07	
Benzo(e)pyrene	Yes	4.15E-07	lb/MMBtu	2.48E-06	6.20E-07	
Benzo(g,h,i)perylene	Yes	4.14E-07	lb/MMBtu	2.48E-06	6.19E-07	
Biphenyl	Yes	2.12E-04	lb/MMBtu	1.27E-03	3.17E-04	
Butane	No	5.41E-04	lb/MMBtu	3.23E-03	8.09E-04	
Butyr/Isobutyraldehyde	No	1.01E-04	lb/MMBtu	6.04E-04	1.51E-04	
Carbon Tetrachloride	Yes	3.67E-05	lb/MMBtu	2.19E-04	5.49E-05	
Chlorobenzene	Yes	3.04E-05	lb/MMBtu	1.82E-04	4.54E-05	
Chloroethane	No	1.87E-06	lb/MMBtu	1.12E-05	2.80E-06	
Chloroform	Yes	2.85E-05	lb/MMBtu	1.70E-04	4.26E-05	
Chrysene	Yes	6.93E-07	lb/MMBtu	4.14E-06	1.04E-06	
Cyclopentane	No	2.27E-04	lb/MMBtu	1.36E-03	3.39E-04	
Ethane	No	1.05E-01	lb/MMBtu	6.28E-01	1.57E-01	
Ethylbenzene	Yes	3.97E-05	lb/MMBtu	2.37E-04	5.93E-05	
Ethylene Dibromide	Yes	4.43E-05	lb/MMBtu	2.65E-04	6.62E-05	
Fluoranthene	Yes	1.11E-06	lb/MMBtu	6.64E-06	1.66E-06	
Fluorene	Yes	5.67E-06	lb/MMBtu	3.39E-05	8.48E-06	
Formaldehyde	Yes	5.28E-02	lb/MMBtu	3.16E-01	7.89E-02	
Methanol	Yes	2.50E-03	lb/MMBtu	1.49E-02	3.74E-03	
Methylcyclohexane	No	1.23E-03	lb/MMBtu	7.35E-03	1.84E-03	
Methylene Chloride	Yes	2.00E-05	lb/MMBtu	1.20E-04	2.99E-05	
Hexane	Yes	1.11E-03	lb/MMBtu	6.64E-03	1.66E-03	
n-Nonane	No	1.10E-04	lb/MMBtu	6.58E-04	1.64E-04	
n-Octane	No	3.51E-04	lb/MMBtu	2.10E-03	5.25E-04	
Naphthalene	Yes	7.44E-05	lb/MMBtu	4.45E-04	1.11E-04	
n-Pentane	No	2.60E-03	lb/MMBtu	1.55E-02	3.89E-03	
PAH	Yes	2.69E-05	lb/MMBtu	1.61E-04	4.02E-05	
Phenanathrene	Yes	1.04E-05	lb/MMBtu	6.22E-05	1.55E-05	
Phenol	Yes	2.40E-05	lb/MMBtu	1.44E-04	3.59E-05	
Propane	No	4.19E-02	lb/MMBtu	2.51E-01	6.26E-02	
Pyrene	Yes	1.36E-06	lb/MMBtu	8.13E-06	2.03E-06	
Styrene	Yes	2.36E-05	lb/MMBtu	1.41E-04	3.53E-05	
Tetrachloroethane	Yes	2.48E-06	lb/MMBtu	1.48E-05	3.71E-06	
Toluene	Yes	4.08E-04	lb/MMBtu	2.44E-03	6.10E-04	
Vinyl Chloride	Yes	1.49E-05	lb/MMBtu	8.91E-05	2.23E-05	
Xylene	Yes	1.84E-04	lb/MMBtu	1.10E-03	2.75E-04	
			Total HAPs	**4.32E-01**	**1.08E-01**	
			Max HAP	**3.16E-01**	**7.89E-02**	

APPENDIX C: STATE REGULATORY REQUIREMENTS ANALYSIS

Appendix C contains analysis of applicable NYSDEC regulations (including Part 212) that have been excerpted from the Air State Facility Permit application submitted to the NYSDEC in January 2022.

testing, maintenance, or operator training on liquid fuel shall not exceed a combined total of 48 hours during any calendar year.

The boilers at the facility will exclusively fire natural gas and are therefore exempt from the requirements of this subpart. Other combustion sources planned to be operated at the Plug Power Innovation Center do not meet the definition of boiler; therefore, NESHAP Subpart JJJJJJ does not apply to them.

3.3 State Regulatory Requirements

This section discusses the applicability of potentially applicable state regulations to the proposed Plug Power Innovation Center.

