COWEN

Equity Research
Cannabis

AHEAD OF THE CURVE® SERIES

COWEN'S COLLECTIVE VIEW OF CBD

FEBRUARY 25, 2019

11 Cowen analysts across consumer, health care, industrials, and regulatory offer a comprehensive view of the global CBD opportunity.

Nearly 7% of adults in our proprietary U.S. survey (n = ~2,500) reported using CBD as a supplement, far higher than we expected.

We believe U.S. CBD can conservatively generate sales of $16 bn by 2025. We offer detailed analysis at the sub-category level, as well as company-specific discussions, including Outperform rated WEED, TLRY, and TPB.

Cowen Research
646 562 1330
cowen.research@cowen.com

Vivien Azer
646 562 1351
vivien.azer@cowen.com

CANNABIS

COWENRESEARCH COWEN.COM

This page left blank intentionally.

COLLABORATIVE INSIGHTS

February 25, 2019

■ Cannabis

COWEN RESEARCH

EQUITY RESEARCH

Cowen Research
646 562 1330
cowen.research@cowen.com

Vivien Azer
646 562 1351
vivien.azer@cowen.com

John Blackledge
646 562 1359
john.blackledge@cowen.com

Andrew M. Charles, CFA
646 562 1332
andrew.charles@cowen.com

Oliver Chen, CFA
646 562 1424
oliver.chen@cowen.com

John Kernan, CFA
646 562 1324
john.kernan@cowen.com

Phil Nadeau, Ph.D.
646 562 1336
phil.nadeau@cowen.com

Charles Neivert
646 562 1370
charles.neivert@cowen.com

Jeffrey Osborne
646 562 1391
jeffrey.osborne@cowen.com

Charles Rhyee
646 562 1376
charles.rhyee@cowen.com

Doug Schenkel
617 946 3918
doug.schenkel@cowen.com

COWEN WASHINGTON RESEARCH GROUP

MACRO POLICY

Eric Assaraf
202 868 5304
eric.assaraf@cowen.com

COLLABORATIVE INSIGHTS

COWEN'S COLLECTIVE VIEW OF CBD - AHEAD OF THE CURVE SERIES

THE COWEN INSIGHT

In a collaboration featuring 11 analysts spanning Cowen's consumer, health care, industrials and regulatory teams, we offer a deep dive on the global cannabis market, with a particular emphasis on the U.S. For consumer goods, we believe the U.S. CBD market could represent a $16 bn opportunity by 2025.

$16 bn Consumer Opportunity (Azer, Blackledge, Charles, Chen & Kernan)

In our monthly proprietary consumer survey (n = ~2,500) we were surprised to see that nearly 7% of respondents in January 2019 reported using CBD as a supplement. This strong consumer interest is validated by the growing number of brands and form factors that are now available through increasingly diverse retail channels, including Amazon, Sephora and Neiman Marcus. That said, consumption of CBD on-premise will likely take longer, given regulatory uncertainty. And, while our analysis primarily focuses on consumer staples applications for CBD, it is interesting to see a growing number of specialty apparel brands embrace hemp as a sustainable textile.

Retail sales of CBD consumer products in 2018 have been estimated between ~$600 mm and $2 bn. By 2025, we believe CBD offerings could conservatively generate $16 bn in retail sales (assuming a ~40% increase in consumer incidence, to 10%, and spend of less than $2 / day). Our bottom-up analysis anticipates a diverse category, that is still led by traditional health & wellness form factors (e.g., $6.4 bn in nutraceuticals, and $4 bn in topicals). And, while likely smaller, we also expect categories like food, beverages, beauty and vapor to all generate sales between ~$1-2.5 bn by 2025.

Herein, we offer a detailed look at category brand and pricing architecture in the U.S. CBD market today, as well as detailed discussions of 21 public and private operators that currently have exposure to the category, including Outperform rated Canopy Growth, Tilray and Turning Point Brands, which have all announced plans to enter the U.S. CBD market.

The Science of CBD (Nadeau)

Cannabis's therapeutic potential is attributable to the valuable overlap between phytocannabinoids (i.e. plant-derived cannabinoids) and the endogenous cannabinoid system in humans, termed a "therapeutic handshake." While THC's activity in the body is fairly well elucidated, CBD's pharmacokinetics are less well understood (no specific receptor for CBD has been identified). Clinical trial results to date demonstrate few adverse effects from oral CBD doses of up to 1500 mg/day or up to 30mg IV. The scientific understanding of CBD's clinical effects is based mostly on studies in specific indications, like epilepsy. GW Pharma's Epidiolex (highly potent, pure formulation of CBD) was approved by the FDA in 2018 for the treatment of seizures associated with Lennox-Gastaut syndrome and Dravet syndrome, and other companies (Tilray, MMJ Phytotech, Insys) have clinical trials underway in seizure disorders as well.

