

A Quick Look at CBD Production Costs

Overview

How much does it cost to produce a gram of CBD? In this study by the Seed economic team, an approximation of the average cost of CBD production is investigated.

Production Method

CBD is produced by running hemp plant material through an extraction process. This process typically involves using a solvent and pressure to concentrate the CBD from the plant material. Many solvents can be utilized, including ethanol and CO₂ (in super critical and sub critical form) as well as various hydrocarbons like butane or propane.

The most common form of extraction observed by Seed is CO₂ extraction and in this report an estimate on the cost of production for this extraction method is established. By analyzing both production capabilities and input costs, Seed estimates that it takes \$7 to produce a gram of CBD through CO₂ extraction.

Apeks Supercritical

As a well-known manufacturer of this specialty extraction equipment, [Apeks Supercritical](#), offers return on investment (ROI) analysis for its CO₂ supercritical extraction systems which also features figures on production capacity and input costs. This analysis can be found [here](#).

While there are several other equipment manufacturers and many producers have also chosen to invest in custom, proprietary equipment, utilizing Apeks' equipment and operating expenses can provide a valuable estimate as the cost to produce a gram of CBD for various levels of production.

Apeks offers a range of extraction equipment, from their introductory series, which can process 600-3,200 grams of dry plant material a day and is intended for smaller operation, to their high production series, which can process 25-38 kilograms in a day. This range allows for an analysis of a variety of CBD extraction operations to obtain an array of estimates for cost of production.

CBD Production

In order to assess the average cost to produce a gram of CBD for each level of equipment, the daily production capacity of each unit needs to be established. Fortunately, Apeks provides specification regarding capacity, inputs, and time needed to establish the daily production capacity in terms of grams of raw plant material.

Processing Capacity: the amount of dried plant material the equipment can process in one run, measured in grams

Cycle Run Time: the number of hours it takes for the extraction process to complete, measured in hours

CO₂ Recovery Time & Reload Time: the amount of time it takes for the recover any CO₂ solvent present in the extract and to reload the equipment for the next run, measured in hours

Runs/Day: the number of full runs a processor can achieve in a 24-hour period for a given piece of equipment

Total Machine Run Time per day: the amount of time in a 24-hour period that the machine takes to complete the full number of run its can achieve, measured in hours

Raw Material Processed per Day: the amount of dried plant material the equipment can completely process in a 24-hour period, measured in grams per day

While Apeks provides specifications on the amount of raw plant material that can be processed in a day, an assumption about the CBD content of this material needs to be made to establish estimates on the potential daily production of pure CBD from each piece of equipment. For this study, a CBD concentration of 10%, based on a dry weight basis, is assumed for the raw plant material. This assumption will be relaxed later through the use of a sensitivity analysis.

CBD Concentration: the percentage of the plant material that is CBD on a dry weight basis, assumed to be 10% in this study

CBD Content: the amount of CBD present in the plant material that can be processed in one run, measured in grams. For this analysis, it is assumed that 100% of the CBD present in the plant material is extracted.

CBD Processed per Day: the amount of CBD that can be fully extracted in a 24-hour period, measured in grams per day

Additional assumptions are put in place to arrive at a final daily CBD production capacity for each piece of equipment. These include full technical efficiency, in that all CBD content will be removed from the plant material in the extraction process, as well as a 24-hour work period.

Figure 1 provides a breakdown of each of these points for the ten different pieces of equipment offered by Apeks. As the processing capacity increases, the daily CBD production potential also increases, topping out at 3.8 kilograms per day for the largest piece in their high production series.

Figure 1: Daily Production Capacity

| | Equipment | Processing Capacity (g) | CBD Concentration (%) | CBD Content (g) | Cycle Run Time (h) | CO2 Recovery & Reload Time (h) | Runs/Day (24 hour period) | Total Machine Run Time per day (h) | Raw Material Processed per day (g/day) | CBD Processed per day (g/day) |
|-----------------------------|----------------|-------------------------|-----------------------|-----------------|--------------------|--------------------------------|---------------------------|------------------------------------|--|-------------------------------|
| Introductory Series | 1500-1L | 225 | 10% | 23 | 6 | 1 | 3 | 21 | 675 | 68 |
| | 2000-5LD | 1600 | 10% | 160 | 9 | 0.75 | 2 | 20 | 3,200 | 320 |
| Mid range Production Series | 2000-20LD | 5,400 | 10% | 540 | 9 | 1 | 2 | 20 | 10,800 | 1,080 |
| | 2000-5Lx5LD | 3,200 | 10% | 320 | 5 | 1 | 4 | 24 | 12,800 | 1,280 |
| | 2000-5Lx20LD | 7,000 | 10% | 700 | 11 | 1 | 2 | 24 | 14,000 | 1,400 |
| | 2000-20Lx20LD | 10,800 | 10% | 1,080 | 18 | 1.5 | 1 | 20 | 10,800 | 1,080 |
| High Production Series | 5000-5LDP | 1,600 | 10% | 160 | 1 | 0.5 | 16 | 24 | 25,600 | 2,560 |
| | 5000-5Lx5LDP | 3,200 | 10% | 320 | 1.75 | 0.75 | 9 | 23 | 28,800 | 2,880 |
| | 5000-20Lx20LDP | 10,800 | 10% | 1,080 | 6 | 1.5 | 3 | 23 | 32,400 | 3,240 |
| | 5000-40Lx40LDP | 19,000 | 10% | 1,900 | 10 | 2 | 2 | 24 | 38,000 | 3,800 |

Assumptions

CBD Concentration 10%
 Full CBD Extraction

Costs of Production

After establishing daily CBD production, daily costs need to be estimated and once again Apeks offers some insight into input costs for its extraction equipment.

