Berkshire Design Group

November 21, 2022

Whately Planning Board
Whately, MA

RE: 7 River Road Site Plan Review
Additional Energy Discussion

Dear Board Members:

Our client, Debilitation Medical Condition Treatment Centers, Inc. (DMCTC) currently has an approved special permit from the Whately ZBA and a pending application for Site Plan Review before the Whately Planning Board, respectively. After the initial public hearing with the Planning Board on 10/25/2022, the Board requested additional information on DMCTC's proposed energy efficiency plan under ~171-28.6.D.6 of the Whately Zoning Bylaw. The bylaw requires:

> *Energy Efficiency: Except for outdoor cultivation, marijuana establishments shall be required to prepare a detailed energy efficiency plan. Cultivators in buildings and greenhouses shall generate a minimum of 50% of their projected energy use on site where feasible. For solar power generation, priority is to be given to roof-mounted facilities, then to siting on non-arable land, then to dual-use facilities that permit agriculture underneath high-mounted and well-spaced panels, and then to the least productive arable land.*

Specifically, the Board requested that the DMCTC team provide a rough estimate of the total energy use for the facility and to provide a more detailed assessment of compliance with the 50% site-generated energy component of the bylaw.

Background

It is important to note that the choice by DMCTC to pursue cultivation inside a greenhouse structure is itself the primary component of DMCTC's energy efficiency plan. The production of a unit of marijuana product requires three primary inputs: water, nutrients, and energy. During initial planning, the cultivator choses to supply these inputs within one of three broad categories of environment: outdoor, indoor, or greenhouse. Focusing on energy, we can consider that each unit of final marijuana product requires a certain amount of "horticultural energy" (in the form light) in order to produce a saleable product. The delivery of input energy varies between the three types of grow:

- An indoor grow (in this context, meaning within a closed building) must supply 100% of horticultural energy through artificial lighting powered by electricity.
- An outdoor grow (meaning growing in an open-air field) supplies essentially 100% of horticultural energy from direct sunlight.
- A greenhouse grow (which, for this discussion, means a grow within a greenhouse structure that uses artificial lighting to supplement sunlight) utilizes both direct sunlight and electricity to provide the required horticultural energy. [1]

The cultivator selects a grow method based on the overall business strategy of the facility. The indoor grow is

[1] Also note that within the cannabis industry, greenhouse-based grows that utilize supplemental lighting are known as "hybrid" grows, pointing to the mixture of the benefits of an indoor and outdoor environment.

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the most expensive due to the need for sophisticated lighting and environmental controls and significant ongoing electrical consumption. In return, the indoor grower is able to produce a consistent, high-quality product through a highly predictable process. The outdoor grower has no control over environmental factors and faces challenges of space, weather, and seasonality, but balances this against near-zero energy costs. The greenhouse grow inhabits a middle ground with a semi-controllable environment that utilizes free sunlight energy supplemented by electrical lighting, which allows a higher yield and lower input costs than an outdoor grow, but less predictability than an indoor grow.

The distinction between grow methods is critical when discussing how much energy a grow operation sources from on-site.

- In the indoor grow case, all the energy inputs are provided by equipment running on electricity or other fuels. If the grower desires to (or is required to) source this energy from on-site, they must generate electricity. To do so, they might install a large solar array on the roof or grounds of the facility, thus utilizing the sunlight falling on the property to power the operation.
- At the opposite extreme, the outdoor grower also utilizes the sunlight falling on the property to provide all the horticultural energy needed to grow their product, but in this case the grower utilizes the sunlight directly. Therefore, it would be reasonable to claim that, as compared to the indoor grower, the outdoor grower sources virtually all the required horticultural energy from on-site.
- By comparison to the two cases above, the greenhouse grow can be considered to occupy a middle ground, where some portion of the horticultural energy required is sourced from direct sunlight and the remainder is provided as an electrical input through artificial lighting, with the electrical energy portion either being sourced from on-site (e.g., solar panels) or from off-site.