CBD Hemp Cultivation (Neivert)

According to the National Conference of State Legislatures, 41 states have set up cultivation and production programs to regulate the production of hemp. There is little research on CBD hemp cultivation methods as hemp cultivation research historically has focused on fiber and grain/seed. This lack of research, combined with a number of variables that affect hemp for CBD yield, makes hemp for CBD cultivation much more art than science at this point. That said, no other crop in the U.S. offers the type of return of the CBD Plasticulture Model, and we would thus expect the country's two largest crops, corn and soybeans, to lose some acreage to CBD hemp.

Synthetic Biology Provides Alternative Cannabinoid Production Method; Life Science Tools Well Positioned To Benefit From QA/QC Testing Opportunity (Schenkel)

As an alternative to cultivation-based methods, cannabinoids can be produced using either chemical or synthetic biology approaches. Synthetic biology methods, which harness fermentation to produce cannabinoids, are particularly attractive considering they can potentially produce a variety of cannabinoids while being highly scalable, efficient, and environmentally friendly.

While QA/QC testing standards for CBD currently vary greatly by state (if any exist at all), we expect Life Science Tools companies to benefit from this nascent market opportunity as testing regulations are implemented and standardized. Similar to medical/recreational cannabis testing, instruments such as mass spectrometers and liquid/gas chromatographs are utilized to analyze CBD samples. Key vendors for mass spectrometry and chromatography instruments include Agilent, Danaher (SCIEX), PerkinElmer, Shimadzu, Thermo Fisher, and Waters Corporation.

CBD From a Retailer and Payor Perspective (Rhyee)

Healthcare: Drug Retailer Perspective: CBD products appear to be gaining traction with independent pharmacies, many of whom are already selling or planning to sell CBD oils. Independent pharmacies likely find the high-margin profile of CBD oils attractive, which we suspect is similar to those of more traditional over-the-counter drugs, as well as the differentiation it affords independents relative to larger chain pharmacies. For those selling CBD oils today, the focus is on quality, particularly as it relates to bioavailability. Large pharmacy chains, such as CVS and Walgreens, don't currently sell CBD oil, but WBA noted it is monitoring the CBD market.

Healthcare: Payor Perspective: Generally speaking, managed care does not cover OTC products, with the same being true for Medicare and Medicaid. Based on our conversations with a number of payors, whether CBD oils will be covered as a medical benefit by government sponsored health programs is determined by the Center for Medicare and Medicaid Services (CMS) and state governments. Currently, CBD products are not a covered benefit, or an extra benefit, that has been approved by CMS or states, and it isn't known at this time whether CMS or states governments are considering reimbursement for CBD products. Separately, Payors noted three factors complicating commercial coverage of CBD oils, including (1) legal issues, as CBD oils derived from THC (cannabis) isn't legal if it contains equal to or more than 0.3% THC; (2) lack of regulation by the FDA; and (3) its availability as an OTC medication.

Global Landscape (Azer)

While the global regulatory landscape varies, the CBD category outside of the U.S. has been evolving rapidly, with more change likely to come with the WHO's current evaluation of CBD, as well as its recent addition to the EU's Novel Food Catalogue. In Europe, CBD products are now widely available in markets like the U.K., Italy and Switzerland, though regulations vary with Italy allowing for "cannabis light" products, with allowable THC of as much as 0.6%, while in Switzerland CBD products can have as much as 1% THC, and are classified as a tobacco substitute. In Latin America, hemp has been in production since the 1500s is also rapidly expanding their regulatory frameworks around marijuana and hemp. Canadian licensed producers have been actively entering the market in Latin America to capitalize on this evolving opportunity, including Canopy Growth, Tilray, Aurora and Cronos.

Regulatory Outlook (Eric Assaraf - Cowen Washington Research Group)

The 2018 Farm Bill declassifies industrial hemp as a Schedule I substance, shifts regulatory authority from the DEA to the Department of Agriculture, and provides autonomy for states to regulate the industry. However, the new law does not change the FDA's oversight authority over CBD products and FDA Commissioner Scott Gottlieb has made it clear that his agency will continue to step in when certain health claims are made. Additionally, FDA has stated that CBD cannot be added to food products sold across state lines or marketed as a dietary supplement, regardless of whether it is hemp-derived. The FDA will explore new pathways for CBD to be sold legally; however, it seems clear that there will be a period of regulatory uncertainty over CBD products at the state and federal level.