Maintenance Cost per Day: each piece of extraction equipment requires the replacement of seals, diaphragms, or general pump maintenance after a certain number of runs. The average cost of these repairs is divided by the days until the repairs are needed to obtain a figure of daily maintenance cost, measured in dollars.

Electrical Use per Hour: the amount of electricity used by the piece of extraction equipment in an hour, measured in kW per hour.

Electrical Cost per Day: the cost of running the piece of equipment for the number of full runs it can achieve in a 24-hour period, measured in dollars.

CO₂ Cost per Day: the cost of CO₂ solvent required to achieve the number of full runs in a 24-hour period, measured in dollars.

In its specification, Apeks provide estimates on the cost of labor; however, these assume that labor only needs to be present during the reloading process. This assumption may be unreasonable as these workers will likely still need to be present during the entire process. As a result, new estimates on daily labor costs need to be created.

Labor Hours: the number of hours that a worker needs to be present to achieve the number of full runs in a 24-hour period. It is assumed that a worker needs to be fully present during all stages of the extraction process.

Labor Cost: the cost of labor in to achieve the full number of runs in a 24-hour period, measured in dollars.

The daily cost of another major input, the raw plant material, also needs to be estimated as well. In this study it is assumed that the average cost of dry plant material is \$300 per pound or \$0.66 per gram. Using this assumption, along with the daily processing capacity, a figure on daily cost of plant material can be achieved.

Daily Cost of Dry Plant Material: the cost of the total amount of dry plant material that can be processed in a 24-hour period, measured in dollars.

Figure 2 provides a breakdown of each of these points for the ten different pieces of equipment offered by Apeks, with daily costs running from as low as \$800 per day for its smallest extraction equipment to over \$25,000 per day for its largest piece of equipment in its high production series.

Figure 2: Daily Costs

| | <u>Fixed Cost</u> | | <u>Variable Costs</u> | | | | | | | |
|-----------------------------|-------------------|----------------|---------------------------------------|-------------------------------|--------------------------------|------------------------------|-----------------------|-----------------|-----------------|-----------------------------------|
| | Equipment | Equipment Cost | Daily Cost of Dry Plant Material (\$) | Maintenance Cost per day (\$) | Electrical Use per Hour (kW/h) | Electrical Cost per day (\$) | CO2 Cost per day (\$) | Labor Hours (h) | Labor Cost (\$) | Total Daily Operational Cost (\$) |
| Introductory Series | 1500-1L | \$39,000 | \$446 | \$18 | 8.9 | \$34 | \$11 | 21.0 | \$336 | \$844 |
| | 2000-5LD | \$79,000 | \$2,112 | \$8 | 8.9 | \$31 | \$12 | 19.5 | \$312 | \$2,475 |
| Mid range Production Series | 2000-20LD | \$135,000 | \$7,128 | \$7 | 13.5 | \$49 | \$8 | 20.0 | \$320 | \$7,512 |
| | 2000-5Lx5LD | \$121,000 | \$8,448 | \$6 | 8.5 | \$37 | \$11 | 24.0 | \$384 | \$8,886 |
| | 2000-5Lx20LD | \$149,000 | \$9,240 | \$8 | 13.5 | \$58 | \$8 | 24.0 | \$384 | \$9,698 |
| | 2000-20Lx20LD | \$168,000 | \$7,128 | \$7 | 13.5 | \$47 | \$4 | 19.5 | \$312 | \$7,498 |
| High Production Series | 5000-5LDP | \$194,000 | \$16,896 | \$15 | 13.5 | \$58 | \$60 | 24.0 | \$384 | \$17,413 |
| | 5000-5Lx5LDP | \$279,000 | \$19,008 | \$14 | 13.5 | \$55 | \$34 | 22.5 | \$360 | \$19,471 |
| | 5000-20Lx20LDP | \$359,000 | \$21,384 | \$14 | 13.5 | \$55 | \$11 | 22.5 | \$360 | \$21,824 |
| | 5000-40Lx40LDP | \$475,000 | \$25,080 | \$15 | 13.5 | \$58 | \$8 | 24.0 | \$384 | \$25,545 |

Assumptions

| | |
|-----------------------------|------|
| Cost of CO2 (\$/lb) | 1.25 |
| Cost of Electricity (\$/kW) | 0.18 |
| Cost of Labor (\$/h) | 16 |
| Cost of Inputs (\$/lb) | 300 |
| Cost of Inputs (\$/g) | 0.66 |

Average Variable Cost

After determining the daily cost and production capacities for each piece of equipment, a figure on average variable cost can be established for each unit. Figure 3 provides a breakdown of this for each piece of equipment with the average variable cost stabilizing at around \$7 per gram of CBD as production capacity increases.

