

Resilient and Sustainable Energy Technologies and Systems

2:00PM – 3:20PM Breakout Sessions

Session 2 – JI-Lecture Hall

Resilient and Sustainable Energy Technologies and Systems

Moderator: **Thomas G. Bourgeois**, *Director, U.S. DOE's New York / New Jersey Combined Heat and Power Technical Assistance Partnership, Elisabeth Haub School of Law, Director of Distributed Energy Resource Policies, Land Use Law Center*

Robert Berninger

Director – Plant Operations, Energy and Engineering, Sloan Kettering Hospital System

Garrett Duquesne, AICP,

Commissioner of Community Development & Conservation, Town of Greenburgh

Kristen Motel, Esq.,

Partner, Cuddy & Feder LLP

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Email Valerie Brown at vbrown@aiawhv.org

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US DOE CHP Technical Assistance Partnership Services

- **End User Engagement**
Partner with strategic End Users to advance technical solutions using CHP as a cost effective and resilient way to ensure American competitiveness, utilize local fuels and enhance energy security. CHP TAPs offer **fact-based, non-biased engineering support** to manufacturing, commercial, institutional and federal facilities and campuses.
- **Stakeholder Engagement**
Engage with strategic Stakeholders, including regulators, utilities, and policy makers, to identify and **reduce the barriers to using CHP** to advance regional efficiency, promote energy independence and enhance the nation's resilient grid. CHP TAPs provide fact-based, non-biased **education** to advance sound CHP programs and policies.
- **Technical Services**
As leading experts in CHP (as well as microgrids, heat to power, and district energy) the CHP TAPs work with sites to **screen for CHP opportunities** as well as provide advanced services to maximize the economic impact and reduce the risk of CHP from initial CHP screening to installation.



www.energy.gov/chp



National Manufacturing Day 2019 at the
University of Illinois at Chicago



The NY/NJ CHP TAP By the Numbers

- *162 Engineering Technical Assessments
- *110 Engagements (e.g., NYWEA 3/30/2023; Green Campus Workshop Rutgers 5/26/2023, IDEA:2023 Chicago 6/6/2023)
- *22 Project & Policy Profiles, showcasing exceptional examples
- * 23 Articles & Newsletters



Evolving and Looking Forward

*The US DOE's NY/NJ CHP TAP winding down its last quarter of operation (2018 – 2023)

* *DOE Selects Nine Organizations that will Implement Regional Onsite Energy Technical Assistance Partnerships to Decarbonize America's Industrial Sector (July 12, 2023)*

* TAPs will have expertise to advise on a wide variety on technologies, including battery storage, combined heat and power (CHP), district energy, fuel cells, geothermal, industrial heat pumps, renewable fuels, solar photovoltaics, solar thermal, thermal storage, and wind power.



Onsite Energy Technical Assistance Partnerships

U.S. DEPARTMENT OF
ENERGY

Office of ENERGY EFFICIENCY
& RENEWABLE ENERGY

INDUSTRIAL EFFICIENCY & DECARBONIZATION OFFICE



The U.S. Department of Energy's regional network of Onsite Energy Technical Assistance Partnerships help facilities across the nation integrate the latest onsite energy technologies by providing specialized technical assistance, including initial screenings for multi-technology solutions, more advanced analysis to support project installations, and more.

For more information, please visit our website or contact us at: onsiteenergy@ee.doe.gov



Next Generation Health Care Infrastructure Heating and Cooling



Memorial Sloan Kettering
Cancer Center

December 8, 2023

Memorial Sloan Kettering Cancer Center New York City Super Campus

Located on Upper East Side overall the Super Campus is 2,490,355 sq. ft.

Main Campus - 7 interconnected buildings of various vintages and renovations 1,405,310 sq. ft.

Memorial Hospital – 1976

Bobst Building – 1938

Howard - 1947

Schwartz – 1948

Haupt – 1970

Radiation Oncology – 1971

Infill - 2006

Rockefeller Research Lab – 1986 287,202 sq. ft.

Zuckerman Research Center - 2006 728,239 sq. ft.



Memorial Sloan Kettering Cancer Center New York City Super Campus

Problem

- Aging high temperature / high pressure steam system
- How do you convert in an operating hospital and research center?

Goals

- Improve efficiency and reduce utility costs
- Reduce net emissions
- Infrastructure resiliency
- Pathway to decarbonization

Solution: Steam to Hot Water Conversion

Design the hot water source for current 180°F load requirements

- High Efficiency Condensing Boilers
- Combined Heat and Power Generators

Design new HW Loads to operate at lower temperatures



High Efficiency Condensing Boilers

Hot Water Source

Main Campus Boiler Room

- Modular mechanical room
- Twelve (12) new condensing hot water boilers
 - Four (4) boilers capable of dual fuel operation
- Four (4) distribution pumps with VFDs
- Two (2) CHP High Temp cooling HEXs

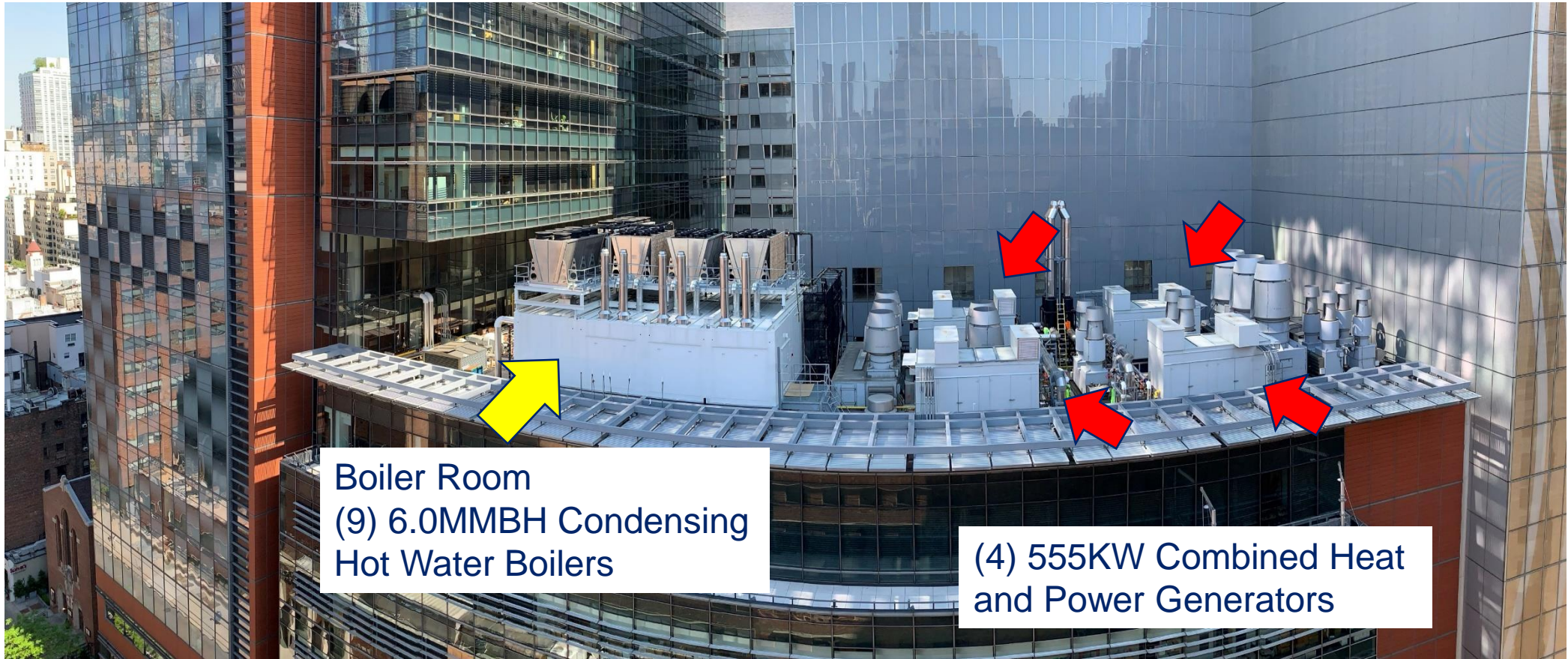


Hot Water Source Main Campus CHP Generators

- (2) 480V 557KW Reciprocating Engine Generator System
- High Temperature and Low Temperature Radiators
- High Temperature heat rejected to the Boiler System
- Integration to the Building Electrical Distribution System