TABLE OF CONTENTS

COWEN'S COLLECTIVE VIEW OF CBD

In a collaboration featuring 11 analysts across Cowen's consumer, health care, industrials and regulatory teams, herein we offer our outlook for the global CBD market, with a particular focus on the U.S. While little science exists supporting medical efficacy of CBD (with the exception of seizures, which GWPharma was able to prove with Epidiolex for Dravet syndrome and Lennox-Gastaut syndrome, as discussed in more detail herein), the popularity of CBD products seems to be growing exponentially in the U.S. Indeed, our consumer survey work suggest that close to 7% of adults in the U.S. already use CBD as a supplement.

With the category gaining increasing interest from consumers we have seen a swell in product innovation. And, the opportunity is increasingly drawing the attention of larger competitors (where for instance, WEED announced that they would consider spending as much as $500 mm in U.S. hemp / CBD). ***By 2025, we estimate that the U.S. CBD market could approach $16 bn (from $600 mm -$2 bn in 2018).***

Herein, we offer our views of:

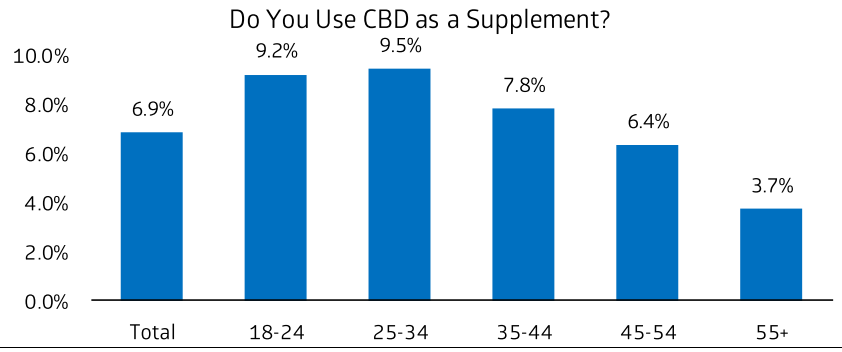
1. Consumer Products Market Sizing (Azer)
2. The Science of CBD (Nadeau)
3. The Hemp / CBD Supply Chain: From Cultivation to Extraction (Neivert & Schenkel)
4. Consumer Products Opportunities (Azer)
5. The CBD Competitive Landscape - Public and Private Company Discussions (Azer)
6. Consumer Discretionary Retail and Brand Opportunities Across:
    a. Pharmacy (Rhyee)
    b. E-Commerce (Blackledge)
    c. Broader Retail (Chen)
    d. Specialty Brands (Kernan)
7. On-Premise Consumption Opportunities (Charles)
8. U.S. Regulatory Outlook (Assaraf, Krueger, Seiberg & Weissenstein)
9. Global CBD Landscape (Azer)
10. Additional Potential Opportunities for Hemp / CBD, Including
    a. Pharmaceutical Applications (Nadeau)
    b. Industrial Applications (Osborne)

Consumer Products Market Sizing (Azer)

In our proprietary Cowen consumer survey (~2,500, 18+ respondents), we found that in January 2019 close to 7% of respondents indicated that they use CBD as a supplement. While this is only the first month's reading of the data (which can fluctuate from month to month), this initial response piqued our interest considerably, as it was much higher than we would have suspected. Indeed, to put the 6.9% incidence rate in context, that compares to JUUL use of 4.2%, and 19.6% of consumers that consider themselves a current tobacco user, per our survey.

From a user perspective, category engagement not surprisingly skews younger, with use among 18-24 and 25-34 year olds at over 9%, while it is below 4% for consumers 55+.

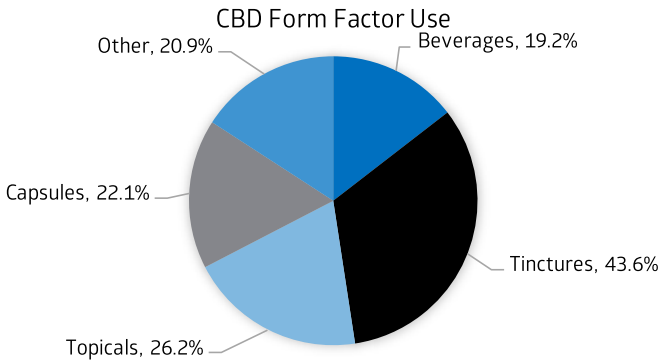
Figure 1 CBD Use Over-Indexes to Consumers Aged 18-34



Source: Cowen Survey, n=~2500, January 2019

While the category remains nascent (with revenue estimates ranging from $600 mm to $2 bn in 2018) it seems clear that the abundance of choice, which we discuss in more detail herein, has been a key driver of that consumer engagement. In particular, we were surprised to see that beverages already account for close to 20% of reported form factor use, given that this segment is among the newer offerings in the market place. Meanwhile, tinctures, which were arguably one of the original delivery systems, has a dominant 44% share.