3.3.1 6 CRR-NY 201 – Permits and Registrations

The owners and operators of air contamination sources in New York State are required to obtain a permit pursuant to 6 CRR-NY Part 201, which dictates permitting requirements and permit application content requirements. Part 201 recently underwent substantial changes that became effective on February 25, 2021. This regulatory analysis references the latest regulatory language.

Facilities in New York State can fall into one of four categories for the purposes of air pollution control permitting. Those categories include sources that operate only emission sources that are exempt from permitting (Subpart 201-3), facilities that are required to file minor facility registrations (Subpart 201-4), Air State Facility permitted facilities (Subpart 201-5) and Title V facilities (Subpart 201-6). As previously mentioned, based on the facility-wide PTE, the Plug Power Innovation Center is subject to Subpart 201-5 permitting. The calculated PTE for the facility is less than major facility thresholds defined in 6 CRR-NY 201-2.1(b)(21).

The State Facility Permit application forms are included in Appendix A to this application. Please note that since the MDEV R&D laboratory does not require permitting per 6 CRR-NY 201-1.16, it is not included as an emission unit in the application form.

3.3.2 6 CRR-NY 211 – General Prohibitions

3.3.2.1 Section 211.1 – Air Pollution

The facility will not cause any particulate, fume, gas, mist, odor, smoke, vapor, pollen, toxic or deleterious emissions, either alone or in combination with others, to be emitted to the outdoor atmosphere in such quantity, characteristic or duration which are injurious to human, plant or animal life or to property, or which unreasonably interfere with the comfortable enjoyment of life or property in accordance with 6 CRR-NY 211.1.

3.3.2.2 Section 211.2 – Visible Emissions

Section 211.2 defines general opacity limits for sources of air pollution in New York State. The general requirement that is applicable is that any air contamination source cannot emit any material having an opacity equal to or greater than 20 percent (six-minute average) except for one continuous six-minute period per hour of not more than 57 percent opacity. The facility will follow and maintain Good Engineering Practice (GEP) and operate its sources in a manner that effectively meets the visible emissions standards.

3.3.3 6 CRR-NY 212 – Process Operations

Part 212 applies to process emission sources associated with a process operation upon issuance of a new, modified, or renewal permit for a facility containing process emission sources and/or emission points.

A process operation is defined in 6 CRR-NY 212-1.2(b)(18) as:

> *Any industrial, institutional, commercial, agricultural or other activity, operation, manufacture or treatment in which chemical, biological and/or physical properties of the material or materials are changed, or in which the material(s) is conveyed or stored without changing the material(s) if the conveyance or storage system is equipped with a vent(s) and is non-mobile, and that emits air contaminants to the outdoor atmosphere. A process operation does not include an open fire, operation of a combustion installation, or incineration of refuse other than by-products or wastes from a process operation(s).*

A process emission source is defined in 6 CRR-NY 212-1.2(b)(19) as:

> *Any apparatus, contrivance or machine, including any appurtenant exhaust system or air cleaning device capable of causing emissions of any air contaminant to the outdoor atmosphere from a process operation.*

3.3.3.1 Emission Sources Not Subject to Part 212

As discussed in subsequent section for Part 228, Surface Coating Process, the coating line at the Plug Power facility is subject to Table 1 of Subpart 228-1. Therefore, per 6 CRR-NY 212-1.4(l)(1), it is exempt from Part 212 requirements for non A-rated VOCs. Since coating line does not have any A-rated VOC emissions, it is exempt from Part 212.

Combustion installations are not process operations per the definition in Part 212. 6 CRR-NY 200.1(l) defines combustion installation as:

> *An installation consisting of a single furnace, device, engine, or turbine in which fossil fuel, wood, and/or other solid, liquid, or gaseous fuel is burned with air or oxygen and the emissions include products from (1) the fuel combustion; (2) fuel additives (3) and material that is specifically introduced to alter emissions.*

The natural-gas-fired boilers, hot water heaters, emergency generator, soak heaters, air handling units and the make-up air unit are combustion installations, and are not subject to the requirements of Part 212.

Trivial and exempt sources in Subparts 201-3.2 and 201-3.3 are excluded from applicability to Part 212 per 6 CRR-NY 212-1.4(a). Table 3-1 presents the list of trivial or exempt activities at the facility. Therefore, all the sources listed in Table 3-1 are not subject to Part 212.