Hot Water Source Zuckerman Boiler Room & CHP Generators



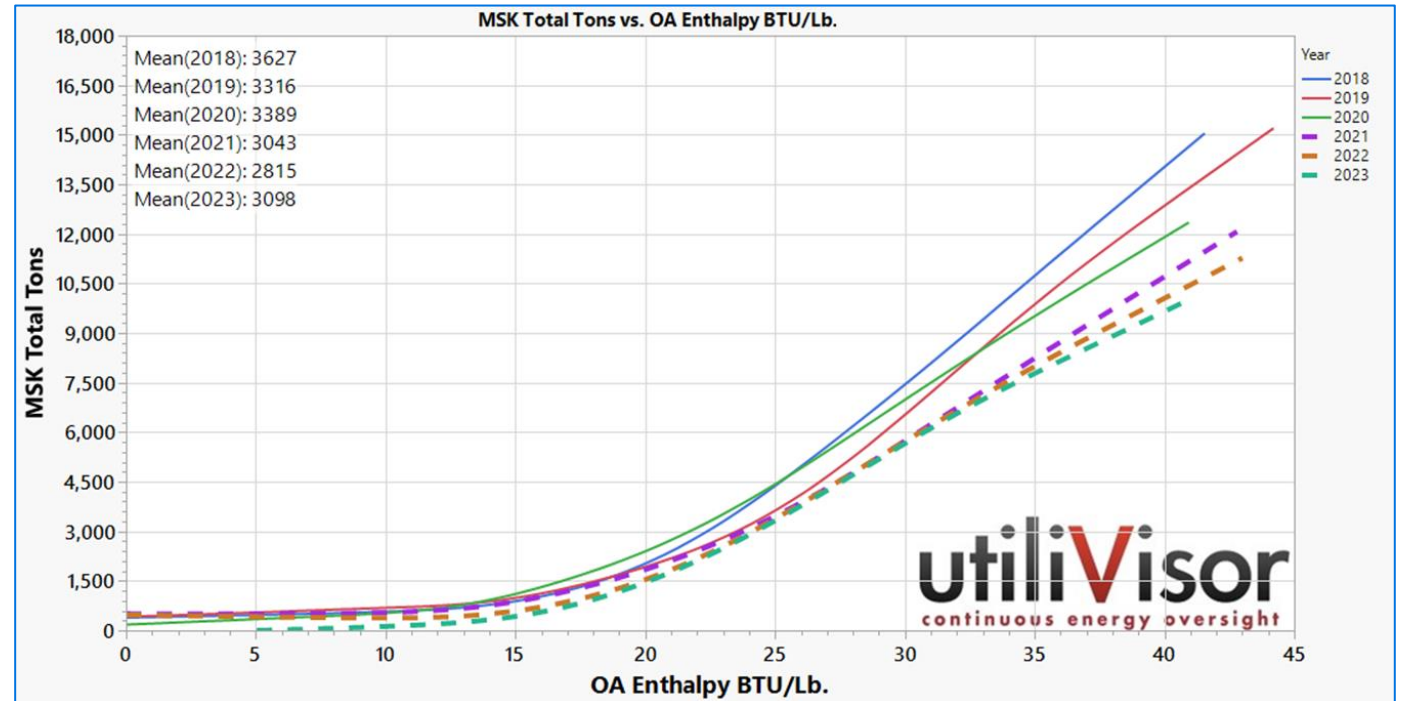
Boiler Room
(9) 6.0MMBH Condensing
Hot Water Boilers

(4) 555KW Combined Heat
and Power Generators

Phase 1 Results: Large Scale Project with Large Scale Savings

Heating and Greenhouse Gas (GHG) emissions reductions across the MSK Super Campus from 2020 to 2022

- 86,055 mmbtu (23%) reduction in heating energy usage
- \$7.9 million in utility cost savings annually
- 34% reduction in GHG emissions
- Chilled Water generation reduced 20%
 - 2020 chiller generation: 31,124,566 ton-hrs
 - 2022 chiller generation: 25,001,196 ton-hrs



*numbers do not include CHP (Q2 2023)

CHP Performance August 2023

CHP Engines ramped up operation in May '23

August '23 data represents nearly full operation

Actual August '23 Utility Rates used to evaluate cost effect:

- \$281,874 monthly utility savings

Potential Improvements:

- ZRC excess heat transferred to main campus (eliminate ZRC dump radiator operation)

Main Campus

Utility	Unit	2022	2023	Delta	Cost Delta
Boiler Gas	Therm	62,384	40,991	-21,393	-\$23,493
CHP Gas	Therm	949	76,244	75,295	\$53,521
Electric	KWH	4,390,001	3,652,800	-737,201	-\$148,486
Total				Subtotal -\$118,458	

ZRC

Utility	Unit	2022	2023	Delta	Cost Delta
Boiler Gas	Therm	29,596	619	-28,977	-\$45,876
CHP Gas	Therm	938	109,619	108,681	\$76,921
Electric	KWH	4,727,200	3,786,400	-940,800	-\$194,460
Total				Subtotal -\$163,415	
				Combined -\$281,874	



Pros & Cons of Phase 1

Pros

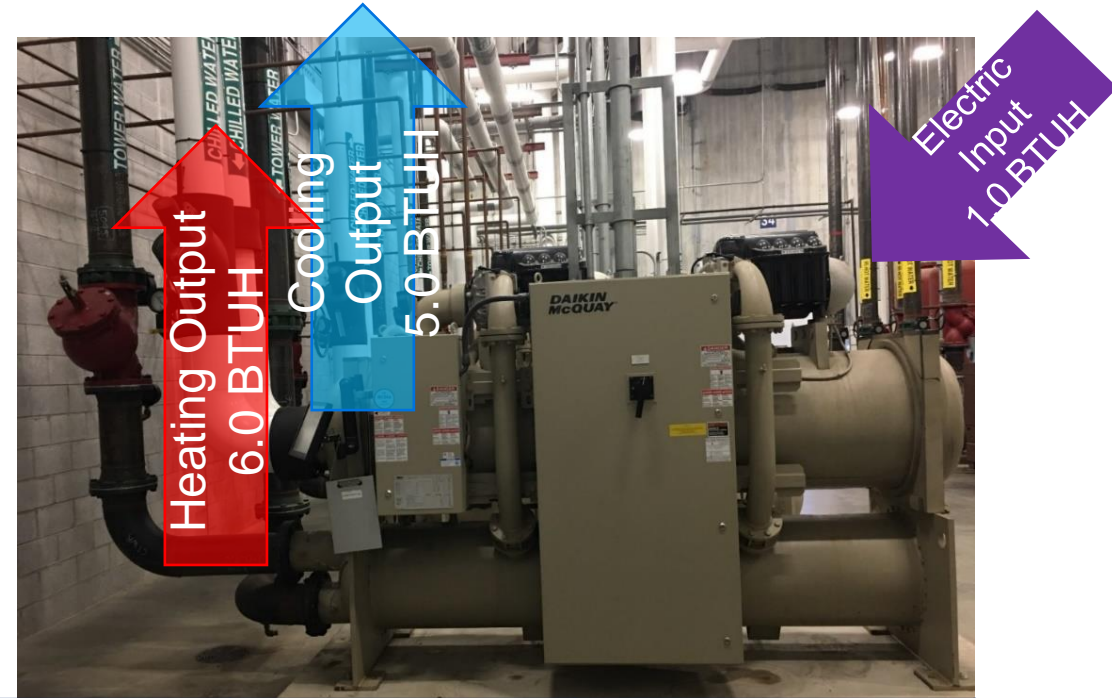
- Aging infrastructure upgraded and modernized
- Efficiency
 - Tighter controls on overall heat usage
 - Reduction on cooling and heating needs
 - 84% combined efficiency of electricity production and heating
- Resiliency - Ability to black start to provide cooling during an electrical outage
- Steppingstone to electrification / decarbonization