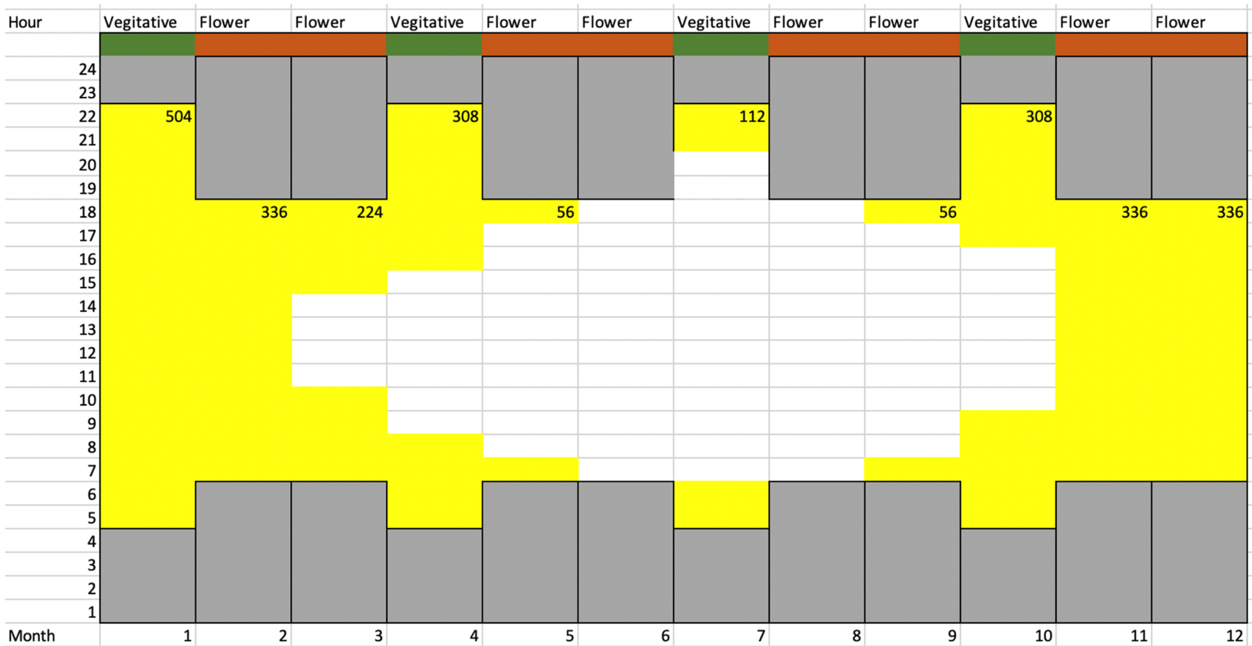
Based on this conceptualization of the energy question, DMCTC and Berkshire Design have compiled data to estimate the impact of the selection of a greenhouse grow on energy inputs. More simply, we asked, “how much energy will the proposed operation source from on-site?” if we consider direct use of sunlight to qualify as on-site energy.

Based on both third-party industry data and DMCTC’s proposed grow plan, we estimate that approximately half of the energy input required to grow a saleable product in a greenhouse comes from direct sunlight, with the remainder from electrical input. Following is a detailed discussion of this data, as well as an assessment of project energy in the context of the zoning bylaw requirement.

Estimated Light Energy at 7 River Road

DMCTC has prepared a proposed lighting schedule for the greenhouses, which estimate the periods when artificial lighting will be required throughout the year. Each plant grown by DMCTC will go through an approximately 3-month life cycle, with one month spent in a “vegetative” phase when light is required 18 hours per day, followed by a two month “flowering” phase when light is required 12 hours per day.

