1. Notice

    Documents:

    ENERGY EFFICIENCY NARRATIVE WORKSHOP 4-13-2023.PDF

2. Minutes

    Documents:

    ENERGY EFFICIENCY NARRATIVE WORKSHOP MINUTES 4-13-2023.PDF

Notice of Agenda

THE TOWN OF GREENWICH
PLANNING AND ZONING COMMISSION AND ENERGY MANAGEMENT ADVISORY COMMITTEE

Energy Efficiency Narrative Joint Workshop

Thursday – April 13, 2023 – 10:30 am

Virtual Meeting via Zoom

Please click the link below to join the webinar:
https://greenwichct.zoom.us/j/81620572895?pwd=amZzVkw3NXpYQ1p0M2RDVDI4dDN0dz09
Password: 3526057

Or join by phone:
Dial by your location: +1 646 518 9805 US (International numbers available: https://greenwichct.zoom.us/u/aegtpNcxUV)
Meeting ID: 816 2057 2895
Password: 3526057

MEETING AGENDA

1. Brief the P&Z Commissioners, staff as well as Conservation staff on guidelines for achieving energy efficiency in buildings.
2. Review energy efficiency narratives received to date.
3. Explore ways to improve the applicants' narratives.

The Town complies with all applicable federal and state laws regarding non-discrimination, equal opportunity, affirmative action, and providing reasonable accommodations for persons with disabilities. If you require an accommodation to participate, please contact the Commissioner of Human Services at 203-622-3800 or demetria.nelson@greenwichct.org as soon as possible in advance of the event.

ENERGY EFFICIENCY NARRATIVES WORKSHOP

ENERGY MANAGEMENT ADVISORY COMMITTEE
BOARD OF SELECTMEN
TOWN OF GREENWICH
APRIL 13, 2023

AGENDA

Introduction and Workshop Goals

SECTION 1

Energy Efficiency & Renewables Guidelines

The Board of Selectmen Energy Management Advisory Committee (EMAC) offers these guidelines to help the building community realize an energy efficient, cost-effective, healthy, and clean-powered built environment.

As a starting point: all projects must conform to the 2022 CT State Building Code and the 2021 International Energy Conservation Code (IECC) in effect.

In addition, policymakers may choose to require municipal buildings to go *beyond* Code(s), in order, for example, to lower operating costs, achieve reputational benefits, and/or meet climate and sustainability goals. Members of the building community may also choose to achieve greater efficiency, performance, and operating cost savings than are required by Code for residential and commercial buildings.

The first step in aiming for a better built environment is to consider a few basic principles.

A. Principles

Energy efficiency and lower emissions typically reflect a few basic principles:

1. **Use Site-sensible Design**
   Before buildings had power, they were designed to take advantage of available heat, light, and air. Today's buildings can significantly reduce their power load when they take advantage of what the site offers. For example,
   - Orient the roof to maximize insulation (measure of direct sunlight)
   - Orient glazing to maximize passive energy gain and natural light
   - Position operable windows to be able to capture airflow for fresh, circulated air and cooling.
2. **Design Flexible, Multi-use Spaces**
   A building's energy use is a function of its energy intensity and size and can be distilled into an EUI (energy usage intensity) score that equals annual energy consumption divided by a building's square footage. This simple truth points to a second principle: **maximize the use of conditioned space**. Energy efficient design offers spaces with multiple uses. For example, a large open space in a commercial building could be used for exhibitions, social gatherings, lectures and presentations, showrooms, etc. Dedicated single use spaces 'multiply' energy use and are the opposite of this principle.

3. **Select Energy-Efficient Systems**
   Energy efficient buildings use less energy per square foot than 'wasteful' buildings. Starting with the building envelope, and including HVAC, lighting, and plug loads, selecting energy efficient alternatives increases energy performance.

4. **Generate Power on Site**
   Now that the building is sited advantageously, sized based on flexible uses of the built area, and operates using highly efficient systems -- it demands less energy per square foot than conventional buildings. Total energy costs can be driven down further by adding renewable power sources – solar, geothermal, electric heat pumps – which reduce grid demand even further, lowers ownership costs, and pollutes less, especially onsite / in home emissions.

With those 4 Basic Principles in mind, let's look at what can be achieved, and the features that drive results.

B. <u>Results: Energy Modeling Metrics & Energy Choices</u>

The following template is meant as a guide for building applicants and for the EMAC reviews of submitted Energy Narratives:

Energy Efficiency Modeling & Metrics	Existing	Proposed[1]	Recommended "Good"	Recommended "Better"
Site Energy Usage Intensity (Site EUI – annual $kBtu/ft^2$)[2]			Residential <45, Non-res <35	Residential <35, Non-res <25
Home Energy Rating System score (HERS) (residential only)			<52	<42
ENERGY STAR score[3] (any building)			>80	>90
Air Leakage (Blower door test)			<0.3cfm/ft²@50PA	< 0.1cfm/ft²@50PA
Energy Source			HVAC All Electric	All Electric – no fossil fuels
Use of Renewables			Yes	Yes + battery storage
Level 2 or higher EV Charging Station[4]			Greater of 1 or 20% of spaces	Greater of 1 or ≥30% of spaces

[1] As a reminder, all applicants must comply with the CT 2022 Building Code and the incorporated IECC 2021. For a summary of *Key Changes in the 2021 IECC for the Northeast and Mid-Atlantic* please see link here.
[2] Site EUI is equal to the annual energy equivalent of all electricity, natural gas, fuel oil or propane consumed on site, divided by building square footage (gross floor area).
[3] A building's Energy Star score is derived from modeling using Energy Star Portfolio Manager, a free, easy to use software program from the Department of Energy. Learn more here.
[4] Please refer to the Greenwich Municipal Code, new Section 162.1, ELECTRIC VEHICLE OFF-STREET PARKING REQUIREMENTS, an amendment to Sec. 6-5(a) which can be found here.