Table 3-1. List of Trivial and Exempt Activities at Saint-Gobain Facility

Activity Description (Quantity)	Capacity	Applicable Exemption
Boiler (1), Heaters (9), Make-up Air Units (2),	<10 MMBtu/hr	§201-3.2(c)(1)(i)

Activity Description (Quantity)	Capacity	Applicable Exemption
Air Handling Units (1), Soak Heaters (3)		
Emergency generator (1)	N/A	§201-3.2(c)(6)
Non-contact cooling tower (1)	N/A	§201-3.2(c)(7)
Roadways and parking lots	N/A	§201-3.3(c)(37)
Analytical lab (1)	N/A	§201-3.2(c)(40)

3.3.3.2 Volatile Organic Compounds

DAR-1, *Guidelines for the Evaluation and Control of Ambient Air Contaminants Under 6NYCRR Part 212.*[4] clarifies that VOC is not a criteria air contaminant and that VOCs should not be addressed using Table 3 of Part 212.[5] As such, individual compounds that are VOC are assessed as described below.

3.3.3.2.1 Propyl Alcohol

The proposed fuel cell manufacturing line will utilize n-propyl alcohol ("1-propanol" or "propanol") as one of the main constituents of the ink/coating prepared at site for coating. In addition, ink preparation/mixing vessels will be cleaned using 50% propanol. Propanol is not assigned a toxicity in the list of pollutants within DAR-1. As such propanol is assigned an initial environmental rating (ER) of B and is subject to the control requirements as specified in §212-2.1(b) and §212-2.3(b) Table 4.

The propanol emissions from different steps in ink/coating preparation, except clean-in-place, will be emitted through a common stack or emission point. The emission rate potential (ERP) of propanol emissions from this emission point and the emission point for clean-in-place is less than 10 lbs/hr. In addition, the ERP of propanol emissions from MDEV R&D lab emitted from a separate stack is less than 10 lbs/hr. Therefore, compliance with Part 212 will be met by using air dispersion modeling to demonstrate that the maximum offsite impacts from the facility-wide propanol emissions are less than the annual guideline concentrations (AGC) listed in DAR-1. The propanol emissions from the RTO will also be included in the modeling. Note that, DAR-1 does not have a short-term guideline concentration (SGC) for propanol. Plug Power will submit an air dispersion modeling protocol under a separate cover following the submittal of this application for NYSDEC's review.

3.3.3.2.2 Ethyl Alcohol

Ethanol is another component of the ink/coating prepared at the Plug Power facility. Ethyl alcohol ("ethanol") is identified as a "Low Toxicity Contaminant" in DAR-1. Low toxicity air contaminants are assigned an initial ER of C. The ERP of ethanol from all Part 212 subject process operations at the proposed Plug Power facility is less than 10 lb/hr. Therefore, compliance with Part 212 will be met using air dispersion modeling to demonstrate that the maximum offsite impacts from the facility-wide ethanol emissions are less than the AGC listed in DAR-1. The ethanol emissions from the RTO will be included in the modeling. Similar to propanol, DAR-1 does not have an SGC for ethanol.

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[4] https://www.dec.ny.gov/docs/air_pdf/dar1.pdf

[5] DAR-1, February 2021; Section V.E.1.

[redacted]

3.3.3.4 Other Criteria Pollutants

Other than PM, which is described above, all other criteria pollutants from the Plug Power facility are from combustion installations and are not subject to Part 212 as illustrated in section 3.3.3.

3.3.4 6 CRR-NY 225 – Fuel Composition and Use

Subpart 225-1 applies to facilities which use fuels in combustion installations and regulates the sulfur content of fuel. All the combustion installation at the Plug Power facility will fire natural gas and Subpart 225-1 does not have any requirements for natural gas firing. Therefore, Subpart 225-1 does not apply.

3.3.5 6 CRR-NY 226 – Solvent Cleaner Processes and Industrial Cleaning Solvents

The facility will not meet the emission threshold of three tons or more of VOC emissions from industrial cleaning solvents on a twelve-month rolling total basis and therefore is not subject to 6 CRR-NY 226-2 Industrial Cleaning Solvents. Purchase records of cleaning solvents subject to §226-2 and associated safety data sheets (SDSs) detailing VOC content of the solvents will be maintained at the facility.

3.3.6 6 CRR-NY 227 – Stationary Combustion Installations

The particulate emission standards of Subpart 227-1 apply to stationary combustion installations that are not subject to NSPS or NESHAP standards, where the particulate matter standards of the federal regulation are less stringent than the standards established within the subpart.

Subpart 227-1 applies to combustion installations that fire solid or liquid fuels alone or in combination with gaseous fuels. The boiler, hot water heaters, and other combustion equipment at the Plug Power facility will fire only natural gas, and as such are not subject to the particulate emission standards in Section 227-1.3.

The facility is subject to the general opacity standards provided in 6 CRR-NY 227-1.4(a), which indicates that no greater than 20 percent opacity (six-minute average), except for one six-minute period per hour of not more than 27 percent opacity is allowed. As stated previously, the facility will follow GEP and effectively operate the combustion installations to ensure that the opacity standards are met.