Figure 2 Tinctures Are the Most Popular Delivery Mechanism



Source: Cowen Survey, n=~2500, January 2019
Note: Users had the option to choose multiple form factors

While we are keen to gain more insights into the evolving use of CBD in the coming months from our survey work, this initial snapshot offers a framework for sizing the ultimate CBD opportunity. With growing consumer awareness, we conservatively believe that CBD use can grow to 10% of adults in the U.S., or ~25 mm consumers (using current population) by 2025. If we assume that the average consumer ultimately spends $640 per year (or less than $2 / day), that would imply a $16 bn market opportunity for CBD. We would note that using the U.S. Census 18+ population projection in 2025, a 10% incidence rate would equate to just over $590 in annual spend to achieve $16 bn. Conversely, holding the $640 in spend constant with the U.S. Census forecasted population would result in over $17 bn in revenues by 2025.

That said, we view this estimate as somewhat conservative, as we can envision a scenario where a consumer that uses a CBD tincture or capsule, may also be inclined to convert his or her beauty regimen to include CBD (e.g., CBD infused beauty products), and or use a topical for targeted relief as well. Our $16 bn estimate assumes the following category contributions:

Figure 3 We Believe CBD Can Be a $16 BN Revenue Opportunity in the U.S. by 2025

Note: $ in mm unless otherwise stated.
Source: Cowen and Company

The Science Of CBD (Nadeau)

The Endocannabinoid System

Cannabis' therapeutic potential is due to this valuable overlap between phytocannabinoids (i.e. plant-derived cannabinoids) and the endogenous cannabinoid system in humans, termed a "therapeutic handshake." However, though THC's activity in the body has been fairly well elucidated (it acts through G-protein coupled cannabinoid receptor 1 and cannabinoid receptor 2), CBD's pharmacokinetics are less well understood (no specific receptor for CBD has been identified).

The scientific understanding of CBD's clinical effects is based mostly on studies in specific indications, like epilepsy. GW Pharma's Epidiolex (highly potent, pure formulation of CBD) was approved by the FDA in 2018 for the treatment of seizures associated with Lennox-Gastaut syndrome and Dravet syndrome, and other companies (Tilray, MMJ Phytotech, Insys) have clinical trials underway in seizure disorders as well. Additional possible indications for CBD products include autism spectrum disorders, psychiatric conditions, diabetic neuropathy pain, fibromyalgia, chronic pain, and back pain; clinical trials in these indications are underway.

Clinical trial results to date demonstrate few adverse effects from oral CBD doses of up to 1500 mg/day or up to 30mg IV. Specifically, CBD studies have not reported effects on blood pressure, heart rate, or respiratory rate, and no negative changes in mood or psychomotor slowing. Some studies (such as GW's in Epidiolex) have shown side effects resulting from high doses of CBD (~2g/day) inhibiting hepatic drug metabolism, prompting increased blood levels of some background medications. Additionally, *in vitro* studies have shown CBD to be pro-apoptotic in lymphocytes and to inhibit IL8 and IL10 production, suggesting that it may suppress the immune system. However, though unknowns remain, the summation of pre-clinical and clinical data suggest that the compound is safe at typical doses seen in over the counter products (5-10mg).

Additionally, other cannabinoids (found in CBD distillate) have been discovered that may have differentiated pharmacological effects. For example, cannabidivarin (CBDV) may have differentiated anticonvulsant effects, tetrahydrocannabivarin (THCV) may have anti-diabetic and appetite suppressant effects, cannabidiol-acid (CBDA) may have anti-nausea effects, and bannabigerol (CBG) may have anti-cancer effects. Further research is needed to elucidate the clinical effects of these compounds.

CBD Hemp Cultivation (Neivert)

2018 Farm Bill Legalizes Commercial Cultivation of Hemp: The 2018 Farm Bill legalized industrial hemp at the federal level removing it from schedule I status under The Controlled Substance Act. The bill defines industrial hemp as a variety of cannabis with a THC concentration of </=0.3% and allows farmers to grow and sell hemp under state regulation. According to the National Conference of State Legislatures, 41 states have set up cultivation and production programs to regulate the production of hemp. (CT, ID, SD, IA, OH, TX, LA, MS and GA do not currently allow hemp cultivation.)