This life cycling is shown in the chart below, where the 24 hours of the day are shown on the vertical axis and 12 months of the year are shown on the horizontal axis. As the greenhouse cycles, they grey boxes denote hours when the greenhouse is kept in darkness, the white boxes represent hours when sunlight is used exclusively, and the yellow boxes represent hours when artificial lighting is turned on. As shown in the chart, during summer months the facility runs almost entirely on natural sunlight, whereas during low-sun-angle periods of the winter artificial lighting is required at all times. Total hours of artificial lighting are noted at the top of each column, based on a 28-day month, accounting for a brief changeover period at the end of each lifecycle.



Based on this schedule, DMCTC's greenhouse crops will require 4,704 hours of light per year. This required lighting input will be provided solely through natural sunlight during approximately 2,128 hours, and during the remaining 2,576 hours artificial lighting will be used.

An energy certification was prepared for the project by Lee Consavage, PE, with Seacoast Consulting Engineers that estimated total lighting power of the full-build greenhouse when artificial lighting is activated. Total lighting power was calculated to be 196,200 Watts.

From the above data, it is possible to estimate the total annual lighting energy requirements of the facility, and to break that energy requirement into the portion provided by direct sunlight and the portion provided by electrical lighting.

- Total lighting input required: 4,704 hours x 196.2 Kilowatts = 923,000 kWh
- Required lighting input provided by sunlight: 2,128 hours x 196.2 Kilowatts = 417,500 kWh
- Artificial lighting input: 2,576 hours x 196.2 Kilowatts = 505,400 kWh

Based on these figures, approximately 45% of lighting energy required by the plants is provided by direct sunlight. (417,500 kWh/923,000 kWh = 45.2%)

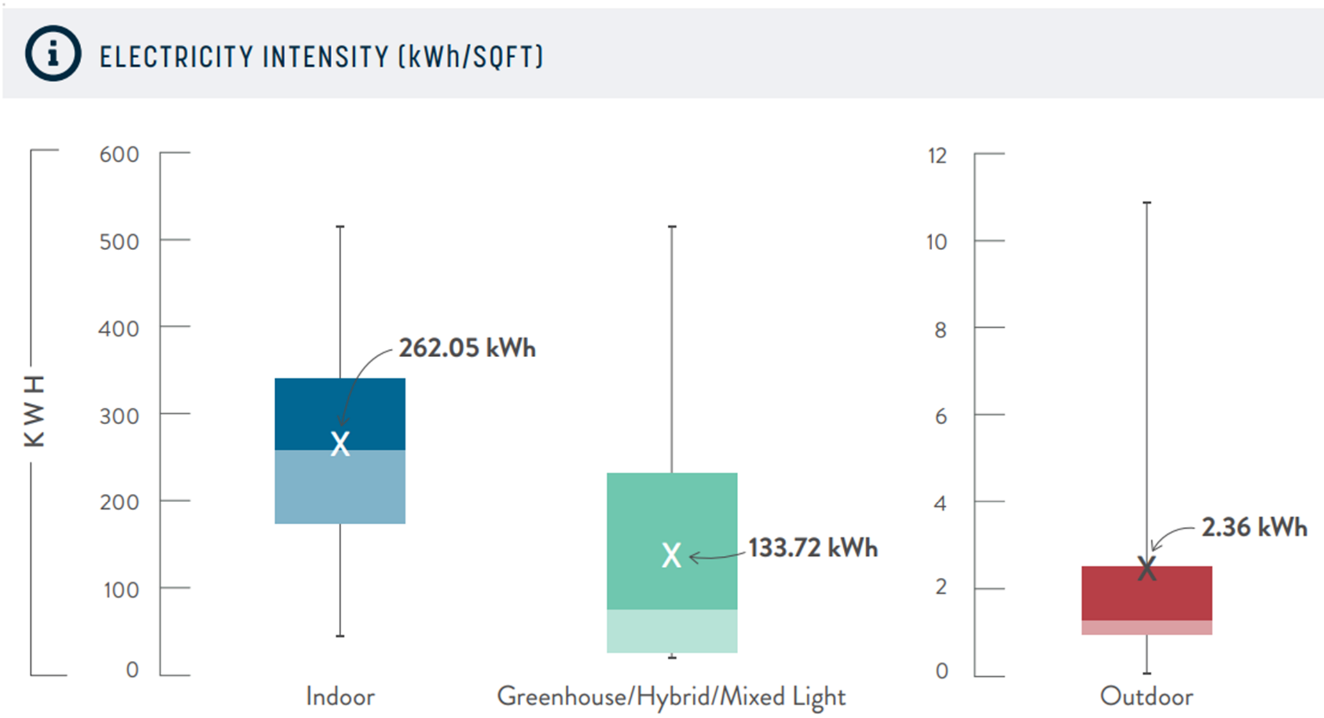
The existing site includes a 10 kW ground-mounted solar panel array. A US Department of Energy calculator was used to estimate the total annual energy supplied by this array (pvwatts.nrel.gov). The estimated energy output of 12,500 kWh per year represents approximately 1.4% of total lighting energy in the greenhouses.