Energy modeling is key to constructing energy efficient buildings. Best practice is to set an EUI goal and a total project budget goal at the outset, and work towards those goals throughout the design process.

The EUI goal should be based on energy efficiency benchmarks for comparable buildings in the same climate zone, e.g., benchmarks for schools, office buildings, multi-family homes, etc. Projects can identify design choices (systems, envelope, size, etc.) needed to realize the target EUI and budget. Modeling to evaluate the energy performance under changing specifications is useful to stay on track towards budget and EUI goals.

Best practice is to revisit the EUI at completion and commissioning, and one year from occupancy to understand any differences between modeled and actual EUI and adjust.

C. Building Features Driving Energy Performance

1. Building Orientation & Roofing
2. Envelope
3. Glazing
4. Lighting
5. Power Systems: HVAC, Domestic Hot Water & Appliances
6. Renewables
7. Materials
8. EV Charging Stations

1. Building Orientation & Roofing

Highly energy efficient buildings reduce their grid-load by generating renewable power. Building orientation and roof configuration determine the potential for solar power generation. Best case is to design a large, unencumbered roof area (no dormers, vents, or mechanical systems unless placed along a perimeter) that is south or east-west facing, and in Greenwich, with an optimal 35 degree tilt.

Besides the roof, a building that maximizes southern or east-west facing glazing maximizes the possibility of passive heat gain in winter, provided there is offsetting shading (awnings, curtains, shutters, etc.) to avoid heat gain in summer. Given that sleeping quarters are used when the sun is not out – these rooms are ideally north-facing, whereas public areas used during daylight hours are best facing south or east-west.

2. Envelope

The building envelope is any part of a building's structure that separates the interior from the outside. This includes the roof, foundation, walls, exterior doors, windows, and air/water/vapor barriers.

Energy efficient buildings reduce energy loss via their envelope. They don't leak conditioned air (warm in winter, cold in summer) and they allow fresh air into the building at desired temperatures. One way they do this is by minimizing thermal bridges in the envelope that transfer energy from the exterior to the interior. For example, a well-insulated roof with a metal plumbing vent will have energy loss via the metal vent. Steel is highly conductive and can transfer energy from a balcony to an interior slab, for example. Using materials that break these energy transfers is key to energy efficiency.

Along with few/no thermal bridges, energy efficient buildings have well insulated envelopes, realized through a variety of techniques and materials, and measured using R values. An energy efficient building has higher R-values than required by most building codes. The type and quantity of materials used in well insulated buildings have a greater ability to resist heat transfer. As a rule of thumb, the thicker the insulating material the greater its resistance to heat transfer. Therefore, a well-insulated building heats more slowly in the summer and cools more slowly in the winter.

Foundation walls and slabs should also be well insulated. Poorly insulated foundations increase energy use and negatively effect comfort.

3. Glazing

Glazing refers to any glass/light penetrable surface in a building's envelope. In general, glazing is less insulating than the rest of a building's envelope – walls, roof, foundation. Therefore, energy efficient buildings are not "all glass" but have a "windows to walls ratio" of no more than 40% and better yet, 30%. As a rule of thumb at least 20% of the envelope should have operable windows to provide access to outdoor air – too great a portion of the envelope, however, can lead to energy loss.

Size and place the windows to harness natural light for both lighting and heating. Use the sun's energy during winter to heat indoor space in key locations (passive heating). Increasing the window area on the south facing side of the house vs the northern, eastern and western side maximizes winter heat and light gains and minimizes heat loss. Use shades and roof overhangs in the summer to keep solar radiation out. The roof overhang can block the high summer sun and its heat.

4. Lighting

For new buildings, lighting design should be part of a whole-building approach with the following elements:

- Fully utilize daylighting.
- Light quality is as important as light quantity.
- Match the amount and quality of light to the performed function of the space.
- Use 100% energy efficient lighting components (LED), controls and systems (e.g., timers and occupancy sensors)
- Exterior lighting should turn off/on automatically when natural light is sufficient/insufficient.
- If extra exterior security is needed, consider LED flood lights with combined photo sensors and motion sensors.

5. Power Systems: HVAC, Domestic Hot Water & Appliances

HVAC systems account for more than 50% of energy consumption in the built environment (IEA, 2013). It follows that HVAC systems powered by fossil fuels emit greenhouse gases.

In contrast, all-electric HVAC systems use less energy in total (they are more efficient) and are powered by a fuel mix that typically includes some or even a high percentage of renewables. Therefore, they pollute less, cost less to operate, and use less energy overall.

The key to transitioning to an all-electric HVAC solution is integrating systems – linking heating, cooling and hot water via a condenser water loop. A condenser water loop uses water-to-water heat pumps that provide hot water or chilled water for heating or cooling. The condenser water loop is fed energy via an air-to-water heat pump, or ground source loops, or a combination of both. Properly designed, HVAC systems can produce more than twice, and often more than 8 times during the shoulder seasons, as much heating and cooling as the energy required to produce it. A properly designed HVAC system is defined as having a Coefficient of Performance (COP) of > 2 on design winter days. Less purchased energy means lower cost and lower emissions.