Figure 3: Average Variable Cost

| | Production Capacity (g/day) | Total Daily Operational Cost (\$) | Average CBD Production Cost (\$/g) | |
|-----------------------------|-----------------------------|-----------------------------------|------------------------------------|---------|
| Introductory Series | 1500-1L | 68 | \$844.14 | \$12.51 |
| | 2000-5LD | 320 | \$2,475.24 | \$7.74 |
| Mid range Production Series | 2000-20LD | 1,080 | \$7,511.60 | \$6.96 |
| | 2000-5Lx5LD | 1,280 | \$8,885.72 | \$6.94 |
| | 2000-5Lx20LD | 1,400 | \$9,698.32 | \$6.93 |
| | 2000-20Lx20LD | 1,080 | \$7,498.39 | \$6.94 |
| High Production Series | 5000-5LDP | 2,560 | \$17,413.32 | \$6.80 |
| | 5000-5Lx5LDP | 2,880 | \$19,470.68 | \$6.76 |
| | 5000-20Lx20LDP | 3,240 | \$21,823.68 | \$6.74 |
| | 5000-40Lx40LDP | 3,800 | \$25,545.32 | \$6.72 |

Sensitivity Analysis

Several assumptions were made regard the CBD concentration of the raw plant material and the cost of this raw plant material. Figure 4 provides a sensitivity analysis that relaxes these two assumption to obtain an array of average cost estimates for Apeks' largest extraction unit in its high production series, the 5000 -40Lx40LDP.

Figure 4: Sensitivity Analysis for 5000-40Lx40LDP - CBD Concentration and Cost of Flower

| Flower Cost: Dollars per pound | CBD Concentration | | | | | | | | | |
|--------------------------------------|-------------------|---------|---------|---------|---------|---------|--------|--------|--------|--------|
| | 1% | 3% | 5% | 7% | 10% | 12% | 14% | 16% | 18% | 20% |
| \$10 | \$3.45 | \$1.15 | \$0.69 | \$0.49 | \$0.34 | \$0.29 | \$0.25 | \$0.22 | \$0.19 | \$0.17 |
| \$20 | \$5.67 | \$1.89 | \$1.13 | \$0.81 | \$0.57 | \$0.47 | \$0.40 | \$0.35 | \$0.31 | \$0.28 |
| \$50 | \$12.34 | \$4.11 | \$2.47 | \$1.76 | \$1.23 | \$1.03 | \$0.88 | \$0.77 | \$0.69 | \$0.62 |
| \$100 | \$23.45 | \$7.82 | \$4.69 | \$3.35 | \$2.34 | \$1.95 | \$1.67 | \$1.47 | \$1.30 | \$1.17 |
| \$200 | \$45.67 | \$15.22 | \$9.13 | \$6.52 | \$4.57 | \$3.81 | \$3.26 | \$2.85 | \$2.54 | \$2.28 |
| \$300 | \$67.89 | \$22.63 | \$13.58 | \$9.70 | \$6.79 | \$5.66 | \$4.85 | \$4.24 | \$3.77 | \$3.39 |
| \$400 | \$90.11 | \$30.04 | \$18.02 | \$12.87 | \$9.01 | \$7.51 | \$6.44 | \$5.63 | \$5.01 | \$4.51 |
| \$500 | \$112.34 | \$37.45 | \$22.47 | \$16.05 | \$11.23 | \$9.36 | \$8.02 | \$7.02 | \$6.24 | \$5.62 |
| \$600 | \$134.56 | \$44.85 | \$26.91 | \$19.22 | \$13.46 | \$11.21 | \$9.61 | \$8.41 | \$7.48 | \$6.73 |

Limitations

This method of estimating CBD production costs has several limitations. First and foremost, these average costs only apply to production processes using Apeks' extraction equipment. While this equipment manufacturer is well known and widely used by many within the CBD processing industry, a large majority of firms devoted to large scale CBD processing own custom and proprietary extraction equipment which may differ significantly in their output potential and input cost. As a result, average production cost for these large-scale processors may be different from those presented here. Second, while utilizing different sizes of processing equipment can give an idea to how average cost changes as production is scaled up, it is not perfect as each piece of equipment behaves differently and produces different results. Finally, while this figure represents the average cost to produce a gram of CBD from dry plant material to extract, many processors chose to apply additional stages of processing and refining after the first run which can also significantly alter the average cost.

While this represents an estimate on costs for CO₂ extraction, many producers may choose to use other solvents in their production process which may also significantly alter costs of production.

Conclusion

This study attempts to take a quick look at how much it costs to produce a gram of CBD in extract form. While several assumptions had to be made and limitations put in place, an ultimate figure of \$7 per gram of CBD was reached.