

PROJECT SUMMARY

12 MW CANNABIS GROW FACILITY CHP PLANT **DETAILED FEASIBILITY STUDY**

PROJECT SUMMARY

Bridgestone Associates prepared a detailed feasibility study for a 225,000 square foot cannabis grow facility to be built in Pueblo, Colorado. The study was prepared for Bridgestone's long-term client Bryan Power Generation Solutions for their prospective client Today's Healthcare Meds (THC). THC is planning to convert and expand an old soft drinks plant in Pueblo to grow and process medical and recreational marijuana. The feasibility study was performed during the early stages of development of the overall project with the goal of determining if a Combined Heat and Power (CHP) plant could cost effectively provide the facility with electricity, heat, cooling and carbon dioxide.

Using the preliminary design drawings for the facility, Bridgestone conducted a detailed analysis of the planned electrical and thermal loads and prepared a comprehensive, hour-by-hour load profile for the thermal and electrical loads within the facility. This required analysis of the loads connected to over 100 electrical distribution panels and a planned 4,800 RT of chillers. Based on the results, Bridgestone then prepared and analyzed a number of alternative CHP plant configurations, their capital and operating costs, and the overall economics of the project. A detailed report recommending a 16 MW turbine based or 12 MW reciprocating engine based CHP plant with 4,000 RT of absorption chillers was then prepared and provided to THC.



PROJECT STATISTICS

Client:	Today's Healthcare Meds (THC) / Bryan Power Generation Solutions
Project Type:	Natural gas fired combined heat and power (CHP) plant
Size:	12 MWe and 4,000 RT chilled water
Unit Sizes:	3 x 5.4 MWe (ISO) combustion turbines + 4 x 1,000 RT absorption chillers Or 6 x 2.0 MWe reciprocating engines + 5 x 800 RT absorption chillers
Estimated Project Cost:	US\$18.8 million
Plant Location:	Pueblo, Colorado, USA
Plant Elevation:	4,700 feet above sea level
Interconnection Voltage:	12.47 kV
Primary Fuel:	Natural gas



Back-up Fuel:	None
Combustion Turbines:	3 x Solar T60 with SoLoNOx combustion
Reciprocating Engines:	6 x Cummins C2000 N6C natural gas reciprocating engines
Absorption Chillers:	Thermax 5 x 800 or 4 x 1,000 RT
Peak Facility Demand (Est.):	9.7 MW with electric chillers, 8.1 MW with CHP
Facility Energy Use (Est.):	67,788 MWh/yr with electric chillers, 53,367 MWh/yr with CHP

PROJECT DESCRIPTION

Through its on-going consulting arrangement with Bryan Power Generation Solutions of Colorado Springs, CO, Bridgestone Associates was asked to prepare a detailed Combined Heat and Power (CHP) plant feasibility study and analysis for an indoor cannabis grow facility being developed in Pueblo, Colorado. The facility was being developed in an old Pepsi distribution facility and when completed in two phases, would have approximately 225,000 square feet of growing and processing space.

CHP can be an ideal solution for an indoor or greenhouse organic grow facility, whether growing cannabis or fruits and vegetables (e.g. tomatoes, lettuce, peppers, cucumbers, etc.). The CHP plant can provide the electrical and thermal requirements of the facility. Exhaust gasses from the generating equipment, rich in carbon dioxide (CO₂), can also be used within the facility to enhance the growth of the crop, while avoiding purchasing CO₂ from outside suppliers.

Because the project was in the development and design phase, there was no past energy use data from which to develop project sizing, etc. To overcome this it was necessary to perform a detailed analysis of the facility's installed loads and how and when each would operate. This included grow lighting in all of the nursery, mothering, vegetation, and flowering rooms; lighting in other areas of the facility; all of the pumping circuits for cooling and heating; chiller loads; and other equipment. There were over 100 distribution panels planned throughout the facility, so the loads attached to each of these had to be determined and their operations included in a detailed hour-by-hour spreadsheet. The hour-by-hour loads for each distribution panel were then