A system that is designed with a holistic approach would also be able to support a building's domestic hot water needs. Domestic hot water units can share energy with the broader building's systems by tapping into the condenser water loop.

For commercial buildings, the coordination, staging, trending of data, and continuous commissioning capabilities of a Building Automation System (BAS / BMS) play a critical role in achieving energy efficiency.

Key items for an efficient all-electric design

- Conditioning the condenser water loop via:
  - Air to water heat pumps
  - Ground source loops for thermal energy storage
  - A combination of both
- Water to water heat pumps providing chilled water or hot water for space conditioning
- Water source domestic hot water heaters that use the condenser water loop for source energy (as an alternative, utilize a heat pump water heater, aka hybrid electric water heater)
- Building Automation Systems (BAS) or Building Management System (BMS)

Studies show that gas appliances leak even when not in use – as much as 1-2% of methane 'used' is released into the air, in addition to carbon monoxide, formaldehyde and other harmful pollutants. Induction electric stove tops are healthier and more energy efficient. In commercial kitchen settings where gas heat might be necessary, waste heat can be recovered from exhaust air via heat exchanger coils with glycol that feed the waste heat energy into the condenser water loop network, or into heating outside air ventilation.

6. Renewables

Assuming energy efficient power systems described above, renewables should be able to provide up to 100% of the energy load (a net zero energy building). Begin by evaluating the site and building location for the use of solar and/ geothermal energy generation. Any solar installer can estimate energy production for a given site and roof using Google Project Sunroof or similar tool without a site visit! Of course, tree canopy and topography may not allow for significant solar energy generation at some sites. Rooftop PV panels should provide electricity for the building during the day and with battery storage, also at night. For new construction with solar potential but no planned system, best practice is to create the electrical infrastructure (chase, panel capacity, etc.) for future building owners to opt in. However, given the wide availability of 'zero capital' solar power purchase agreements, capital availability should not be the constraint.

Geothermal systems can heat, cool, and provide domestic hot water to the building. Where the subsurface characteristics favor geothermal, ground source heat pumps can provide long lasting energy savings to the building's owners or tenants. This is critical for affordable housing applicants in particular, whose residents benefit disproportionately and perpetually from lower energy bills. Additionally, ground source systems can be combined with air source heat pumps to reduce installation costs and increase flexibility and resiliency. The combination of air source heat pumps and ground source loops also reduces capital costs by requiring less drilling for fewer wells, and a smaller air source heat pump system due to the lower load.

7. Materials

Energy is expended and greenhouse gases are emitted in manufacturing new building materials. This is referred to as the building's "embedded energy." Significant use of conventional concrete, for example, causes significant energy use and emissions. Best practice is to choose materials that reduce a building's embedded energy use. In general, this means less concrete and steel, fewer materials transported from great distances, and where possible, more recycled materials.

8. EV Charging Stations

Under the Town's new EV Charging Regulations, newly constructed commercial, multifamily and municipal buildings with 30 or more parking spaces must install Level 2 charging stations in 10% of the parking spaces allocated to cars or light duty trucks. Additionally, newly constructed schools or those undergoing major renovations must install Level 2 charging stations in 20% of the parking spaces allocated to cars or light duty trucks.

For residential buildings, best practice is to equip the garage with a 50 (min) to 100 (max) amp NEMA 14-50 240-volt outlet that can be connected directly to the EV or can be used in conjunction with a Level 2 home EV charger to service all cars at that location. Second best is to size the electrical system to accommodate outlets / chargers to be added later. Where feasible, batteries can be charged with solar PV during the day to service the cars at night. For smaller commercial buildings, best practice is to provide EV charging options for parking spaces expected to be occupied for more than one hour.

SECTION 2

CASE STUDIES – see Appendix B, pages 15-24

Three sample Energy Narratives as submitted to P&Z are provided, along with the written EMAC review for each submission.

- Unacceptable Energy Narrative – see 206 Sound Beach Avenue
- Fair Energy Narrative – see 420 Field Point Rd, PLPZ 2022 00496
- Good Energy Narrative – see 204 Otter Rock Drive, PLPZ 202200551

SECTION 3

ENERGY NARRATIVES REVIEW

Summary Chart

The following chart outlines the Energy Narratives received by P&Z from May, 2022 through March 7, 2023.

Building Type (1)	# of Apps. (2) / % of All Building Types	Energy Modeling? (Yes?)	Above E.E. Requirements (Yes?)	Renewables? (Yes?)	All Electric? (Yes?)	EV Charging Stations* (Yes?)
All	**27/ 100%**	**10/ 37%**	**14/ 52%**	**9/ 33%**	**9/ 33%**	**10/ 37%**
Single Family	**7/ 26%**	**4/ 57%**	**6/ 86%**	**5/ 71%**	**4/ 57%**	**5/ 71%**
Two Family	**4/ 15%**	**4/ 100%**	**2/ 50%**	**2/ 50%**	**0/0%**	**1/ 25%**
Multi Family	**5/ 19%**	**2/ 40%**	**2/ 40%**	**0/ 0%**	**2/ 40%**	**1/ 20%**
All Other	**11/ 41%**	**0/ 0%**	**4/ 36%**	**2/ 18%**	**3/ 27%**	**3/ 27%**

(1) Buildings with two uses are assigned to the category with the primary use. All Other category includes restaurants, offices, pool houses, RR Station redo, Arnold Bakery and Boys and Girls Club.
(2) Please see Appendix C for list of applicants providing energy narratives.