Cons

- Increased gas usage
- Additional maintenance
- Even more specialized staff
- Emission testing requirements

Phase 2 – Decarbonization / Electrification Objectives

- To pursue all options to further reduce energy usage, costs and GHG emissions
- Transition away from natural gas



Description	Electric Resistance	Heat Pump	Chiller	Direct Heat Recovery
Output Temperature	Any	140°F	95°F	60°F
Heating COP	1.0	3.0	6.0	NA
Input (3.4MMBH output)	1,000 KW	333 KW	167 KW	0 KW

Phase 2 – Decarbonization / Electrification Current Path

Heat Load	Heat Source
Low Temperature Preheat (60°F)	Direct Heat Recovery
High Temp Preheat (80°F)	Traditional Chiller
Domestic HW & Reheat (<140°F)	Heat Pumps
Perimeter Heat (<140°F)	High Temp Heat Pumps
Higher Temp Loads (>180°F)	Electric Resistance

Heat Recovery Source

Chilled Water / Cooling Tower Water Systems (60°F – 80°F)

Exhaust Systems (70°F - 80°F)

Effluent (70°F - 80°F)

Pros & Cons of Phase 2 – Decarbonization / Electrification

Pros

- Reduced Greenhouse Emissions
- Energy Efficiency

Cons

- Increased electrical needs
 - MSK will need anywhere from 5 to 31 MW of new electrical. (Dependent on which path)
- Initial high cost to convert fossil fuel dependent equipment to electric
- Will require additional emergency generators to comply with regulations of back up power

More to Come...



- As MSK is halfway through the Decarbonization Master Plan, there is more to come
- MSK will coordinate the implementation of projects within the Decarbonization Master Plan base on several factors including the local grid: what energy is available and reliable



Memorial Sloan Kettering
Cancer Center

Questions?



Memorial Sloan Kettering
Cancer Center

Robert Berninger
Director - Plant Operations, Energy & Engineering
Facilities Management Division
berningr@mskcc.org

Further information

Links for more Information

AEE Webinar: Electrification Master Plan for major Cancer Research Campus

<https://youtu.be/RZsKBwiDQP0?si=fNdT2LmMQbqXkqH2>

Health Facilities Management Magazine Article:

<https://www.hfmmagazine.com/articles/4787-decarbonization-project-shows-sustainable-savings>



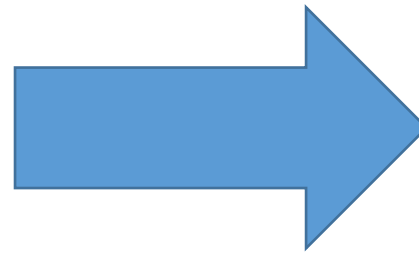
Memorial Sloan Kettering
Cancer Center

Zoning and Sustainability Infrastructure Considerations
Garrett Duquesne, AICP – Town of Greenburgh
Friday, December 8, 2023





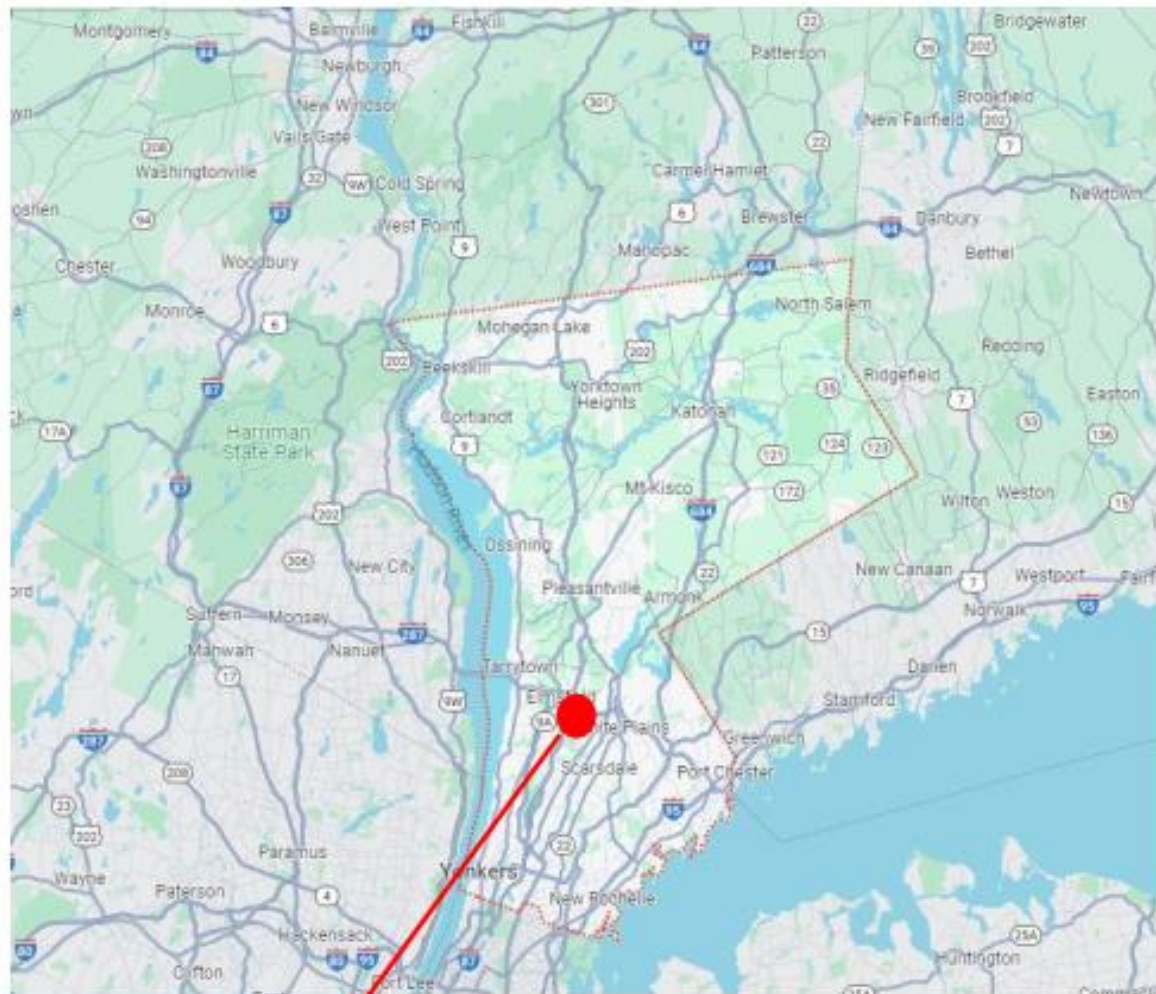
Initial Call –
September 2022



Formal Application –
December 2022



Groundbreaking – July 2023



Town of Greenburgh

Resilient and Sustainable Energy Technologies and Systems Presentation Topics

- How Existing Zoning Facilitates or Inhibits Sustainable Energy System Development
- Town of Greenburgh examples creating new sustainable energy system legislation
- Case Study QuadGeneration @ Coca-Cola Bottling Facility
- Questions/Comments

Chapter 285 Zoning

285-3 Interpretation.

B. Further, any land use that is not specifically permitted in this chapter is prohibited.

Implications of above for: Resilient and Sustainable Energy Technologies and Systems?

285-34 PD Nonresidential Planned Development District.

(c) Accessory uses.

[1] Uses customarily accessory to uses permitted by right in Subsection B(2)(a).