Equipment	Connected Load		Calculated Demand		Voltage
	KVA	A	KVA	A	
PHASE 1					
General Facility Receptacles	14.32	52.00	14.32	52.00	208
Veg Room 114 & 157 Receptacles	25.20	71.00	20.21	57.00	208
Flowering Room 138 & 201 Receptacles	43.20	121.00	31.60	88.00	208
Mothering Room 215 Receptacles	14.04	39.00	12.02	33.00	208
Veg Room 114 Lighting	446.40	536.00	558.00	673.00	480
Veg Room 157 Lighting	1,336.80	1,608.00	1,671.00	2,012.00	480
Flowering Rm 138 Lighting	1,053.40	2,931.00	1,316.75	3,664.00	208
Flowering Rm 201 Lighting	1,384.00	3,840.00	1,730.00	4,800.00	208
Mothering Room Lights	310.40	374	388.00	467	480
General Lighting	8.10	23.00	8.10	23.00	480
Fan Coils - Veg Room 157	55.09	154.00	55.48	154.00	208
Fan Coils - Veg Room 114	21.31	59.00	21.44	60.00	208
Fan Coils - Flowering Room	87.40	243	109.25	304	208
TOTAL PHASE 1	4,800	10,051	5,936	12,387	
PHASE 2					
ESTIMATED LOADS					
General Facility Receptacles	14.32	52.00	14.32	52.00	208
Veg Room 152 Receptacles	33.24	93.64	26.65	75.17	208
Flowering Room 208 & 302 Receptacles	43.75	122.54	32.00	89.12	208
Veg Room 152 Lighting	1,519.17	1,827.37	1,898.97	2,286.49	480
Flowering Rm 208 Lighting	1,291.14	3,582.34	1,613.92	4,477.93	208
Flowering Rm 302 Lighting	1,291.14	3,582.34	1,613.92	4,477.93	208
General Lighting	8.10	23.00	8.10	23.00	480
Fan Coils - Veg Room 152	100.76	280.92	101.45	282.23	208
Fan Coils - Flowering Room 208	44.26	123.04	55.32	153.93	208
Fan Coils - Flowering Room 302	44.26	123.04	55.32	153.93	208
TOTAL PHASE 2	4,390	9,810	5,420	12,072	
TOTAL PHASE 1 + 2	9,190	19,861	11,356	24,459	

combined to develop an overall facility hour-by-hour electrical demand and energy use estimate.

Once the hour-by-hour facility electrical demand and energy use had been estimated, a model was developed for the applicable local electrical utility electric tariff. This was then used to develop an estimate of the monthly electric costs that would be incurred without on-site generation or a CHP plant. The estimated monthly costs were then combined to develop an estimated “avoided” annual electricity cost.

Based on the overall facility demand and how that demand varied hourly, daily and seasonally, Bridgestone developed a number of alternative equipment configurations. These included both natural gas fired reciprocating engine generator and natural gas fired combustion turbine configurations.

<u>Configuration</u>	<u>Prime Mover</u>	<u>Absorption Chillers</u>	<u>Utility Backup Power</u>
1	6 x Cummins C2000 N6C	5 x 800 TR	0 kW
2	5 x Cummins C2000 N6C	5 x 800 TR	2,000 kW for 5% hours
3	6 x Cummins C2000 N6C	None	0 kW
4	2 x Solar T60 CTGs	4 x 1,000 TR	4,500 kW for 5% hours
5	3 x Solar T60 CTGs	4 x 1,000 TR	0 kW

Waste heat from the engines or turbines would be used in absorption chillers to provide chilled water for facility cooling 365 days per year. These absorption chillers would replace the planned electric chillers. The absorption chillers would also provide hot water for space conditioning, general uses, as well as humidity control.

Carbon dioxide (CO₂) in the combustion exhaust would also be captured and used to enhance plant growth within the facility. This would avoid purchases of liquid CO₂ from an outside supplier.

Heat balances, capital costs, and operations and maintenance costs were developed for each of these configurations and used as input data into Bridgestone’s proprietary Combined Heat and Power (CHP) and Independent Power Plant (IPP) Evaluation Model. Other assumptions on natural gas costs, back-up power costs, equipment degradation, property and other taxes, insurance, etc. were also included in the model.

Using the proprietary CHP/IPP model, Bridgestone was able to develop an estimate of the cost of energy and total costs with each CHP Plant configuration. These costs were then compared to the “avoided” cost of energy purchases from the local utility and other operating costs that would be avoided with a CHP plant. These included approximately \$750,000 – 1,000,000/year in CO₂ purchases that could be avoided by using combustion exhaust instead of purchased liquid CO₂.





The total avoided cost less the operating cost with CHP was calculated for each equipment configuration. This was then used to determine simple payback and Return on Investment (ROI) (see table below) for each configuration. The analysis showed the natural gas fired reciprocating engine generator configurations to be the most economically beneficial. This was partially due to the high elevation of the facility site (4,700 feet above sea level) which resulted in an approximately 15% reduction in combustion turbine power output.

Configuration		Capital Cost (incl. IDC)	Simple Payback	Internal Rate of Return	
				5 Year	10 Year
1	6 x Cummins Engines + 5 x 800 TR Chillers	\$15,941,179	3.7 years	171%	172%
		\$8,539,141 (CHP cost less avoided capital cost)	2.1 years		
2	5 x Cummins C2000 N6C + 5 x 800 TR Thermax Absorption Chillers with utility backup	\$14,363,458	4.0 years	177%	178%
		\$6,961,420 (CHP cost less avoided capital cost)	2.0 years		
<i>Avoided capital cost includes equipment that would not be required with a CHP plant. This includes the planned electric chillers.</i>					

The project was placed on hold pending completion of financing of the overall facility.