Key Takeaways

- The overall results from requiring energy narratives have been disappointing:
  - Less than half of all applicants are doing energy modeling and only half expecting to exceed E.E. targets.
  - Only 1/3 of all applicants are using renewables or going all-electric.
  - Slightly more than 1/3 of applicants will install EV charging stations.
- Responses from Multi Family and All Other applicants fell short: (These are large projects).
  - Less than half the applicants in these two categories expected to exceed E.E. Targets.
  - No plans for energy modeling from All Other applicants.
- Single Family and Two-Family applicants are much more energy conscious:
  - The majority use energy modeling and expect to exceed E.E. Targets.
  - Single Family applicants score highly on all the E.E. Metrics.
    - 57% plan to build all electric residences and 71% will have EV charging stations.
  - 100% of Two-Family applicants are doing energy modeling.

- Explanation: SFH's generally owned by occupants who benefit from E.E. Multi-family homes are typically owned by nonresidents of those buildings and occupied by renters. Since the renters pay the utility bills, such multi-family owners don't directly benefit from employing E.E. Measures.

SECTION 4

CHALLENGES & OPPORTUNITIES GOING FORWARD

The EMAC P&Z subgroup has learned a great deal about the energy efficiency planned for our built environment since we began reviewing energy narrative submissions in May of 2022. As indicated in Section 3 – the overall results are well below our aspirations with only 1/3 of projects reviewed, at best, reaching desired metrics, and not very many projects reviewed in total.

This suggests a few potential next steps.

1) P&Z's energy narrative regulation could be expanded in scope to include a greater portion of applications. For example, it could include: renovations on buildings > 3000sf, conversions from residential to non-residential, athletic/recreational facilities >1200 sf. See Appendix D for Regulation language.

2) The energy narrative regulation could require energy modeling for buildings above a reasonable size, for example, 10,000sf. Very few projects share how much energy the building is expected to use, annually, per square foot. This is not a complicated calculation and is the basis for assessing energy efficiency.

3) The Site Plan Application website could provide the Energy Narrative Template as a 'form' for applicants to complete, including the table of 'Results: Energy Modeling Metrics and Energy Choices" and the narrative sections.

4) Town staff could, over time, be responsible for writing the reviews of the submitted Energy Narratives. Energy Narrative Reviews are currently written by EMAC volunteers. This leaves the process vulnerable to changes in EMAC's composition and skill. Institutionalizing the Energy Narrative Review responsibilities within Town staff can mitigate this risk.

5) Site Plan applications could require discussion of energy efficiency and the use of renewables, consistent with the site planning goals to 'protect environmental quality', specifically air quality, by reducing or eliminating air pollution from greenhouse gases.

6) Other issues from today's discussion and further review

However these issues are resolved going forward, the EMAC P&Z Subgroup wishes to thank the skill, insight, and tremendous efforts of those involved. The Town has made strides in defining and educating the building community regarding energy efficiency aspirations and possibilities. Let's keep it up.

Appendix A

Glossary of Metrics Requested in Energy Narrative Regulation

Energy Use Intensity (EUI): EUI = total site energy used in one year measured in thousands of British Thermal Units (kBTUs). 1 EUI = 1,000 BTUs. Typically, EUIs are provided on a square foot basis, i.e. number of EUIs per square foot.

Site EUI: Includes all energy generated on site as well as from renewables.

Coefficient of Production (COP): COP equals the ratio of the heating or cooling that a HVAC system produces divided by the amount of energy used to produce that heating or cooling over the same time period (all measured in BTU equivalents). Gas boilers can never achieve a COP of greater than 1. Efficient all electric heat pumps can achieve COPs of 2-3 times.

Home Energy Rating System (HERS): Used to measure the energy efficiency of SF, two family and multi family residential buildings. HERS compares the energy use of an actual or as designed home against a reference home of the same size and shape. The reference home is based on the standards of the International Energy Conservation Code (IECC). The CT Building Code is based on the IECC for both residential and commercial projects.

HERS Ratings for Representative Homes (Lower is Better)

100 and up	Older Home
85 and lower	ENERGY STAR Home
50 – 40	New Home built to IECC 2021
45 and lower	Zero Energy Ready and LEED Homes
35 and lower	Passive House
0	Net Zero Energy Home

ENERGY STAR Portfolio Manager (ESPM): Used to measure energy efficiency of many types of nonresidential buildings, e.g. schools, offices, hospitals, restaurants etc. The ESPM score of a specific building, say a school, is based on how the energy use of that building compares to the national median EUI of schools. In this case, the higher the score the more efficient the building is compared to the national median of that building type.

Air Changes Per Hour (ACH): Used to measure the air tightness of a building prior to ventilation. The fewer the number of air changes per hour the tighter envelope of the building and therefore the better the control layers (air/water/vapor/insulation). A tighter envelope translates into greater energy efficiency.