Threshold Question - How can the 1st QuadGeneration Facility in the country be deemed a **customary accessory use?**



Coca-Cola 440,000 sq. ft. facility
22-acre site



Quad-generation
Location



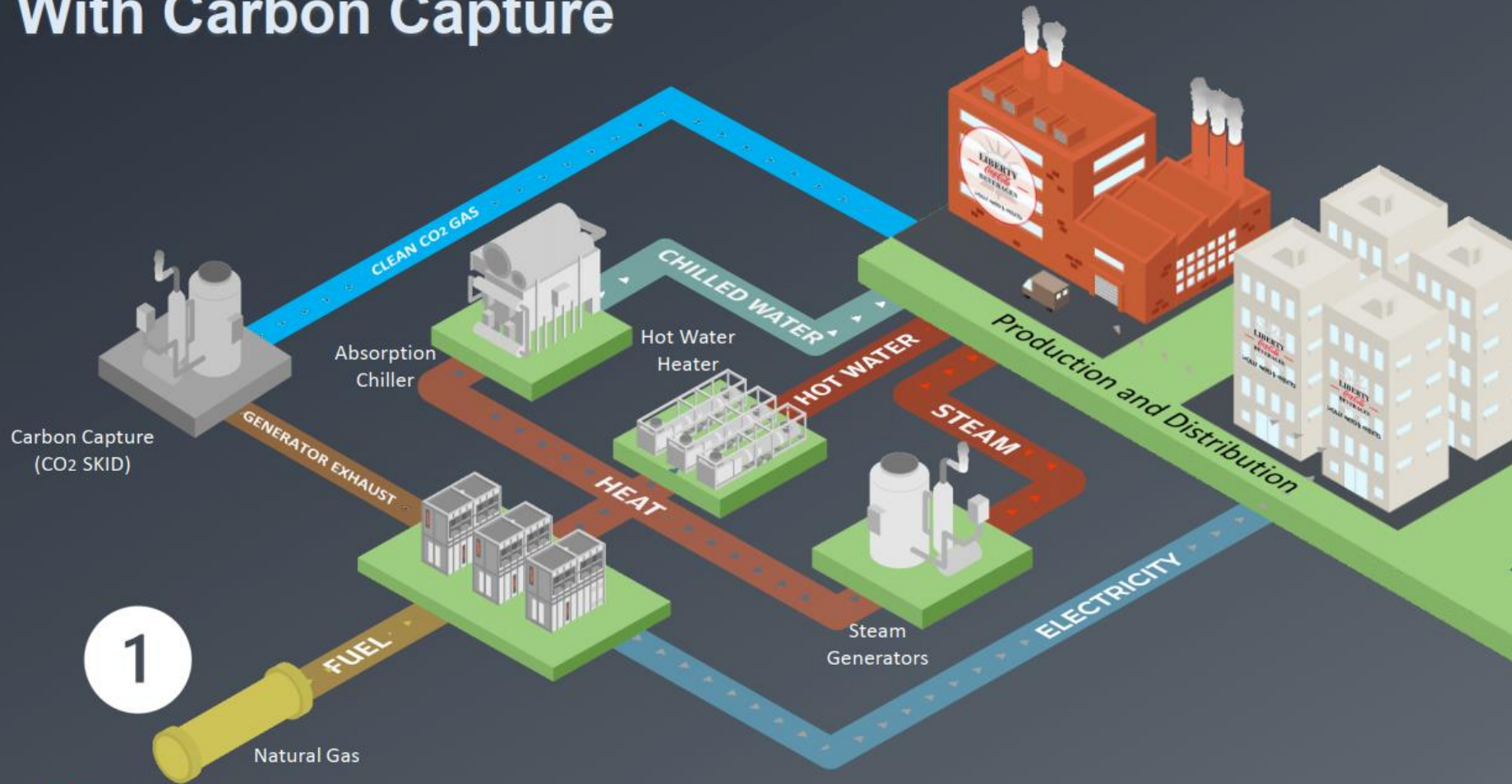
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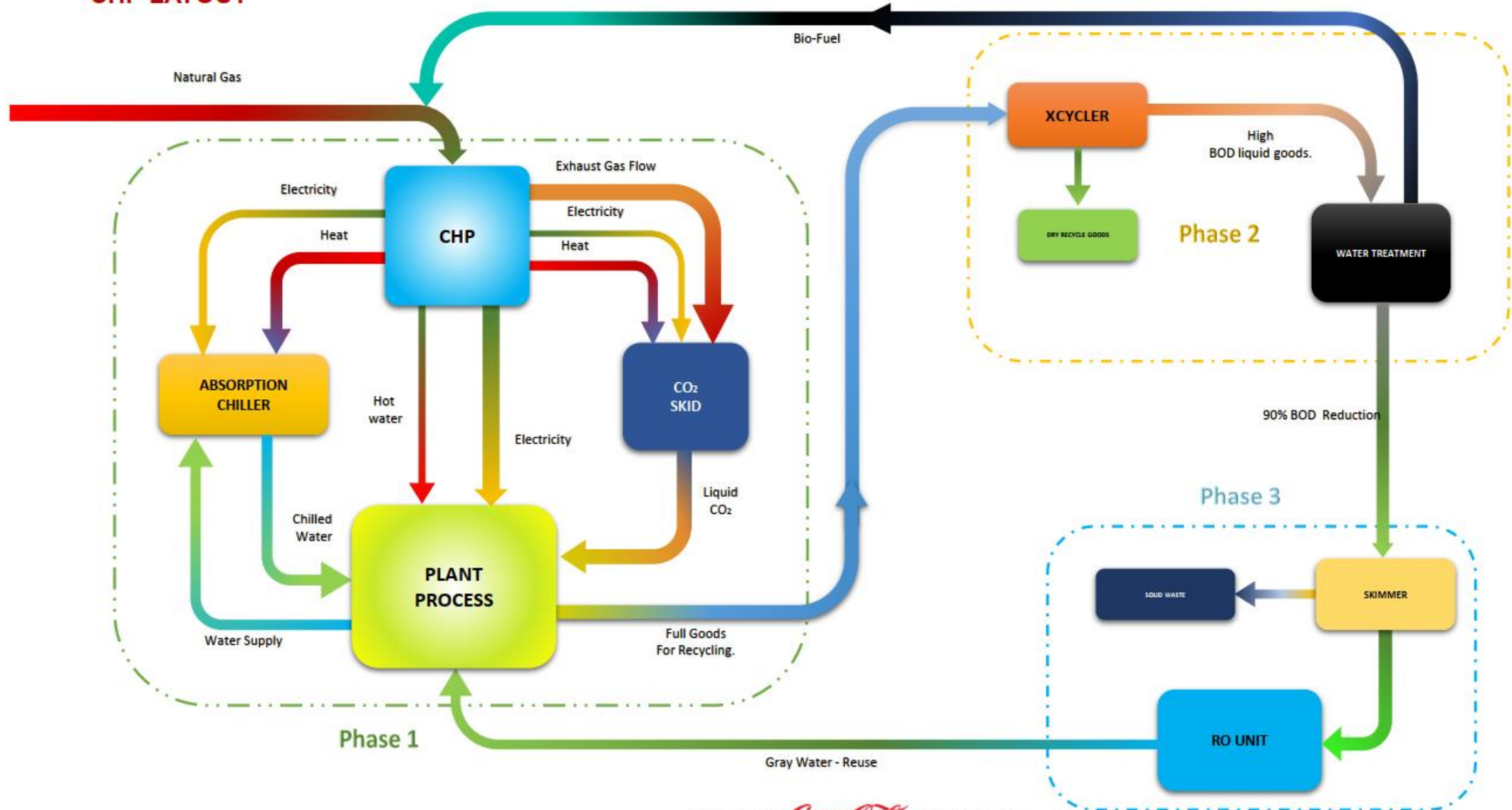
Don't