3.3.7 6 CRR-NY 228-1 – Surface Coating Processes

This Subpart applies to facilities containing coating lines which consist of the application of surface coatings (including inks). Per 6 CRR-NY 228-1.1(a)(1), coating lines identified in Table 1 of Subpart 228-1 are subject to the requirements of the Subpart if certain conditions are met (i.e., location of the source and if emission thresholds are exceeded). Based on the type of substrate on which coating will be applied, the coating line at the Plug Power facility is classified as Class D in Table 1 of Part 228.[6] Per applicability in 6 CRR-NY 228-1.1(a)(1), since the Plug Power facility is not located in New York City metropolitan area, or the Orange County towns of Blooming Grove, Chester, Highlands, Monroe, Tuxedo, Warwick, and Woodbury and it will have PTE of greater than or equal to 10 tons per year, the coating line at the facility is subject to Part 228 requirements. Plug Power is proposing to control the VOC emissions from the coating line using an RTO with at least 98% overall control efficiency which meets the requirements for add-on control in 6 CRR-NY 228-1.5(b) as allowed by §228-1.4(d)(1).

The proposed coating activities in the MDEV R&D laboratory are exempt from Part 228 requirements per 6 CRR-NY 228-1.1(b)(1).

3.3.8 6 CRR-NY 231 – New Source Review

The Plug Power Innovation Center is located in Monroe County, New York. Monroe County is currently designated as attainment or unclassifiable for all pollutants in 40 CFR Part 81.333. However, all of New York State is located within the ozone transport region. Therefore, Monroe County is treated as a nonattainment area for ozone.

3.3.8.1 NSR Applicability Overview – PSD

Major source thresholds for PSD regulated pollutants for facilities in New York are established in 6 CRR-NY 231-13.5, Table 5. According to §201-2.1(b)(21)(v), a 250 ton per year "major" source threshold for criteria pollutants applies to facilities that are not on the list of sources categories in §201-2.1(b)(21)(iii)(a) through (z). Fuel cell manufacturing facilities are not one of the source categories identified in that list. As demonstrated in the PTE summary in Appendix B, the facility-wide emissions of all PSD-regulated pollutants are below 250 tpy; therefore, the facility is considered a minor source with respect to the PSD permitting program and is not subject to Part 231 permitting for attainment air contaminants.

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[6] NESHAP Subpart JJJ (Paper and Other Web Coating) defines "web" as a "continuous substrate (e.g., paper, film, foil) which is flexible enough to be wound or unwound as rolls." The substrate used at the Plug Power facility is flexible enough to be wound as rolls, therefore, Plug Power is categorizing its coating line as a Part 228 Class D coating line which includes web type substrate such as paper, film and foil.

3.3.8.2 NSR Applicability Overview – NNSR

Major facility thresholds for the NNSR regulated pollutants for facilities in New York are established in 6 CRR-NY 231-13, Table 1. The major facility thresholds for NO_X and VOC for facilities located within the ozone transport region are 100 tpy and 50 tpy, respectively. As demonstrated in the PTE summary in Appendix B, the facility-wide emissions of NO_X and VOC are below 100 tpy and 50 tpy thresholds, therefore, the new facility is considered a minor source with respect to NNSR program and is not subject to Part 231 permitting for nonattainment air contaminants.

3.3.9 6 CRR-NY 234 – Graphic Arts

This regulation applies to certain graphic arts facilities in New York. 6 CRR-NY 234.2(b)(13) defines graphic arts as "*Packaging rotogravure, publication rotogravure, flexographic, offset lithographic, letterpress and screen printing processes*". The ink preparation and coating processes proposed at the Plug Power facility do not meet the definition of graphic arts. Therefore, the requirements of Part 234 do not apply.

3.3.10 6 CRR-NY 617 – State Environmental Quality Review Act

New York's State Environmental Quality Review Act (SEQR) requires all state and local government agencies to consider environmental impacts equally with social and economic factors during discretionary decision making. This state facility permit application seeks to authorize the installation and operation of a new fuel cell manufacturing line at the Plug Power Innovation Center. The project meets the definition of an action because it requires NYSDEC approval; however, is not considered a Type I Action (6 CRR-NY 617.4) likely to have significant adverse environmental impact, nor does it meet the criteria to be considered a Type II Action (§617.5). Therefore, Plug Power is submitting a short environmental assessment form (SEAF) as part of this application illustrating no environmental impact. The SEAF is included in Appendix C.

3.4 Climate Leadership and Community Protection Act

The Climate Leadership and Community Protection Act (CLCPA) was signed into law in July 2019 and became effective January 1, 2020. CLCPA currently requires the NYSDEC to review applications for new state facility permits, new Title V permits, and significant modifications to state facility permits and Title V permits for consistency with the requirements and goals of CLCPA. Since the proposed project is a new state facility permit, an analysis of this project with respect to the objectives of the CLCPA is required.