Appendix B

<u>Samples of Energy Narratives as submitted to P&Z and EMAC's Reviews of those Narratives</u>

- Unacceptable Energy Narrative – see 206 Sound Beach Avenue
- Fair Energy Narrative – see 420 Field Point Rd, PLPZ 2022 00496
- Good Energy Narrative – see 204 Otter Rock Drive, PLPZ 202200551

<u>Energy Narrative Submitted:</u>

206 SBA PROPERTY OWNER LLC
206 Sound Beach Ave,
Old Greenwich, CT

ENERGY EFFICIENCY NARRATIVE

OVERVIEW

The proposed project is the demise of an existing property, previously used as a non-conforming Bank use, into a restaurant and retail unit. Energy efficiency will be achieved through the installation of new energy efficient equipment.

22 (A): Energy efficiency will be achieved through: i) the installation of new mechanical. electrical and plumbing systems; ii) the installation of energy efficient LED lighting to replace existing dated fittings, and; iii) the demise of the existing building into two units with increased insulation.

22(B): The proposed project is the demise of an existing property into two units for a restaurant and a retail store mitigating the potential for renewable energy systems.

22(C): There will be new independent HVAC systems for each of the two units (restaurant and retail store) which will significantly enhance the building's energy efficiency compared to the existing dated system. The system is currently being designed.

<u>EMAC's Narrative Review:</u>

None completed, given the incomplete nature of the submission.

Energy Narrative Submitted:

420 Field Point Propco LLC
420 Field Point Road
Greenwich, CT 06830

Section 6-14 (22) of the Greenwich Building Zone Regulations

I. Project Type, Address, Site Characteristics, Developer, Square Footage

The project consists of the renovation of 4 existing buildings and 1 proposed new building located at 420 Field Point Road. The existing buildings will maintain their existing footprint, but will undergo upgrades inclusive of new doors, windows, insulation, walls, ceilings, etc. The existing buildings on the project site will undergo a dramatic upgrade from their prior inefficient state to conform with the current State of Connecticut codes. The Manor House, Carriage House, Cottage House, and the Barn are the existing buildings set for renovation. A summary of each existing building's square footage is listed below.

The new building, referred to as "The Stables" will be a two-story wood-framed building and is approx. of 4,256 square feet.

Manor House: Existing three-story + a basement, wood-framed building and is approx. of 9.262 square feet.
Carriage House: Existing three-story, wood-framed building and is approx. of 4,682 square feet.

Cottage House: Existing single story, wood-framed building and is approx. 978 square feet.

Barn: Existing two-story, wood-framed building and is approx. 3,795 square feet, inclusive of a new garage addition of approx. 531 square feet.

Energy Objectives & Anticipated Results

This project objective is to convert a series of existing inefficient buildings into more efficient and comfortable structures. The intent is to replace the previous mechanical units with new Mitsubishi Air Cooled Split Heat Pump Evaporator Units and Condensing Units. The project will also be outfitted with a new direct exhaust (DX) Outdoor Air Split System with two modules for both the evaporator / compressor and the remote condenser. The buildings will include new ductwork throughout the ground floor of the existing Manor House, new ductless units in suites, and insulated where required in the project specifications. Exterior partitions are being upgraded to include new sheathing and insulation to meet R21 for the building envelope, however the roof will receive upgraded insulation to achieve an average of R-49 via spray-applied insulation. Prior to the proposed renovations, the existing buildings were uninsulated at exterior wall conditions and had poor thermal stability. Upon completion of the proposed project, the developer intends to provide a Blower Door Test to demonstrate the significantly reduced air leakage and therefore increased energy efficiency introduced by the renovations.

Building Operating Strategy

All existing building windows will be replaced with new glazing to better enhance the user experience with continued natural daylight, upgraded U-Value/SHGC, and less thermal loss through the window system. The building envelope will be completely insulated allowing warm air to remain indoors in the winter months, and cool air in the summer. All existing light fixtures are intended to be replaced with new LED fixtures for reduced energy consumption and designed with occupancy sensors in public areas. The project's ventilation strategy will conform to current code requirements.

All occupied spaces, except for the existing kitchen in the Manor House, will be provided with new mechanical systems. The Manor dining room is provided with a packaged DX heat pump with electric reheat and Trane air-- cooled split heat pump systems f or the cooling and heating loads. The remaining floors in the Manor, along with the suites in both Carriage & Cottage Houses are supplied with new Mitsubishi air cooled split heat pump systems. A wall effectivmounted evaporator is located in each room for e zoning temperature control. Two (2) 100% DX outdoor air split systems will provide conditioned (heated or cooled) air into each of the buildings with MERV 13 filter for the indoor air quality per ASHRAE standards 62.1 and 62.2.

Building Operating Features

The existing mechanical system includes an air-- cooled heat pump and multiple PTACs with electric board heaters. Not only does PTAC have loud noise, but it has comparatively lower energy efficiency than the air cooled split system. The new mechanical sys tem includes 100% outside air systems, providing tempered air to the relative spaces for efficient local temperature control. All new split systems used in the project have high efficiency (SEER 20, EER 13.2).

Order of Magnitude Budget Impacts

The developer expects to construct each unit within their respective building as energy efficient and sustainable units that take advantage of cost savings through significantly reduced thermal loss, leakage, and higher quality mechanical, electrical, plumbing systems.