DMCTC has also proposed to install rooftop solar on the existing farmhouse, if it is determined that this can be done without significant structural modification. Based on the same DOE application, BDG estimates that this array would be up to 10 kW in size, representing an additional 1.4% of potential on-site electrical production.

Therefore, under the current proposal, we estimate approximately 48% of light energy input would be sourced from on site, inclusive of direct sunlight.

Industry Data

The project team reviewed data on the larger cannabis industry in the United Stated in order to validate the conclusions of the site-specific energy totals above. A 2018 Cannabis Energy Report, published by New Frontier Data[2] collected, summarized, and analyzed energy use information from 81 individual cannabis cultivation operations across all 31 states where some form of cannabis cultivation is legal. These results were divided into separate categories for indoor, outdoor, and greenhouse grows. The following chart shows the results for total electrical usage for each type of facility.



The New Frontier dataset shows that energy usage by a greenhouse grow operation is, on average, approximately half that used for indoor grow operations. If we consider that 100% of embodied energy of a unit of final marijuana product from an indoor grow was supplied from artificial sources, it follows that this difference is primarily based on the energy input of direct sunlight on the greenhouse grow operation. Similarly, in the "outdoor" case, energy consumption is extremely low due to the fact that virtually all the embodied energy of the outdoor product was provided by direct sunlight.

What About Mechanical Energy?

In the simplified site analysis above, our discussion focuses on lighting energy, which represents the vast majority of energy used in a grow facility; however, mechanical energy makes up most of the remaining energy embodied in the final marijuana product.

In the case of a greenhouse grow, some portion of the mechanical energy that would be required is offset by sunlight and natural ventilation. In comparison to an indoor grow, where all mechanical energy input comes from equipment powered by electricity or other fuels, the mechanical energy required in a greenhouse is lower,

[2] https://resourceinnovation.org/wp-content/uploads/2018/11/The-Cannabis-Energy-Report.pdf

but the comparison includes complications that are not obvious on the surface and the difference is difficult to estimate.

In the indoor facility, most mechanical energy is dedicated to cooling, even during much of the cooler months. This is because of the need to remove heat produced by grow lights, as well as dehumidification to prevent mold that can quickly destroy a crop. In the case of a greenhouse, excess heat from lights must also be removed, but this is achieved without mechanical cooling by simple fan venting, which can be aided by wind blowing across the greenhouse surface. Conversely, the greenhouse facility requires greater heating input due to the low insulation factor verses an enclosed building, but this heat load is partially offset by direct sunlight, which is efficiently captured by the greenhouse structure (“the greenhouse effect”) and heat produced by the grow lights themselves, which is greater in the colder, darker months. Further, the use of blackout curtains increases the insulation factor during the coldest periods of the night.