The overall project, installation and operation of a fuel cell manufacturing facility in New York, is aligned with the goals of CLCPA to achieve 85% GHG emissions reductions by 2050.[7] A hydrogen fuel cell combines hydrogen and oxygen to produce electricity, with water and heat as the only by-products.[8] The fuel cells allow devices with electric motors to run cleanly and efficiently with zero emissions. Investing in green hydrogen manufacturing will provide significant carbon reductions to Plug Power's customers.[9] The new facility will accelerate the expansion in innovative green hydrogen solutions that will replace fossil fuel supported electricity production. Plug Power's innovative technology powers electric motors with hydrogen fuel cells amid an ongoing paradigm shift in the power, energy, and transportation industries to address

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[7] The CLCPA includes economy-wide requirements to reduce GHG emissions in New York State by 40% below 1990 levels by 2030, and 85% below 1990 levels by 2050.

[8] Plug Power ESG Rpeort 2020 - https://www.plugpower.com/wp-content/uploads/2021/06/PlugPower_2020ESGReport_F.pdf

[9] *Ibid.*

climate change and energy security, while meeting sustainability goals.[10] Hydrogen and fuel cell products are integral parts of a comprehensive, sustainable energy and climate mitigation strategy to achieve the needed reduction in GHG emissions to achieve net zero goals.

For the purposes of this application, Plug Power has also evaluated the project emission sources with respect to the objectives of the CLCPA and considered following components:

- Identification of GHGs emitted from emission sources for the project or at the facility under review.
- Quantification of emissions of individual GHGs and the total CO_2e based on the 20-year GWP of each individual GHG resulting from:
    - Direct emissions of GHGs released from the process operations at the facility,
    - Direct emissions of GHGs that are generated due to the combustion of carbon-based fuels in combustion equipment at the facility, and
    - Indirect emissions of GHGs associated with the extraction, production and transmission of carbon-based fuels imported into New York State for the project or the facility under review.
- An analysis of the emission sources affected by the permitting action to determine if there are alternatives that are technically viable that result in less emissions of GHGs.
- An evaluation of co-pollutants (i.e., HAP) which are also emitted from the GHG sources.

3.4.1 Greenhouse Gases Emitted from the Facility

None of the process emission sources, existing or proposed, at the facility have the potential to emit any GHGs as defined in 6 CRR-NY 200.1(cu) or listed in §496.5. The only GHG emissions from facility operations are the results of the combustion of carbon-based fuels in support equipment such as the RTO, heaters, MAUs, boilers and emergency generator. Plug Power is proposing to use natural gas (fossil fuel with lowest GHG emissions on a heat-input basis) for all of its support combustion equipment.

3.4.2 Quantification of Greenhouse Gases

The GHGs emissions from fuel combustion at the facility are included in the emission calculations in Appendix B and presented on Table 3-2. The calculation methodology is described in Section 2 of this application. The carbon dioxide equivalent emission rates presented in Appendix B have been calculated on a 100-year and 20-year GWP basis for completeness.

Table 3-2. Carbon Dioxide Equivalent PTE

Air Contaminant	Existing Combustion Equipment (tpy)	RTO (tpy)	Soak Heaters (tpy)	Boilers (tpy)	Emergency Generator (tpy)	Facility Wide Potential to Emit (tpy)
Direct 20-Year CO_2e Emissions	2,944	2,824	539	13,349	175	19,831
Upstream 20-Year CO_2e Emissions	2,447	2,348	448	11,098	146	16,517
Total 20-Year CO_2e Emissions	5,391	5,172	987	24,447	321	36,318

[10] *Ibid.*

3.4.3 Alternatives Analysis

As previously stated, all sources of GHG at the Plug Power facility are sources of combustion. Each type of combustion source is addresses in the following paragraphs.

3.4.3.1 Thermal Oxidizers

Plug Power is proposing to install a natural gas-fired RTO to reduce the emissions of VOCs (propanol and ethanol) from its coating operations.