EMAC's Narrative Review:

Town of Greenwich
Energy Management Advisory Committee
101 Field Point Road Greenwich, CT 06830

MEMORANDUM
EMAC P&Z Subgroup Review Comments
Energy/Renewables Narrative

TO: P & Z staff
FROM: EMAC P&Z Subgroup
DATE:
RE: **420 Field Point Rd**, PLPZ 2022 00496, Narrative by Peter Schweinfurth on Dec 19, 2022
420 Field Point Propco LLC, narrative undated 2022

The Sub-Group has reviewed the above-referenced narrative. The following comments are offered for your consideration:

Energy Efficiency Modeling & Metrics	Existing	Proposed	Recommended "Good"	Recommended "Better"
Energy Use Index (Source EUI)		NA	Residential <40 Commercial <30	Residential <30, Commercial <20
Coefficient of Performance* (COP)		NA	>2	>3.25
Home Energy Rating System (HERS)		NA	<40	<35
ENERGY STAR Portfolio Manager (ESPM)		NA	>80	>90
Air Changes per Hour**		NA	. <1.5	< or = 0.6
Fuel Source		NA	HVAC Electric	All Electric – no gas
Use of Renewables		NA	Yes	>30% of energy load
EV Charging		NA	Yes	Yes + battery

*As measured during winter at 15F outdoor air temperature.
** As measured during blower door test under 50 PA pressure.

I. **Project Description**
Renovation of 4 existing buildings and construction of 1 new building. Approx. 23,000 total square feet.

II. **Energy efficiency and overall performance,**
The energy narrative answers none of the questions above, which is disappointing and makes it difficult to provide any quantitative assessment of the project. The narrative pays lip service

only to sustainability and energy efficiency. Text from narrative in italics with page #'s (copy/paste text)

III. Project features and systems driving energy efficiency minimizing greenhouse gas emissions.

Subgroup Comments

The intent is to replace the previous mechanical units with new Mitsubishi Air Cooled Split Heat Pump Evaporator Units and Condensing Units. – we believe you are describing a VRF system. Note that R410a is next on the list of refrigerants to be phased out, likely well within the lifespan of the system, notwithstanding that they continue to be widely marketed. Also, VRF systems contain significantly higher amounts of refrigerant than other systems. Given that the GWP (global warming potential) for 410a is 2,088 (so more than 2,000 times worse than CO_2 as a greenhouse gas), any releases during installation / maintenance or other leaks are consequential.

The project will also be outfitted with a new direct exhaust (DX) Outdoor Air Split System with two modules for both the evaporator / compressor and the remote condenser. We don't understand what this means, please elaborate.

new ductless units in suites -- Ductless units that use refrigerant are less desirable than ductless splits that use water. Hydronic units have no exposure to future refrigerant bans.

With respect to insulation generally, consider more / better, which will result in a superior thermal envelope, better indoor comfort, reduced HVAC sizing and lower energy costs. Here are two resources that may be useful:
https://www.energystar.gov/campaign/seal_insulate/identify_problems_you_want_fix/diy_checks_inspections/insulation_r_values
https://www.energy.gov/eere/buildings/articles/high-r-walls-building-america-top-innovation

*Upon completion of the proposed project, the developer intends to provide a Blower Door Tes*t – some energy modeling / projected EUI would have been nice to see. Note that a blower door test is required.

The project's ventilation strategy will conform to current code requirements. – please elaborate

Two (2) 100% DX outdoor air split systems will provide conditioned (heated or cooled) air into each of the buildings with MERV 13 filter for the indoor air quality per ASHRAE standards 62.1 and 62.2. This description doesn't make sense to us. Please also consider the use of energy recovery units (either a fixed plate or energy wheel).

IV. Potential and proposed use of renewable energy systems.

While the project describes the use of air source heat pumps, it is silent on the source of DHW or if a heat pump hot water heater will be installed. If so then this project could be all electric, which we would strongly encourage. Please do also install heat pump dryers, which use less than half the electricity of a conventional dryer.

No mention is made of incorporating renewable energy (a solar PV system with battery storage) or if EV Chargers will be installed in any garages. At a minimum, each building should be prepared to be solar ready, and garages should also be pre-wired for level 2 EV charger installation.

Energy Narrative Submitted:

December 09, 2022

Otter Boulder LLC
204 Otter Rock Drive
Greenwich, CT 06830

Energy Efficiency Narrative
New Construction at 204 Otter Rock Drive, Greenwich, CT Site is a 60,527 SF lot (1.3895AC) in an RA-1 single family residence zone

<u>Overall Energy Objectives and Features</u>

At this time, our client is considering using a geothermal heating and cooling system for this home, along with radiant floor heating. The primary energy system for these systems is electricity, thus reducing the home's overall fossil fuel usage.

The geothermal system design would include the following:

- A vertical closed loop ground source heat exchanger. This would include HDPE (high density polyethylene) plastic piping installed below grade that will enter the basement mechanical rooms of the home. A thermally enhanced grout will be used in each vertical well for proper heat exchange.
    - A closed loop system is one in which the fluid within the piping never leaves the system and simply circulates between the closed wells and heat pumps.
    - The wells and associated exterior connection piping are completely below grade and not visible.

- Radiant floor heating may be installed throughout the house and if so, using high efficiency water to water geothermal heat pumps that operate at lower supply water temperatures providing increased efficiency.
    - Radiant floor heating contributes to the health and comfort of the occupants. IAQ (indoor air quality) is better with a radiant floor system, as it reduces the transmission of airborne viruses, dust, and allergens, and doesn't dry out sinuses like a forced hot air system. Radiant floor heating is also silent (no fan or duct noise), responds more quickly to temperature changes, and provides more even temperatures.
    - Radiant floor heating is estimated to be about 25% more energy efficient than a forced air system.