Combined Heat and Power (CHP) With Carbon Capture

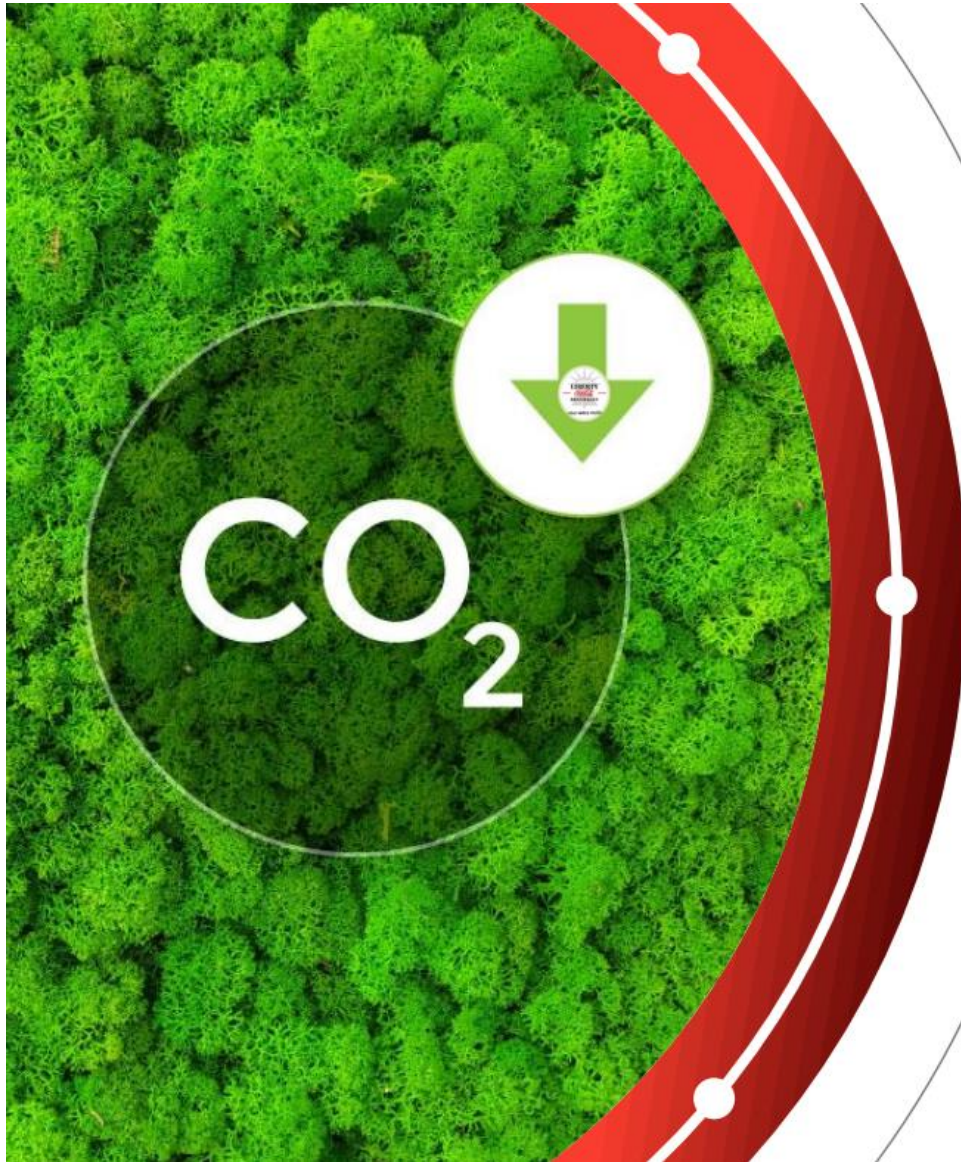


1

CHP LAYOUT



↳ Biochemical Oxygen Demand | CO2: Carbon-di-Oxide | RO: Reverse Osmosis |



Greenhouse Gas Emissions

This technology allows us to eliminate impurities from the exhaust gas to parts per billion.



CARBON CAPTURE

Targeting just the carbon dioxide molecules from the exhaust and purify, liquify, and use as the carbonation in our beverage.



285-34 PD Nonresidential Planned Development District.

(c) Accessory uses.

[1] Uses customarily accessory to uses permitted by right in Subsection B(2)(a).

Threshold Question - How can the 1st QuadGeneration Facility in the country be deemed a **customary accessory use?**

Battery Energy Storage System Proposal

(b) Public utility structures and utility rights-of-way, when said facilities are needed to serve the Town or the immediate neighborhood, subject to a determination by the Town Board that no other reasonable location in this district or in a less restrictive district can be utilized for the proposed facility and further subject to such conditions as the Town Board may deem appropriate for the protection of adjoining uses and of the character of the given district.

BESS Proposal in Town of
Greenburgh - Deemed
Special Permit Use





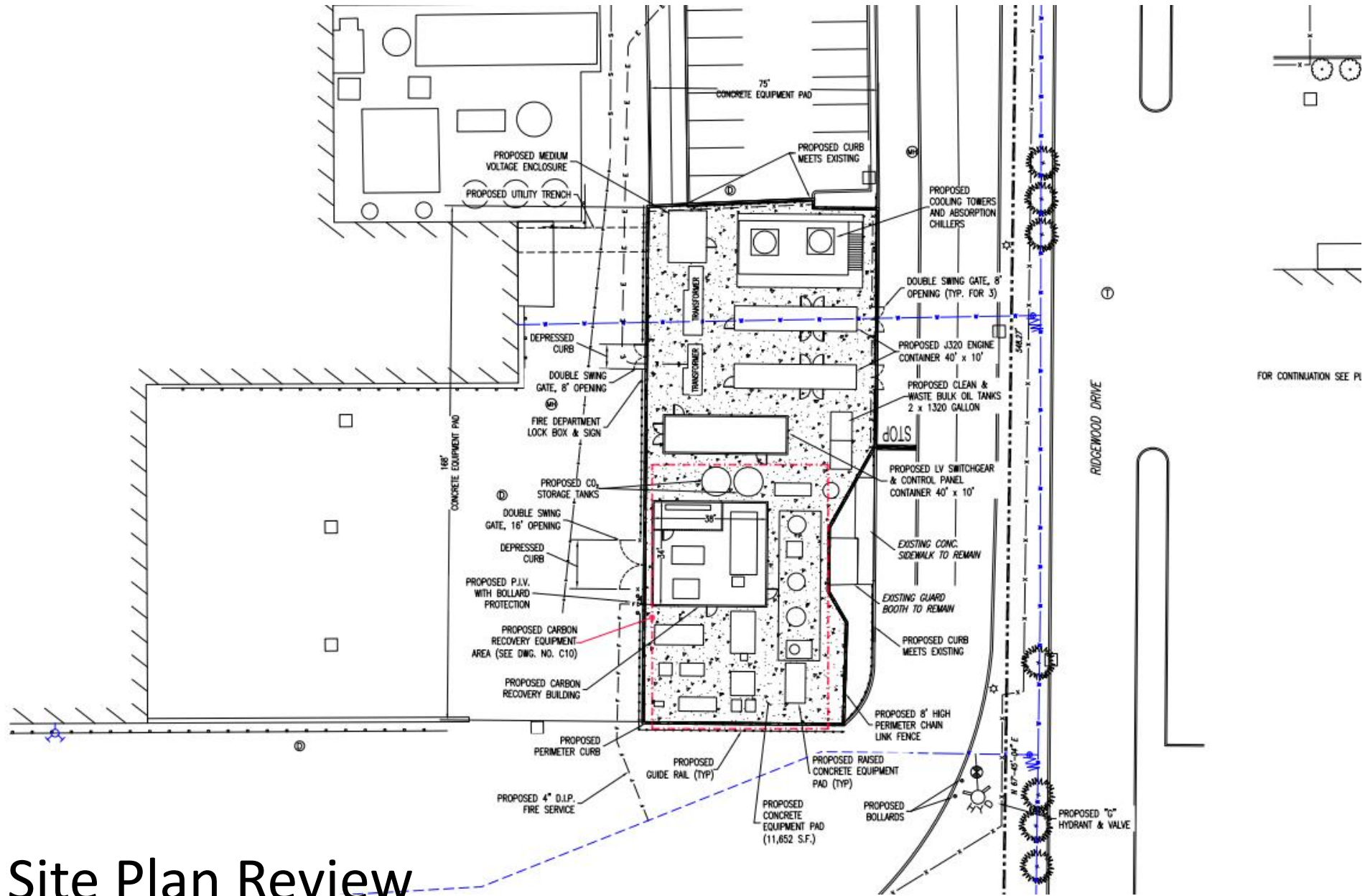
Nearest Residential = Approx 2,500 linear ft. from site