3.4.3.1.1 Alternative Technologies

In addition to thermal treatment of VOCs, other generally acceptable means of controlling VOC include adsorption onto media such as carbon, absorption into a liquid medium such as water or another solvent, or condensation.[11] As demonstrated in Table 1-1 of the Control Techniques for Volatile Organic Compound Emissions from Stationary Sources,[12] various combustion-based control techniques are capable of achieving similar levels of emission control. In practice the actual level of VOC control depends on several design and operation characteristics. This CLCPA analysis is required to evaluate reduction of onsite and upstream GHG generation and emissions of co-pollutants. By design, a *recuperative* thermal oxidizer is to recuperate waste heat from the combustion of fuel and VOC for use in preheating incoming gasses prior to combustion. This makes an RTO highly thermally efficient when compared to other combustion-based VOC control technologies that do not recuperate wasted heat. Because the proposed RTO have a very low heat input (5.5 MMBtu/hr), the inherent efficiency of an RTO, and the fact that multiple thermal control of VOCs generally achieve a similar emission control efficiency, the various types of thermal control options are not considered further in this CLCPA analysis. It is assumed that any reduction in GHG emissions that may be realized by changing from proposed RTO to a boiler, an incinerator, a flare or other similar device would be minimal because of the small heat input into the proposed RTO.

Carbon adsorption is commonly used to control vapor streams with varied organic compositions. Carbon adsorption utilizes a column of activated carbon to adsorb organic pollutants. In adsorption (as opposed to absorption) the molecules of organic pollutants are attracted to the carbon by a physical, rather than chemical, process. The result is a weak bond that can be reversed with heat or pressure. EPA's Air Pollution Control Cost Manual, Chapter 1 (2018) on Carbon Adsorbers states the following:

> *Activated carbon can adsorb a wide range of VOCs; however, there are some limitations. First,* ***activated carbon is less effective for compounds that are highly polar, volatile*** *or have small diameters. For example, vinyl chloride, methanol, and formaldehyde are not adsorbed well by activated carbon.*[13] *[Emphasis added]*

The chemical compounds in the coating operations exhaust include n-propanol and ethanol. Both of which are highly polar, volatile compounds. Because activated carbon is less effective at controlling highly polar, volatile compounds such as propanol, the effectiveness of this technology is questionable. Finally, Table 3-3

[11] Control Techniques for Volatile Organic Compound Emissions from Stationary Sources; EPA 453/R-92-2018, December 1992. Section 3.

[12] *Ibid.*, Page 1-7.

[13] https://www.epa.gov/sites/default/files/2018-10/documents/final_carbonadsorberschapter_7thedition.pdf, page 1-6.

of Control Techniques for Volatile Organic Compound Emissions from Stationary Sources[14] does not list propanol (the main component requiring control) as an organic compound that is controlled by carbon adsorption. Because of these reasons, the use of activated carbon to control the VOC from coating operations at Plug Power is not considered further in this analysis. In addition, polar adsorbents such as silica gel and activated alumina are poor adsorbents of volatile organic compounds[15] such as propanol and ethanol. Therefore, adsorption is not considered further in this analysis.

Condensation may be used as a separation technique where condensable VOC compounds in a vapor stream are separated from the remaining vapors through reducing the temperature below the saturation temperature of the VOC forcing condensation on the cool condenser surfaces and removal from the vapor stream. EPA's Air Pollution Control Cost Manual, Chapter 2 (2017) on Refrigerated Condensers indicates that condensers are suitable for high VOC concentrations (usually >5,000 ppm by volume, ppmv), and that removal efficiencies of up to 90% can be achieved.[16] The proposed operations at Plug Power facility require greater than 95% VOC removal efficiency in order to stay under the major source applicability threshold for VOC. Therefore, achieving higher control efficiency is a key requirement for the proposed control device. Because of this reason, condensation is not considered further for this analysis.

Absorption of air contaminants may be accomplished through the use of several types of absorption equipment ranging from packed tower beds to venturi scrubbers. When used for air pollution control, absorption is the process of mass transfer of contaminants from a gaseous stream into an absorbent stream (typically water or another solvent). As discussed in Section 3.4 of EPA's Control Techniques for Volatile Organic Compound Emissions from Stationary Sources,[17] there are several factors that impact effective removal of air contaminants in an absorbent process. The most notable aspects are the solubility of contaminants in the absorbent and the means of ensuring good air-to-absorbent contact within the absorber. Since propanol and ethanol present in the coating operations exhaust stream are readily soluble in water, absorption presents a potential alternative to RTO. However, at maximum capacity, the coating line has the potential to evaporate over 230 lb/hr propanol. Capturing this volume (over 30 gallons per hour) and managing the wastewater presents additional environmental challenges, including wastewater treatment and the potential for evaporation of the captured propanol from the wastewater stream. Plug Power's coating operation requires high propanol-based, which makes an attempt to reclaim propanol from the wastewater for on-site use impractical without specialized and costly equipment. Additionally, EPA's Control Techniques for Volatile Organic Compound Emissions from Stationary Sources,[18] notes that absorption is generally more expensive compared to incineration. The exhaust stream from Plug Power coating operations may have variable VOC concentration, depending on the ink/coating type being used, which makes the design of adsorber challenging.