- Multiple zoning systems will be provided where thermostats are used to allow for system operation based on the customer's preferred indoor temperature and would be based upon exposure (i.e.: North, South, etc..). These multiple zone systems along with 2 stage heat pumps will increase the efficiency of the overall system operation.
    - All HVAC zones within the house will be controlled with seven-day programmable thermostats.

- Energy recovery ventilators (ERVs) will be used to provide fresh-air exchange throughout the living areas of the home. These units are a benefit with newer tight home building envelope practices.
  - ERVs provide whole-building ventilation; they provide fresh air while helping to preserve the indoor air temperature. They help to heat the building more efficiently in winter, and cool it more efficiently in summer, thus reducing overall energy usage.

The system design is based on standard practices consistent with the engineering associated with geothermal systems coupled with the Owner's specific needs and requests. Both heating and cooling are considered in the design process and the geothermal system provides both with the same equipment. The size of the system and the number of wells is based on calculations made by the engineer that include heat gain and heat loss and the thermal performance of the structure itself. This includes the U values for walls, roofs, floors, windows and doors. The higher insulation values recently adopted on October 1, 2022 by the Connecticut State Building Code will be incorporated in the building envelope for the house: R20&5ci for walls, R30 for floors, R60 for ceilings, and R13&5ci for basement walls.

The lighting system throughout the house will utilize energy-efficient LED based fixtures. A lighting control system will also be provided, Lutron or similar, to maximize energy savings by providing whole-house control of lighting zones, including dimming and automation, and providing owner convenience and safety/security features.

- The Department of Energy estimates that an LED lighting system uses at least 75% less energy, and lasts up to 25 times longer, than incandescent lighting.

Appliances for the house, such as the dishwasher, refrigerator, and washer/dryers, will be selected with Energy Star labels. These selections will use less electricity and be more energy efficient than unlabeled models.

The garage will be equipped with (2) Level 2, 240-volt Electric Vehicle (EV) charging stations.

- EVs contribute to the reduction of greenhouse gas emissions and have lower lifetime climate impacts than cars equipped with internal combustion engines.

Energy modeling has not been completed for the project at this time, but it is anticipated that the REScheck report will meet or exceed the IECC energy code requirements. The project will undergo a blower door test (as required by Code) to assess building envelope leakage, so that corrections to the building envelope can be made at that time.

Lastly, all work will be in compliance with the current State Building Code.

End of Energy Efficiency Narrative

EMAC's Narrative Review:

Town of Greenwich
Energy Management Advisory Committee
101 Field Point Road Greenwich, CT 06830

MEMORANDUM
EMAC P&Z Subgroup Review Comments
Energy/Renewables Narrative

TO: P & Z staff
FROM: EMAC P&Z Subgroup
DATE: February, 14, 2023
RE: Single-family residence at **204 Otter Rock Drive**, PLPZ 202200551
Narrative by: Mark P. Finally Architects, dated December 9, 2022

The Sub-Group has reviewed the above-referenced narrative. The following comments are offered for your consideration:

Energy Efficiency Modeling & Metrics	Existing	Proposed	Recommended "Good"	Recommended "Better"
Energy Use Index (EUI – Kbtu/sf)		Not provided	Residential <40 Commercial <30	Residential <30, Commercial <20
Coefficient of Performance* (COP)		Not provided	>2	>3.25
Home Energy Rating System (HERS)		Not provided	<40	<35
ENERGY STAR Portfolio Manager (ESPM)		Not provided	>80	>90
Air Changes per Hour**		Not provided	. <1.5	< or = 0.6
Fuel Source		Electric + gas	HVAC Electric	All Electric – no gas
Use of Renewables		Not provided	Yes	>30% of energy load
EV Charging		Yes	Yes	Yes + battery

*As measured during winter at 15F outdoor air temperature.
** As measured during blower door test under 50 PA pressure.

I. **Project Description**
Construction of a new single-family residence at 204 Otter Rock Drive.

II. **Energy efficiency and overall performance,**
EMAC would feel better if the applicant were committed to (rather than "is considering") a geothermal heating/cooling system, which is the most efficient, lowest cost technology for

HVAC. Combined with radiant floor heating the applicant will have an efficient, effective, and comfortable home. Combined with other elements in the energy narrative, EMAC has high hopes for a residence that could, with the inclusion of slightly higher levels of insulation, air infiltration control, and the use of solar PV be a Net Zero Energy home.

III. Project features and systems driving energy efficiency minimizing greenhouse gas emissions.

Comments and questions on text follow:
EMAC – Excellent pending choice of a geothermal HVAC system, combined with radiant floor heating.
EMAC would suggest extending the radiant floor heating to cover the garage floors as well, especially if there will be rooms above the garage.

Inclusion of an ERV (energy recovery ventilator) is an equally excellent decision, and will allow for the introduction of fresh, outdoor air for all circulation.

EMAC would encourage the applicant to consider modest increases to code to achieve higher R values for the walls, roof and below grade spaces. For example, 2" of rigid insulation under the exterior finishes (polyiso or XPS) combined with dense pack cellulose in a 2"x8" wall cavity, along with high performance windows, could achieve an R-40 insulation value. Please pay careful attention to the control layers to create a tight enclosure! A highly insulated, low infiltration enclosure could also allow for a smaller geothermal well / HVAC system (lower cost, more efficient).

