Powering Cannabis Cultivation

COGENERATION FOR CROP SECURITY

The cultivation of high-quality cannabis requires climate-controlled facilities. Indoor cultivation produces industry leading results because of the ability to tightly control lighting, temperature, and humidity. However, controlling for these conditions will exponentially increase the power demand. Therefore, while cultivators are in pursuit of higher quality product with efficient yields, they will also be raising their electricity demand.

1. ***Evaluating the potential of CHP***
2. *Choosing grow room air handlers for temperature and humidity control*
3. *Matching CHP heat recovery to the facility climate control system*
4. *Selecting electric chillers to work with CHP*
5. *Executing a CHP project*

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INTRODUCTION

The emerging cannabis industry is big business with the potential for high returns in the early going. As supply begins to catch up with demand, however, market prices will tighten and cost control will become increasingly critical to continued success. Cultivators who invest in high-efficiency climate control coupled with cogeneration will enjoy a competitive advantage and higher valuation over time. This series explores the energy infrastructure of cultivation.

EVALUATING THE POTENTIAL FOR CHP

Climate management in a grow room is not a matter of conventional space heating and cooling, but should instead be approached as an industrial process control problem. Many small facilities have achieved quasi-stable – if sub-optimal – climate control using standard equipment and dehumidifiers. However, these technologies do not scale cost-effectively to the large operations currently in development and construction. As part of a suite of technologies, integrated combined heat and power (CHP) systems – also called cogeneration – minimize energy costs, reduce carbon footprint, and ensure energy security for maximum competitiveness over the long-term. But CHP may not be the right choice for every cultivation facility. In this issue, we will explain the factors that determine whether CHP is a good fit for your business.

1. FACILITY SIZE

There can be significant economies of scale in the deployment of CHP. As generator size increases, power density and output capacity increase proportionally faster than material, engineering, and manufacturing costs. Larger systems, therefore, embody a lower cost of capital per kW of capacity and, when properly sized to the facility, a lower cost of per kW-hour and BTU produced. Additionally, engineering, permitting, and administrative costs tend to be about the same for any size CHP project with the complex heat recovery systems most cannabis applications require. So as the size of the CHP increases, you get more power for your buck to make more bud. CHP for cannabis cultivation begins to show a good return on investment at a rating of 800kW and above. At a typical power demand of around 40W per square foot, a facility with vegetation and flowering canopy of at least 20,000sf will require about 800kW of electric power and may benefit from CHP. Below 20,000sf, capital and development costs may be too high to provide a good return on investment. Additionally, larger facilities with more flower rooms can maximize the value of the CHP system, as we'll see in consideration #2.

2. REDUCING POWER PEAKS

Whether operating your facility on CHP or utility power, it pays to flatten your electric demand. Large industrial customers typically pay both "energy charges" and "demand charges" for their electricity. Energy charges are a function of the total kilowatt-hours (kWh) delivered, but these can be consumed as a high power (kW) demand for a brief period or a lower power demand over a longer period of time. The higher the power and current delivered, the more copper the utility must install, even if it is only required for a brief time. The demand charge is designed for the utility to recover the costs of transmission and distribution wires and equipment necessary to flow power to a customer with high peak demand.

Peak demand affects CHP systems in the same way. You get the most value when you use the generator to its fullest capacity. High peaks with periods of low load can result in CHP running at lower fuel efficiency and increase maintenance costs of each kWh delivered. Flower rooms, with a typical 12-hour lighting schedule can be alternated so that only one of each pair of rooms is on at a time. Facilities with a large number of small flower rooms can level their load to minimize both CHP and utility peaks, ensuring the lowest possible cost of power.

Demonstrated in Figure 1, you can see the electric load curve of a cultivation facility that leveled their load by alternating their typical 12-hour lighting schedule per room. This facility lowered their peak load vs the facility in Figure 2 that didn't alternate their lighting. Since only half of the flowering rooms have lights on at a time, the facility in Figure 1 has a peak load just under 2.5 MWs, and a min load just over 2MWs. Meanwhile, the facility in Figure 2, that isn't alternating their lighting schedule per room, has all the lights on at one time. This results in peak loads near 4MWs, and min loads around 1MW. This will cause the second facility to pay a higher demand charge to the utility, because demand charges are based on the peak kW load and not quantity of energy (kWh) purchased over the month. Notice as well the large differences in peak and min load for these two cases. CHP system efficiency and lifetime performance increases as the generator is ran closer to the rated output. In Figure 2, the CHP system sized for 4MWs of output would have to turn down to less than 25% of its output when the facility has a min load case half of the day. In Figure 1, the CHP would never turn down below 2MWs of output after a peak close to 2.5MWs. That means the facility in Figure 1 never drops below 80% of it's rated power output while in Figure 2 the facility is running at 25% of it's rated power output half of the time. Staying closer to the rated output means the CHP will run more efficiently, and that will lead to a faster return on investment. Having a close differential between the peak and min loads is a critical requirement for CHP to maximize efficiency and lifetime performance.