Existing PD Non-Residential Planned Development District

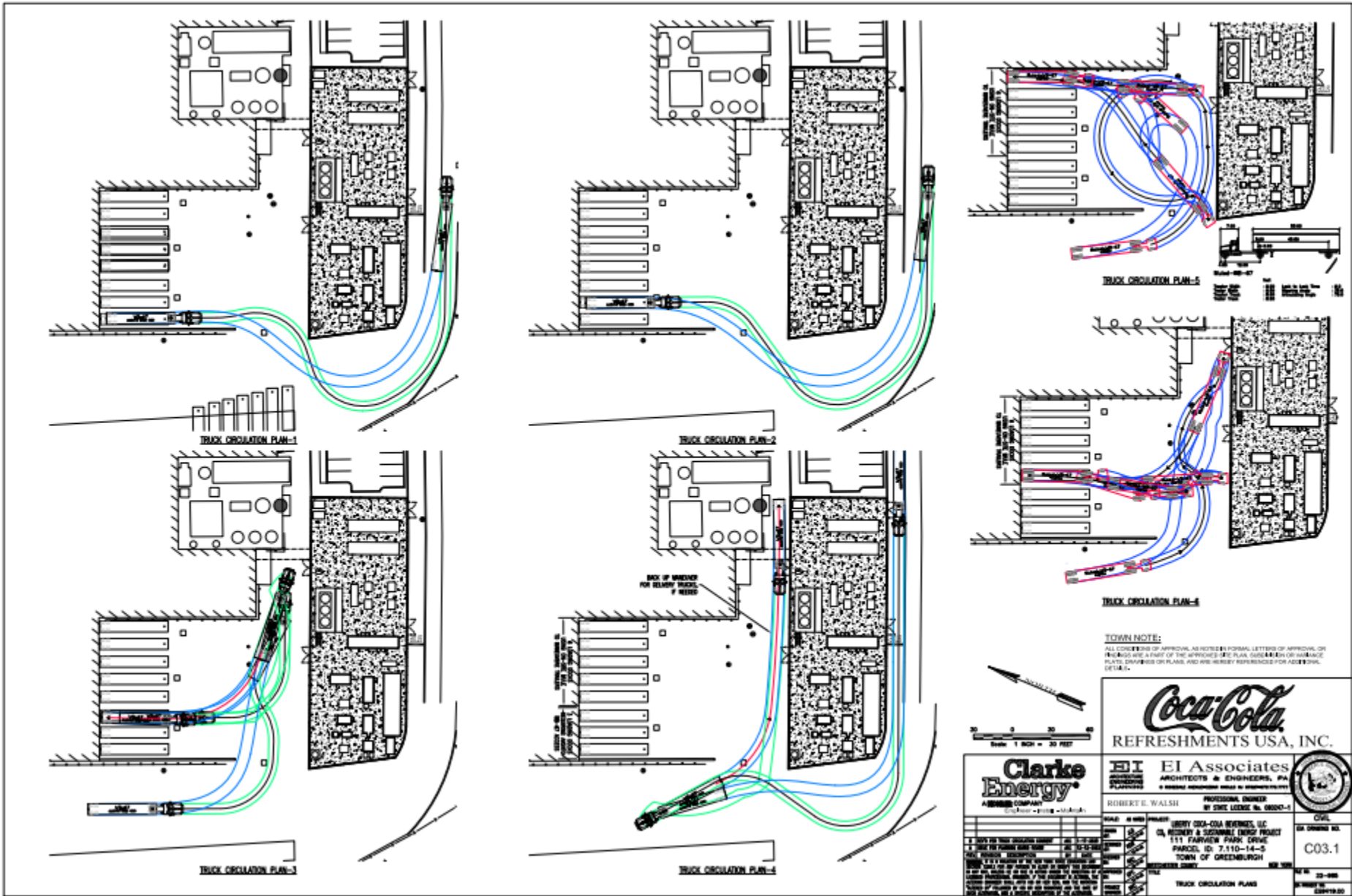


Hypothetical Site for Quad-Generation in the PD District - Adjacent to Residential Uses

QuadGeneration – Accessory Use
Planning Board - Site Plan Approval
Zoning Board - Area Variances – 40 ft. max height 77 ft. towers/tanks proposed