The application implies that fossil fuels will be used for some purposes, e.g., DHW or cooking. EMAC would encourage the applicant to consider an all-electric home, which can be accomplished with a variety of heat pump appliances and induction stoves, which will eliminate internal air pollutants such as nitrogen oxides, CO_2 and CO, and fine particulate matter, which can contribute to a variety of health concerns.

IV. Potential and proposed use of renewable energy systems.

Applicant does not address siting, or if they have flexibility to orient the proposed house to the south (+/- 20°). Orientation to the south is conducive both to passive solar gain, and solar PV. Solar PV, combined with battery storage, is now commonplace and provides an ideal complement to EV charging, as well as potentially backup electricity for use in grid outages (note that not all EVs / EV chargers support bi-directional current flows.)

Appendix C

Energy Narratives Applicants

	Project Address*	Building Type	Energy Modeling? (Y/N)	Above E.E. Requirements? (Y/N)	Renewables? (Y/N)	All Electric? (Y/N)	EV Charging Stations (Y/N)
1	O Old Track Rd	Multi-Family	Yes	Likely	No	Yes	Yes
2	17 Stiles Lane	Single Family	Not clear	Likely	No	Yes	Yes
3	31 Vista	Single Family	Yes	Likely	Yes	Yes	Unknown
4	240 Greenwich Ave	Multi-Family	Yes	No	No	No	Unknown
5	17-23 Smith Rd	Single Family	Yes	Yes	Yes	Yes	Yes
6	18 Armstrong Ct	Single Family	No	Unlikely	No	No	No
7	2 Lighthouse	Single Family	Yes	Likely	Yes	No	Yes
8	16-38 Lake Avenue	Medical Building	Not Clear	Likely	No	Yes	Yes
9	0-4 Horseneck Lane	Recreation Facility	Not Clear	Likely	Yes	Yes	Unknown
10	60 LaFrentz Rd	Single Family	Yes	Likely	Likely	Yes	Yes
11	26 Homestead Lane	Two-Family	Yes	Yes	Likely	Unknown	No
12	25 Orchard Street	Two-Family	Yes	Unlkely	No	No	No
13	270 Lake Ave	School and Multi-Family	No	Unlikely	No	No	Unclear
14	145 Mason Street	Office	No	Unlikely	No	No	Yes
15	220 Davis Street	Two-Family	Yes	Unlikely	No	No	No
16	10 Hamilton Ave	Bakery	No	No	No	No	No
17	109 Byram Shore Rd	Pool House + Office	No	Yes	Yes	Unknown	Unclear
18	12 Grigg Street	Residence + Office	No	No	No	No	No
19	177 Hamilton	Multi-Family	No	No	No	No	No
20	17 Stiles Lane	Residence + Garage	No	Yes	No	Yes	Yes
21	204 Otter Rock Rd	Single Family	No	Likely	Yes	No	Yes
22	206 Sound Beach Ave	Restaurant + Retail	No	No	No	No	No

23	24 Homestead Lane	Two-Family	Yes	Yes	Likely	No	Yes
24	281 Railroad Ave	Multi-Family + Retail	No	Yes	No	Yes	No
25	420 Field Point Rd	Restaurant + Inn	No	Unlikely	No	No	No
26	45 Burying Hill Rd	Pool House + Office	No	Unlikely	No	No	No
27	2-28 Railroad Ave	Non Residential Multi-Use	No	Unlikely	No	No	No

*in initial construction (not planned for some future time)

Appendix D

Energy Narratives Regulation

Adopted at the May 10, 2022 Planning and Zoning Commission meeting. Effective date of May 18, 2022.
Add a new Sec. 6-14(a)(22) as follows:

(22.) Two copies of a brief narrative addressing:
(A.) Energy efficiency including overall energy efficiency performance, as well as how a development project's features and systems will contribute to minimizing greenhouse gas emissions.

(B.) The potential and use of renewable energy systems, as well as highly energy efficient equipment such as air and ground source heat pumps, hot water heat pumps and fuel cells. Renewable energy systems generate energy from wind, solar radiation, geothermal steam, and biogas. Such information shall include a description of the site's relevant features (including but not limited to: site slope, ground composition, shading), as well as the proposed building's potential for renewable energy generation (including but not limited to: orientation, scale, roofing, and systems.)

(C.) Any available energy efficiency modeling and metrics that outline a project's energy profile. Examples of such information would include an Energy Use Index (EUI), and greenhouse gas emissions in terms of carbon equivalents, as well as the heating ventilation and air conditioning (HVAC) and hot water equipment's' efficiency, calculated as a Coefficient of Performance (COP). Residential projects (including multifamily homes) of 10,000 sf or larger in size could highlight their energy efficiency by providing a Home Energy Rating System (HERS) index rating on an as designed basis. Commercial and Industrial projects of 10,000 sf or larger in size could highlight their energy efficiency and renewables use by providing a source ENERGY STAR Portfolio Manager (ESPM) score, also on an as designed basis.

(D.) Excluded from the requirements Sec.6-14(a)(22):
(i.) A non-residential use, or group of uses, of less than 3,000 square feet
(ii.) A building constructed or altered in such a manner as to require additional off-street parking or access from the street to the premises.
(iii.) Change of use from residential to non-residential use.
(iv.) A building, or portion of a building, housing an athletic facility that occupies more than 1,200 square feet of floor area.
(v.) An increase in non-residential usable floor area as a result of enlargement of a building, or conversion of accessory storage space, or interior alterations.
(vi.) Construction or alteration of structure(s) within an HO zone.