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[14] Control Techniques for Volatile Organic Compound Emissions from Stationary Sources; EPA 453/R-92-2018, December 1992, page 3-37.

[15] Control Techniques for Volatile Organic Compound Emissions from Stationary Sources; EPA 453/R-92-2018, December 1992. Section 3.3.2

[16] https://www.epa.gov/sites/default/files/2017-12/documents/refrigeratedcondenserschapter_7thedition_final.pdf, page 2-1.

[17] EPA's Control Techniques for Volatile Organic Compound Emissions from Stationary Sources; EPA 453/R-92-018, December 1992, page 3-52.

[18] EPA's Control Techniques for Volatile Organic Compound Emissions from Stationary Sources; EPA 453/R-92-018, December 1992, Section 3.4.

In addition, absorbers require regular operational checks and maintenance to ensure operation within the design parameters which adds to the operational cost. Finally, as noted in detail above, the VOC removal through absorption produces wastewater or a waste liquid stream that must be treated before discharge. Considering these additional infrastructure requirements, high capital and operational costs, energy requirements for driving pumps, blowers, cooling water associated with adsorption, Plug Power considers the use of RTO option to be more technically and economically feasible than installation of a water scrubber and the associated infrastructure.

3.4.3.1.2 Summary of Alternative Technologies to Thermal Oxidizers

Several alternatives to use of RTO that would not generate GHG emissions have been evaluated and have been found to not be suitable for this project. This conclusion was made based on several factors, including the following:

- Candidate alternate technology's lower control efficiency than the current/proposed thermal oxidation technology which would result in the potential for higher VOC emissions, potentially exceeding major source thresholds.
- The inability for activated carbon to reliably control emissions of propanol.
- Higher costs and additional required infrastructure and environmental risk generated by use of absorption technology to achieve similar control efficiency as an RTO.

In conclusion, the RTO proposed for use at the Plug Power facility offers the best option to achieve the dual goals of the CLCPA of reducing emissions of GHG overall and controlling emissions. Further, the proposed RTO have a relatively low carbon footprint and maximum reliable reduction in emissions of VOC from the facility.

3.4.3.2 Emergency Generator and Other Combustion Sources

The facility fires and will continue to fire natural gas for its existing and proposed combustion equipment including emergency generator, boilers, and heaters. The utility network in the project location does not have the electrical infrastructure to support this equipment with electrically-heated equipment. Due to the availability of natural gas through the local utility, and lower GHG potential of natural gas compared to diesel fuel, no other fuels are considered appropriate for firing in these combustion equipment at this time. In addition, the emergency generators may operate only for a limited time of 500 hrs/yr so resulting GHG and co-pollutant emissions are very low.

3.4.4 Co-Pollutant Emissions

Co-pollutants are defined by the CLCPA as "hazardous air pollutants produced by greenhouse gas emissions sources".[19] As previously mentioned, all the GHG sources at the facility are sources of combustion. Each of the GHG sources was evaluated for applicability and compliance with federal NSPS and NESHAP regulations and each source fell below the applicability thresholds or was demonstrated to be in compliance with the applicable requirements. Further, those co-pollutants emitted from sources of combustion that are comingled with emissions from process operations (i.e., the RTO) are subject to and evaluated for compliance with 6 CRR-NY 212, and have been confirmed to meet the applicable requirements therein. Therefore, the requirement of the CLCPA to address co-pollutant emissions is met.

[19] CLCPA Section §2, amending Environmental Conservation Law §75-0101.3; https://nyassembly.gov/leg/?default_fld=&leg_video=&bn=A08429&term=2019&Summary=Y&Actions=Y&Text=Y

APPENDIX D: RESPONSE TO NYSDEC COMMENTS ON MODELING PROTOCOL

On February 11 2022, the New York State Department of Environmental Conservation (NYSDEC) provided air dispersion modeling protocol approval in response to the protocol submitted by Trinity Consultants (Trinity) to the NYSDEC on February 4, 2022 for Plug Power's Innovation Center in West Henrietta, NY provided that NYSDEC's comments included in February 11 letter are addressed in the final modeling report.

Each comment in the NYSDEC February 11, 2022 letter has been restated below with a response to the comment/question following in italic font prefaced with "RESPONSE:". In addition, NYSDEC's comment on CP-29 V Environmental Justice Review from January 27, 2022 Notice of Incomplete Application (NOIA) is also included in this section.

1. Please include sensitive and any elevated receptors in the modeling. The report should include a table displaying the modeled impacts at those receptors with each receptor identified.

   RESPONSE: A list of sensitive receptors included modeling is presented in Table 3-2 of the modeling report. As presented in Section 5 Modeling Results of the report, the modeled impacts at all sensitive receptors (and other receptors) are below the respective AGCs for propanol, ethanol and carbon black.