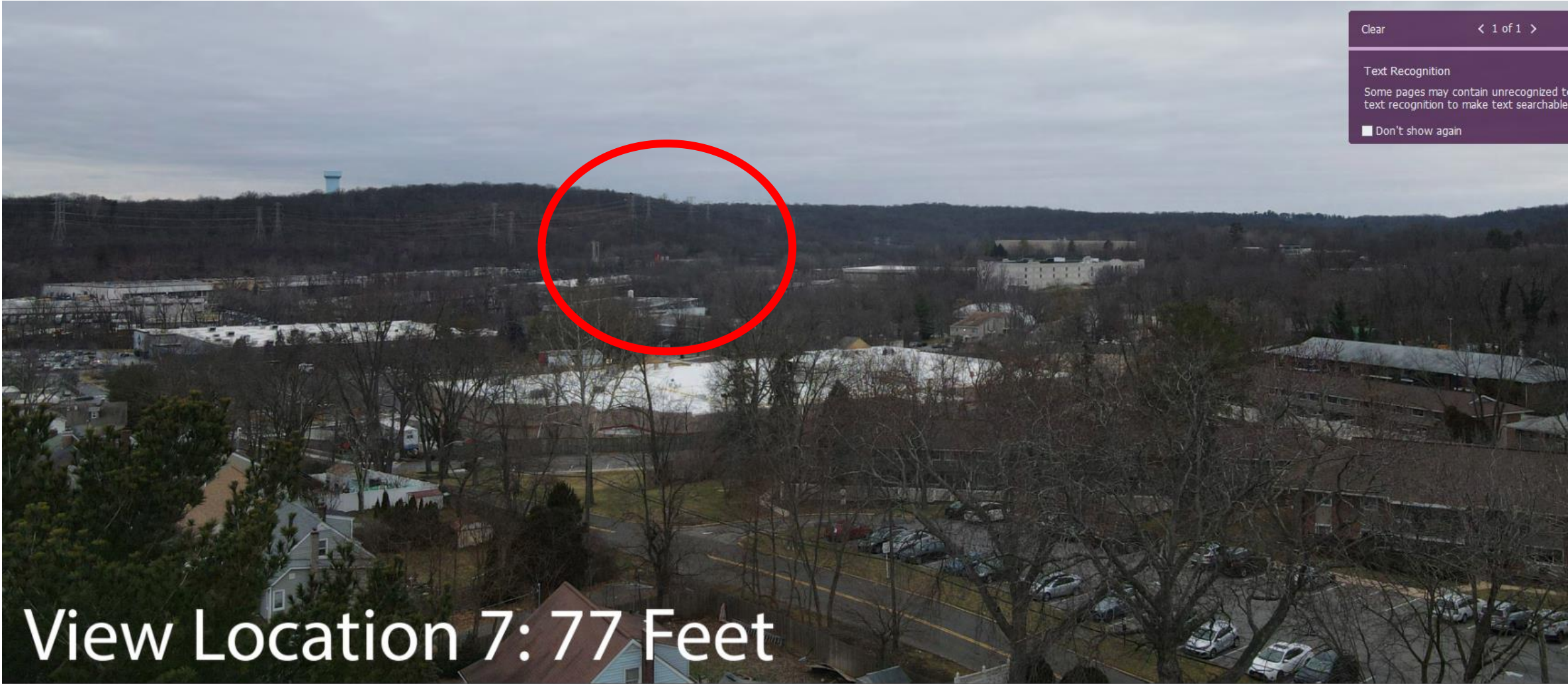


Site Plan Review



Truck Turning Analysis

Viewshed Analysis



View Location 7: 77 Feet

Zoning for Sustainable Infrastructure Takeaways

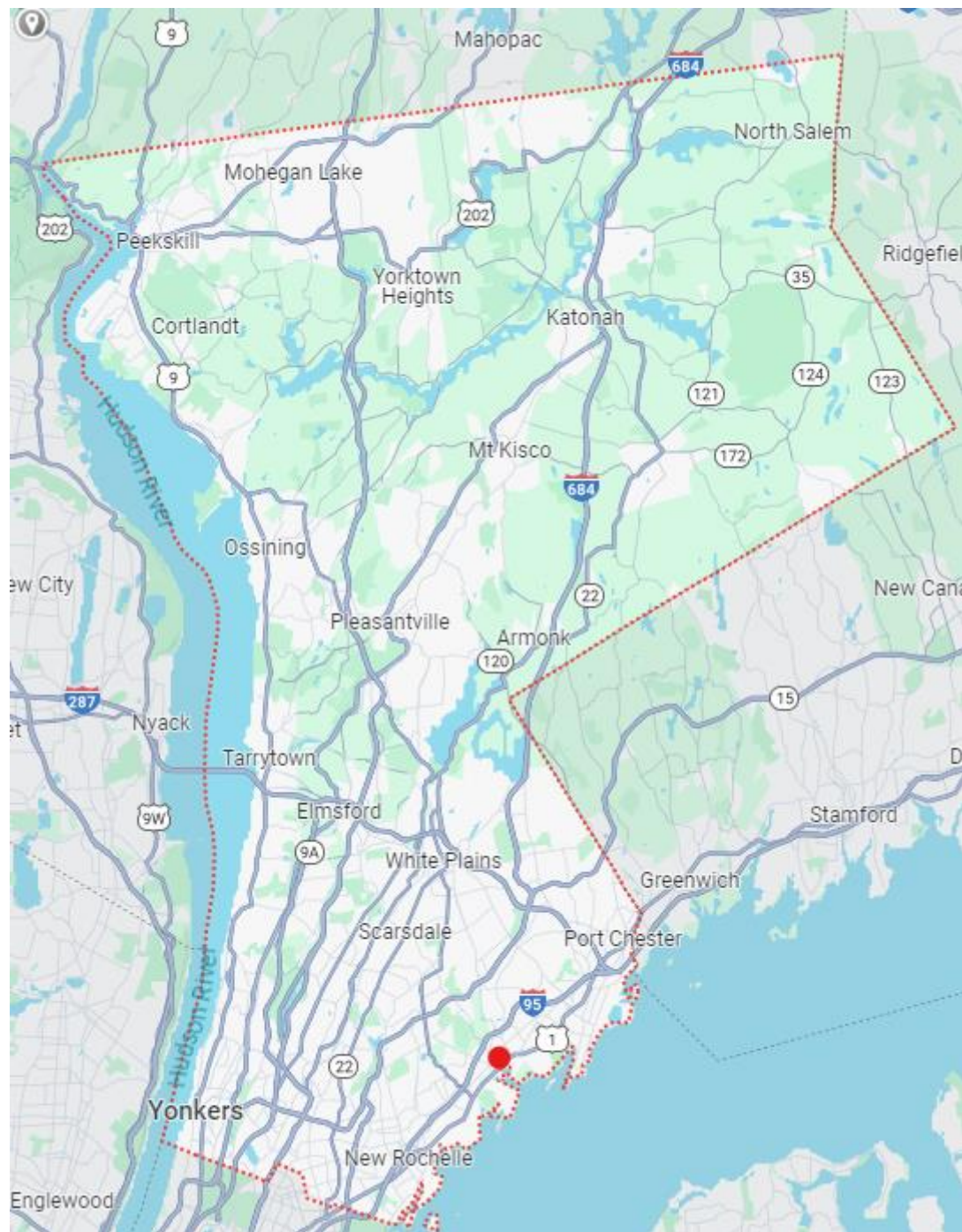
- Conduct a zoning barrier analysis
- Sometimes its ok to stay status quo
- If there is an express prohibition identified – take that on, be proactive
- If a use is great in some locations / disaster-potential nuisance in others - take that on, be proactive