Alternating the grow room lighting at a facility will lower your peak power demand, the difference between peak and min power demand, and total cost of capital. If CHP is involved, this means you'll have a smaller (lower cost) system running optimally meeting peak and mean load efficiently for that system, and continuously running daily to maximize the simple payback on the equipment. Facilities that cannot alternate lighting, such as glass greenhouses, will operate their CHP at lower loads or

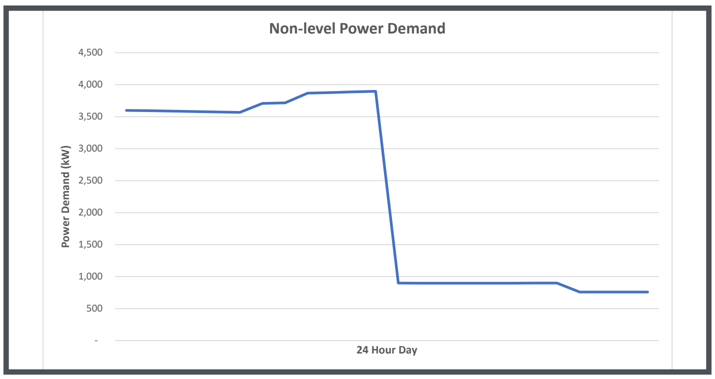


Figure 1: Level power demand over 2 weeks

perhaps not at all for half or more of the day. The less you operate your CHP, the longer it takes to earn back the cost of your investment. Earnings are generated when a facility has a favorable spark spread.