2. Figure 1-1 of the protocol shows other buildings close to the main building where the stacks will be located. Please provide justification for excluding these buildings in BPIP PRIME. In particular, the building to the immediate northeast. Otherwise, building downwash from nearby buildings should be included in the modeling?

   RESPONSE: As addressed in Section 3.1 of the modeling report, Plug Power only included the onsite building in the downwash analysis, as nearby offsite structures do not encompass the stacks within the Good Engineering Practice (GEP) 5L area of influence.[6] *The GEP 5L area of influence for each structure is determined by measuring a distance of five times 'L' from each edge of the structure, where 'L' is the lesser of the building height or projected building width. Only those stacks within the area of influence are affected by building wake effects. For example, the building to the immediate northeast of the facility is shorter than it is wide, so 'L' is defined as the height (i.e., approximately 30 ft) and 5L equals 150 ft. The closest distance to any modeled stack location is approximately 300 ft. Since the shortest distance to any stack is greater than the GEP 5L area of influence, the building does not need to be included in the downwash analysis. All other buildings are of similar height and located further away from the point sources. As such, the other nearby buildings do not need to be included in the downwash analysis.*

3. Please include a terrain map of the area surrounding the facility in the modeling report.

   RESPONSE: A terrain map of the area surrounding the facility is included as Figure 3-1 in the modeling report.

4. The emission rates of n-propyl alcohol and ethanol from the lab area in Section 1.13 of the protocol are significantly lower than the values in the emissions calculations. Please correct these values in the modeling or provide updated emissions calculations to support the lower modeled emission rates.

[6] EPA-454/R-93-038. User's Guide to the Building Profile Input Program. February 8, 1995. https://gaftp.epa.gov/Air/aqmg/SCRAM/models/related/bpip/bpipd.pdf

RESPONSE: The emission rates from the lab area are corrected in Table 4-4 of the modeling report. They are aligned with the emission calculations and are utilized in the final modeling files.

5. The stack diameter for the lab area is 1 ft. in the ASF permit application versus 4 inches in Section 1.12 of the protocol. Please verify which value is correct and update the modeling input if necessary.

   RESPONSE: Based on the revised project design, the diameter for the lab area was revised to 4 inches after the submission of the ASF permit application in January 2022. The correct diameter for the lab area is 4 inches as presented in the modeling protocol and in Table 4-2 of the modeling report. Plug Power will submit the revised stack parameters to the NYSDEC permitting department.

6. Using the stack diameters and exit flows provided in the ASF permit application, the estimated exhaust gas velocity for the lab and ink preparation areas are inconsistent between the application and protocol. Please verify these values are correct and update the modeling inputs if necessary.

   RESPONSE: The correct exhaust gas velocity for the lab and ink preparation areas are presented in Tables 4-2 and 4-3 of the modeling report. As previously mentioned, there were project design changes after the submission of the ASF permit application in January 2022. Plug Power will submit the revised stack parameters to the NYSDEC permitting department.

7. Section 3.3.3.3 of the protocol indicates that particulate emissions from material loading will primarily consist of carbon black. Per DEC Program Policy DAR-1 this is a moderate toxicity air contaminant and has been assigned an initial Environmental Rating of B. The Department requests that emissions of carbon black be included in the modeling to verify compliance with the DAR-1 guideline concentrations and confirm the initial Environmental Rating.

   RESPONSE: As requested by the NYSDEC, air dispersion modeling for carbon black is included in the report. As presented in Section 5 Modeling Results of the report (Table 5-1), the highest modeled impacts of carbon black from the facility are below its AGC and initial Environmental Rating of B does not require revision.

<u>Comment from January 27, 2022 NOIA</u>

1. The proposed action is subject to CP-29 V, Environmental Justice review procedures because the proposed facility is within Potential Environmental Justice Area (PEJA) which is partly shown in purple on the attached map (the attached map also has a draft area of impact of ½ mile for example only). We will need to identify the actual area of impact for the facility emissions in this regard. In similar applications, it was helpful when applicants provided materials including an area view with any exceedances of applicable air pollution standards outside of the facility fence identified/mapped, showing the distance and concentrations of pollutants in question. We can discuss this in further detail as the review process continues.

   RESPONSE: As presented in Section 5 Modeling Results of the report (Table 5-1), the highest modeled impacts of pollutants (propanol, ethanol, and carbon black) from the facility are below their respective guideline concentration (AGCs). Therefore, the offsite impacts from the facility demonstrate compliance with 6 CRR-NY Part 212 and a further analysis CP-29 V Environmental Justice review procedures is not required. It should be noted that the modeling analysis did not include a fenceline and all receptors outside the main building were included in modeling analysis.