Questions/Comments



**DGC Capital –
572 Van Ranst
Place,
Mamaroneck,
New York**





Mamaroneck



8-19-403

28 Madison St
8-19-84

46 Madison St
8-19-89

Old White Plains Rd
8-19-100

632 Mamaroneck Ave
8-19-1

101 Sheldrake Pl
8-22-333

Jefferson Ave
154-41-1-2
Mamaroneck Village

Jefferson Ave
154-41-1-1

Van Ransst Pl
8-22-1

Mamaroneck Village

572 Van Ransst Pl
8-22-255

Old White Plains Rd
8-32-84

120 Madison St
8-32-124

Center Ave
8-23-598

134 Center Ave
8-23-601

128 Waverly Ave
8-23-545.2

148 Center
8-23-5

1 Station Pl
9-1-419

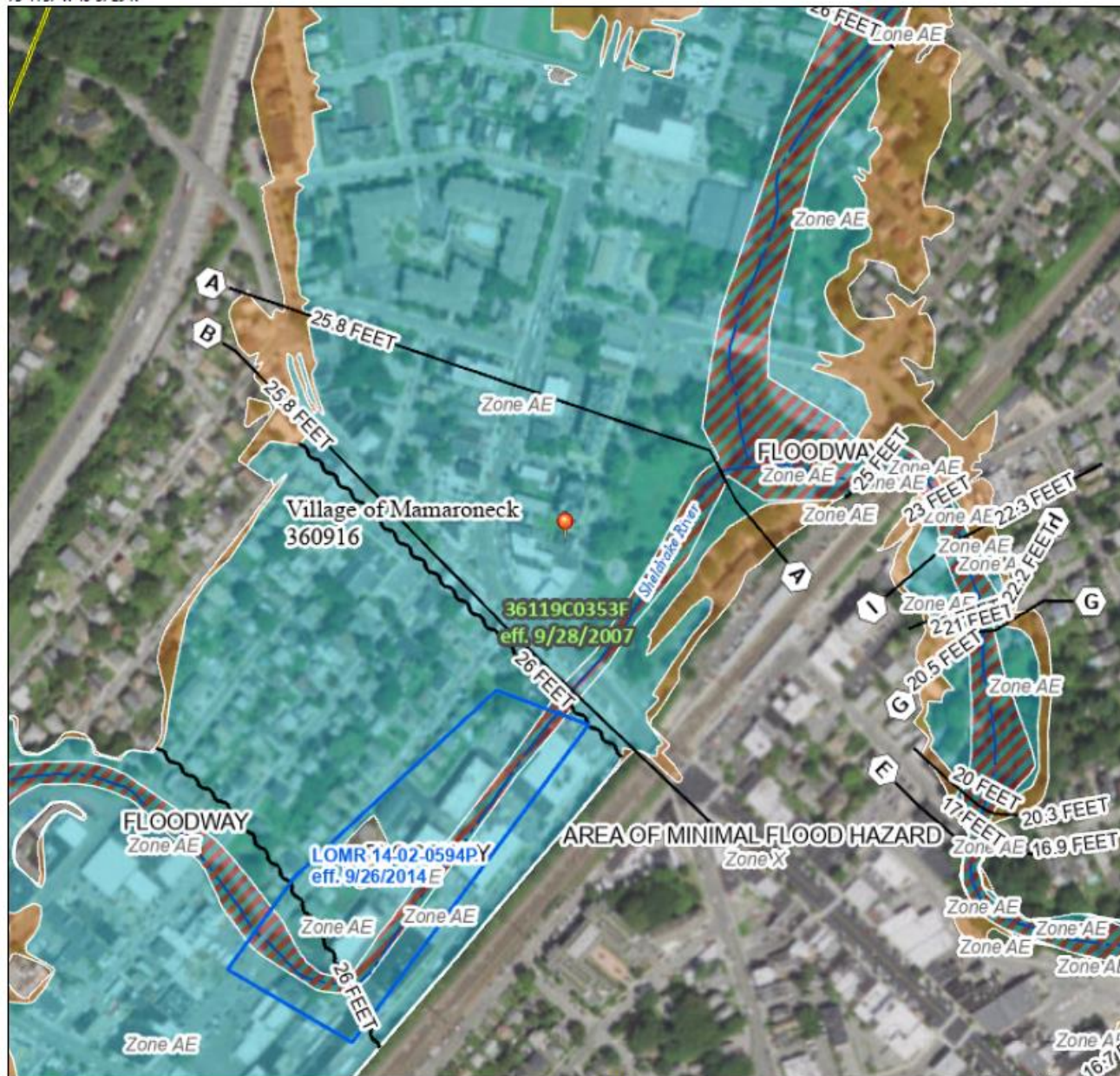
Halestead Ave
9-1-355

Mamaroneck Village

National Flood Hazard Layer FIRMette



73°44'37"W 40°57'29"N



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

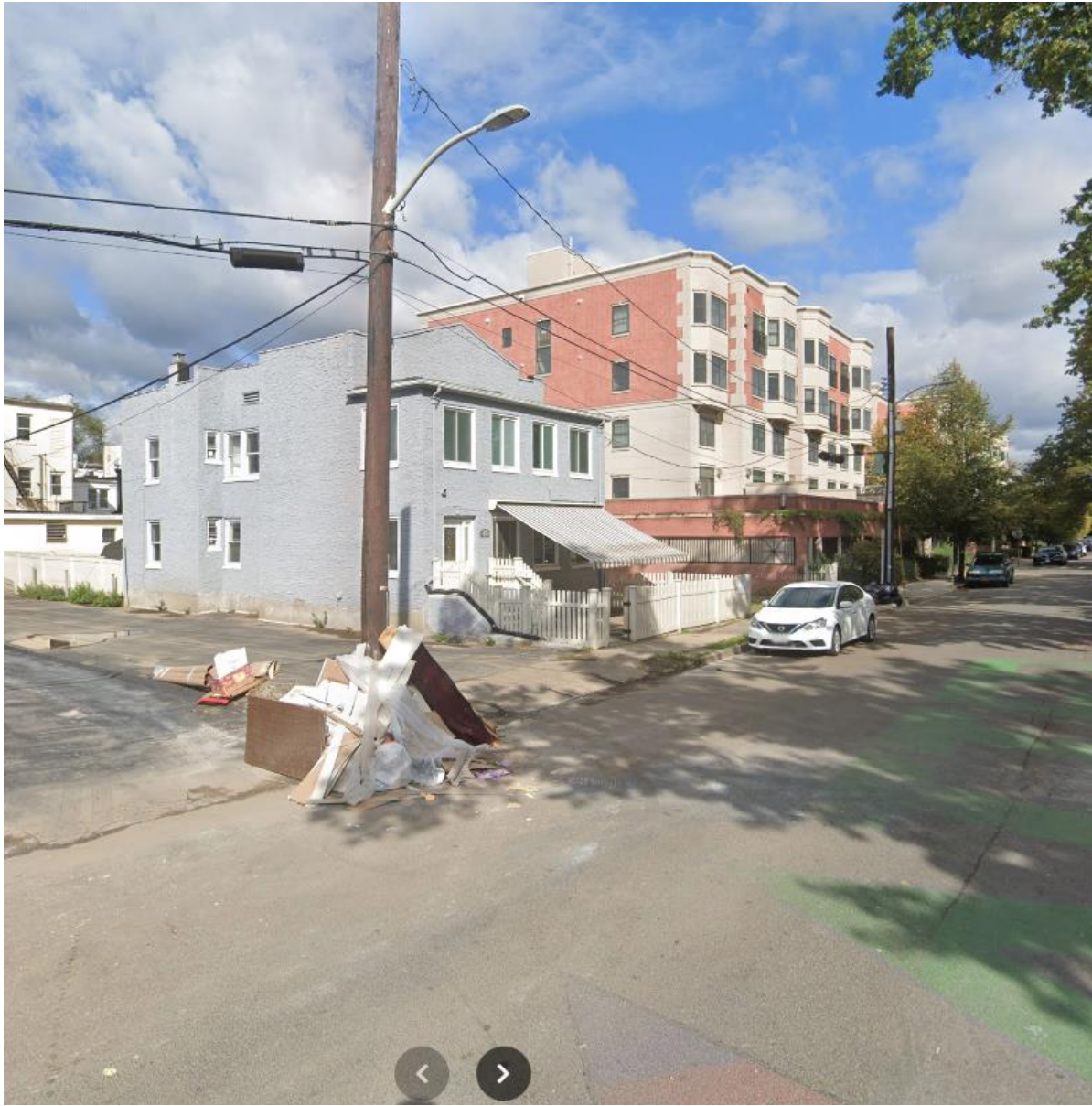
SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
		Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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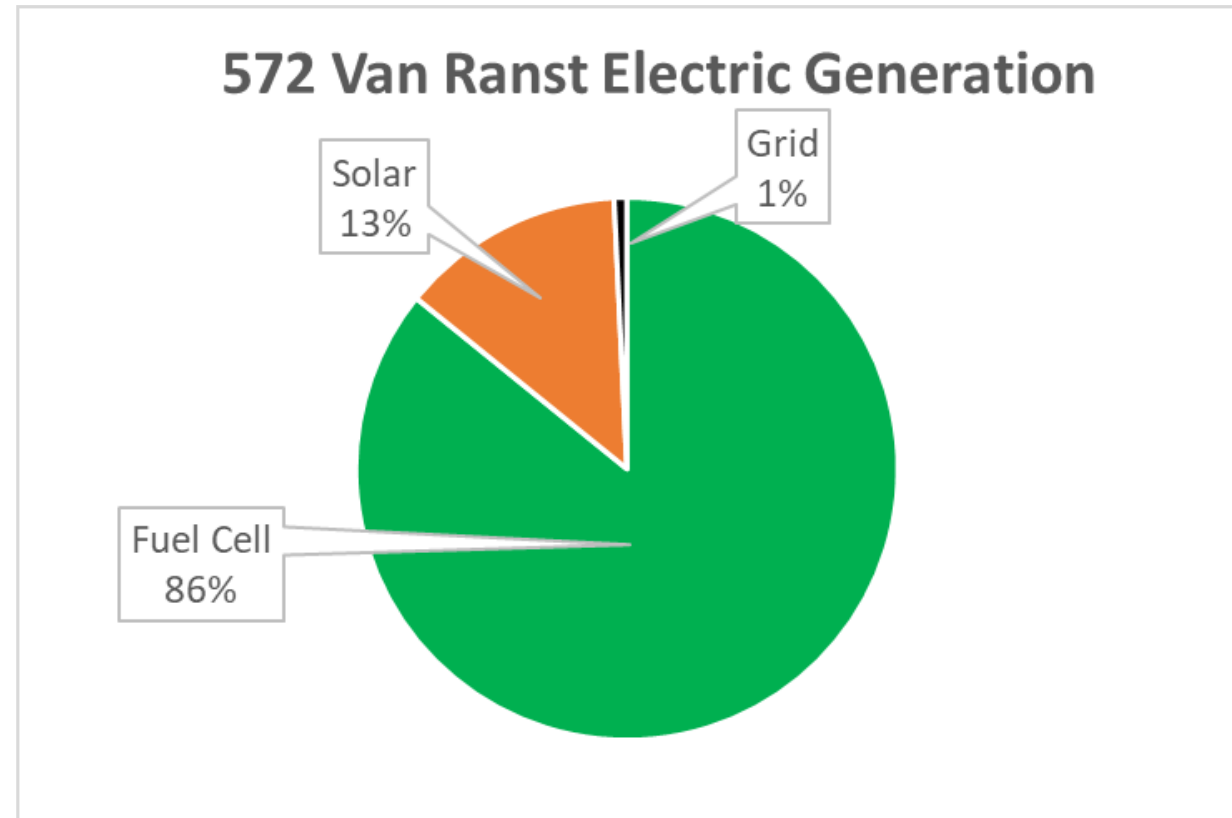
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Project Details



Hydrogen Fuel Cell Technology



Land Use Approvals & Challenges

- Planning Board
 - SEQRA Lead Agency
 - Fire Department review
 - NYS SHPO
 - Emergency Management
- Zoning Board of Appeals
- Harbor & Coastal Zone Management Commission
 - Comments from Flood Mitigation Advisory Committee
- Board of Architectural Review



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