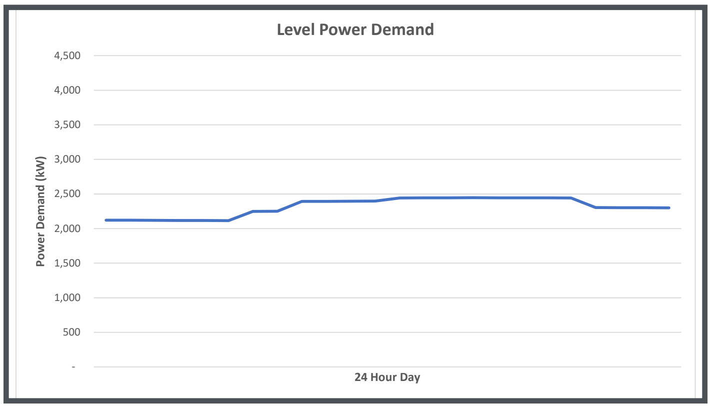


Figure 2: Non-level power demand over 2 weeks

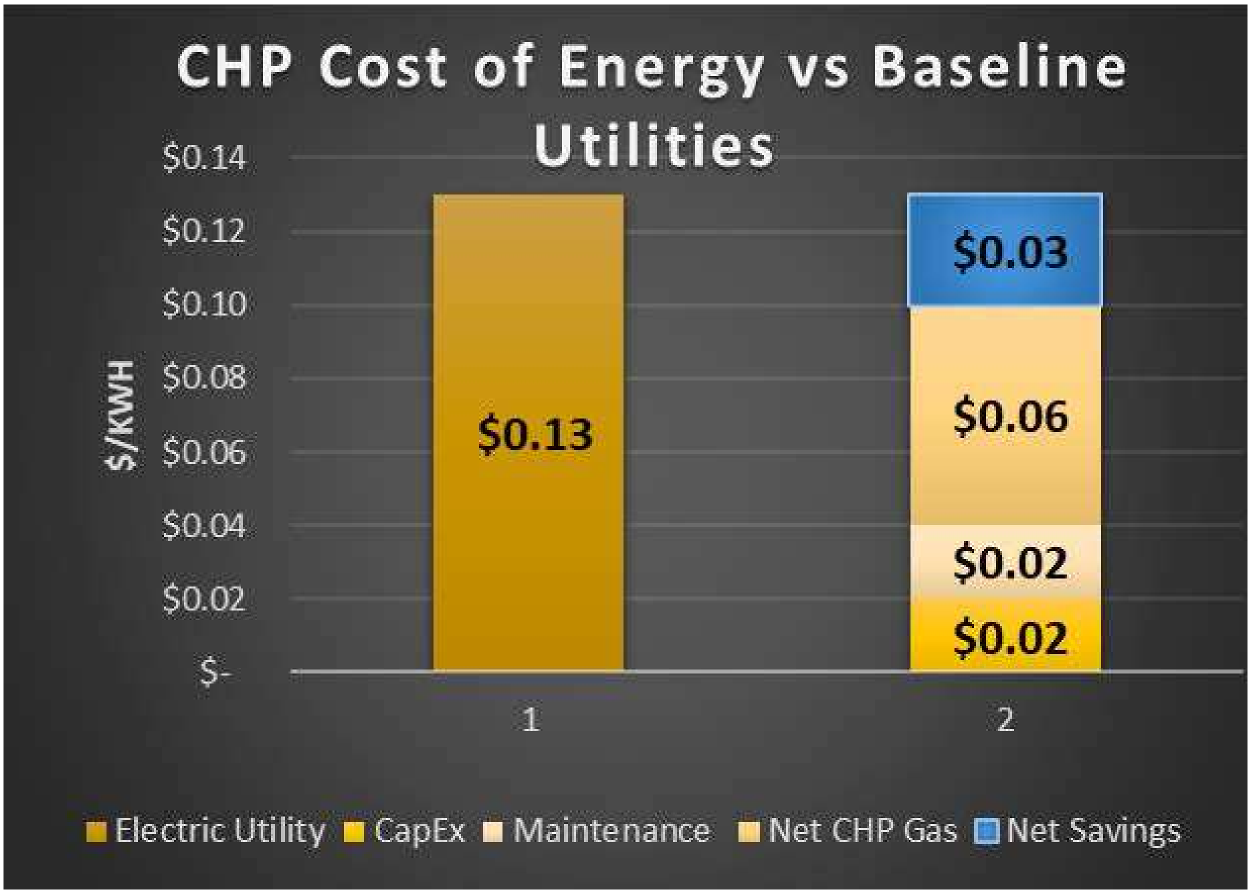
3. SPARK SPREAD

Spark spread is the difference in the cost of generating your own electricity and the cost of buying it from the electric utility. The cost of independent power generation has three components:

1. The capital cost of equipment, about 2¢/kWh
2. The cost of equipment service, about 2¢/kWh
3. The cost of fuel consumed depends on the fuel rates, about 1¢/kWh for 10¢/gas therm. Gas cost can range from 30¢ to $1.00 per therm, resulting in costs of 3-10¢/kWh.

At a fuel cost of 60¢/therm, the cost of cogeneration is therefore about (2 + 2 + 6) = 10¢/kWh. This is demonstrated in Figure 1 below where the facility is saving $0.03 on every kWh generated by the CHP for an effective 23% reduction in operating costs associated with electric power.

In addition to the savings accrued by a favorable utility rate the "free" thermal energy recovered from the CHP during operations supplements the building's requirement to generate that energy elsewhere. Recovering heat from the CHP will offset the use of boiler fuel and/or electricity



for cooling (more in Issues 3 and 4), a "negative" cost that improves your spark spread by lowering your cost of energy production.

In regions where utility rates are greater than 10¢/kWh and gas cost is less than 80¢/therm, the spark spread may be large enough to offer a good return on investment in CHP. There can be other reasons, however, for considering self-generation.

4. UTILITY CAPACITY AND RESILIENCY

When developing any industrial facility, the gas and electric utility must be engaged early on in the process. Programs are available from many utilities and states to incentivize CHP. CHP can qualify for utility payment up to as much as 50% of the total capital budget, substantially increasing the payback. Other states allow CHP owners to sell renewable energy credits worth 2-5¢ per kWh. The rules for these programs vary widely and often require thorough instrumentation, monitoring, and verification; the technical support of an experienced CHP provider is essential to confirm valid sources of funding and to take full advantage of investment tax credits for energy efficiency.

Whether an existing building retrofit or new greenfield construction, cannabis facilities will very often require a substantial utility upgrade. Increased or new service in range of several megawatts can take from 12 to as many as 36 months. While CHP can alleviate utility demand, an interconnection agreement with the utility can also take up to a year.

Some cannabis operators elect to go "off grid" and operate independently from the utility. Without the utility as a backup, however, the cultivator should also consider redundancy of power generation to ensure sufficient capacity during routine service and repairs.

Similarly, CHP can require upgrades or new natural gas service. Where gas rates are high, gas service installation is lengthy, or natural gas is not available, a facility can be served cost effectively with compressed or liquefied natural gas. The final architecture and utility plan must be carefully selected taking all of these factors into account.

5. FACILITY SIZE

High transpiration rates and low humidity make for a challenging climate control problem. Conventional HVAC systems generally cannot effectively maintain a healthy plant environment and are not electrically efficient or economically sustainable. And many technologies are not compatible with CHP. Proper selection of air handlers and their associated energy infrastructure is essential for a competitive facility. That will be subject of our next edition.

At this point, if a facility meets the criteria we discussed here, pursuing CHP as an on-site energy solution is well worth the time. CHP will enable these cultivators to increase the efficiency of their facility bringing down their cost of bud with every kWh saved. The emerging Cannabis industry is growing exponentially, but it is the cultivators that can lower their operation costs reaching economies of scale the fastest that will win in the long run. The right CHP solution will lower cannabis cultivation energy cost, greenhouse gas emissions, and increase resiliency against power outages.

Next in our series on Powering Cannabis Cultivation, Topic 2 will discuss *choosing grow room air handlers for temperature and humidity control.*

Kinsley Energy Systems engineers are available for project consultation. Contact us at info@kinsley-group.com.