What the DMCTC team would point the Board to is the industry data referenced in the previous section. As was demonstrated by that data, the total energy usage of greenhouse facilities is approximately half that of indoor facilities. It follows that, roughly speaking, the contribution of direct solar energy to the greenhouse offsets approximately half of the energy inputs that would required to produce a unit of marijuana in indoor condition where the plants are fully cut off from the environment.

Additional Opportunities for On Site Energy Generation

The current project proposal includes maintaining the existing 10 kW ground-mounted solar array at the site and adding an additional array (estimated to be up to 10 kW) to the roof of the existing house to the extent that panels can be added without significant structural modification.

BDG reviewed the 7 River Road site for additional opportunities to site additional solar. Our conclusion was that there is essentially no available space at 7 River Road where additional panels can be sited due to regulatory restrictions. Under the Whately Zoning Bylaw, rooftop solar and ground-mounted solar of up to 10 kW are allowed by right in all districts. Ground-mounted solar larger than 10kW is allowed in zone A/R2, but not A/R1.

The only additional roof space on site is the existing barn near the eastern property line, which we do not believe is structurally sufficient to carry an array. Any other installation would need to be ground-mounted, and thus cannot be installed within the A/R1 portion of the site. The dividing line between A/R1 and A/R2 is coincident with the eastern fence line of the marijuana grow area, with all areas east of the fence lying in A/R1. Within the A/R2 area, essentially all land falls within one of the following:

- Active Marijuana Cultivation Field
- Greenhouse Structure
- Wetland or 25’ No-Disturb Buffer
- Property Line Setback

Marijuana crops require direct sunlight and are not suited to dual-use solar. Similarly, greenhouse structures are not suitable for solar as the panels would interrupt direct sunlight to convert to electricity which is a less efficient use of solar energy. Wetland areas may not be directly disturbed for the construction of a solar array and historically the Conservation Commission has sought to protect a 25’ no-disturb buffer around wetland areas, which would prevent construction of solar panels. Finally, ground mounted solar arrays must respect zoning setbacks.

At the 10/25 hearing, the Board also suggested consideration of solar panels on other properties owned or controlled by DMCTC. One such site is 3 River Road, adjacent to 7 River Road and leased to a business entity affiliated with DMCTC. On this site, rooftop solar is precluded because the main building consists of pre-engineered steel structure ("Butler Building") that is specifically designed to provide code-compliant structure with minimal excess structural capacity in order to minimize production costs. This is further complicated by the fact that the main portion of the 3 River Road building was previously modified by the landowner and DMCTC's engineering team is currently assessing whether and how the existing building can be brought up to compliance with the building code. For these reasons, DMCTC is not in a position to commit to the installation of rooftop solar. 3 River Road is located in the A/R 1 district, and there are no portions of the site that respect zoning setbacks that could be developed with a small array.

The Board also suggested consideration of the property at 420 State Road (formerly 424 State Road, Unit B), which is owned by a business entity affiliated with DMCTC. DMCTC may choose to install a solar array on the building in the future; however, at this time DMCTC is not willing to commit to the construction of solar. In DMCTC's opinion, that location does not reasonably constitute "on site" in the context of the zoning bylaw provision cited above.

Conclusion

We hope the above narrative provides more clarity around the expected energy usage dedicated to the proposed indoor grow operation at 7 River Road.

Based on both the projected lighting schedule for this project and industry data, it is our opinion that slightly less than half of the total embodied energy in the finished product produced by this facility will be sourced from on site by utilizing direct sunlight. This is supplemented by existing and proposed solar arrays at 7 River Road totaling an additional 3% of total horticultural energy (note, this is closer to 5-6% of actual projected electrical usage). Based on a review of the 7 River Road site and the adjacent 3 River Road site, regulatory and structural restrictions prevent the construction of additional solar power supply.

We look forward to discussing this information at your next meeting.

Sincerely,

Berkshire Design Group

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Principal