Hemp is currently being grown under state Industrial Research Pilot Programs. Once USDA rules are released, pilot programs may end in favor of USDA rules and rules of state programs approved by the USDA.

Prior to the 2018 Farm Bill, the 2014 Farm Bill allowed universities and state departments of agriculture to conduct hemp research under Agricultural Pilot Programs in an effort to evaluate industrial hemp as a commercial crop. The bill allowed states to begin research on best methods for hemp cultivation.

Cultivation Practices Of Hemp Dependent On Intended Harvestable Component

Hemp is grown for fiber, grain/seed and floral materials with different varieties of hemp planted for each component. Fibers are used in rope and textiles, grain is used in human food (not legal for animal feed), pressed seed oil from grain is used like sunflower seed oil, and oils, including CBD, are removed from floral materials for health supplements.

Cultivation practices differ for fiber, grain/seed and CBD in an effort to maximize the yield of the desired harvestable component. U.S. states have conducted pilot programs in recent years to help gain a better understanding of best practices.

Limited Research Available On CBD Hemp Cultivation

There is little research on CBD hemp cultivation methods as hemp cultivation research historically has focused on fiber and grain/seed. This lack of research, combined with a number of variables that impact hemp for CBD yield, makes hemp for CBD cultivation much more art than science at this point. Cultivation methods have been described as all over the map. That being said, we detail methods from recent academic research studies and conversations with industry participants below. (The University of Kentucky and University of Vermont have both conducted research in CBD hemp cultivation in recent years but further research is needed for conclusions regarding proper production techniques.)

Hemp CBD Cultivation Steps:

- **Obtain a license.** Growers must obtain a grower license from their state department of agriculture for the specific type of hemp they want to grow.
- **Find a buyer/processor.** Growers then need to find a buyer/processor for their harvest as crops can only be sold to licensed processors.
- **Source seeds or clones.** The grower must acquire seeds or transplants. Clones (rooted cutting of a plant) can be used instead of seeds. The key factor in selecting seeds or clones is understanding which strains produce flowers with high CBD concentrations while keeping THC at </=0.3% since CBD and THC are positively correlated which caps the CBD level. (A crop that exceeds 0.3% THC

will be destroyed.) Seeds that are certified (sold by domestic and international hemp seed distributors) contain </=0.3% THC or produce hemp with </= 0.3% THC.

CBD is more concentrated in female flowers (3%-6%) compared to male flowers making male seeds unwanted. Unfertilized female flowers have been found to produce higher CBD levels than female flowers fertilized by male plants making male seeds unwanted in a production field. We note that seed mix (male and female) costs are significantly lower than feminized seed costs (incremental work is needed to increase the supply of feminized seeds).

Conversations with industry participants indicate that clones (first grown in a greenhouse and then transplanted to the field) are becoming more common as they provide a cheaper path to all female flowers in the field. Retail clones can cost $4-$7 each and can be produced for $3 each with access to a greenhouse.

- **Test soil for contaminants.** We note soil that has been used for corn production has been cited as supportive for maximizing hemp yields.

- **Water System Installation.** A drip irrigation is most effective way to water hemp as it allows roots to breathe and conserves the most water.

- **Pesticides:** Currently, pesticides are illegal for industrial hemp cultivation which makes plastic mulch an important step. So far, disease pests and insects have not been found to significantly impact yields.

- **Fertilizer.** Fertilizer requirements similar to wheat are considered adequate with nitrogen the most critical.

- **Planting.** Adequate soil moisture and temperature (>/=50°F), which influences timing for planting, is recommended for successful germination. Industrial hemp can be planted in late April in Kentucky and late June in Vermont. Planting depth for seeds should be ~0.50 inches.

  Female seedlings, started in a greenhouse approximately 6 weeks prior to planting, or transplanted female clones (planted with root structure), can be planted into black plastic outdoors to control weeds. 5 ft x 5 ft plant spacing has been found to be ideal and results in a population of 1,742 plants per acre.

- **Harvest.** Average time to harvest a 6 inch clone is 90-120 days, Flower buds from outdoor plants are removed by hand or using a debudder machine after using a chainsaw or lopper to cut the plant down. Flower bud harvest is labor intensive and can take ~30 hours per acre. Flower buds in a UVM study were dried at 80°F for 18-36 hours until dry enough for storage without molding. Indoor storage requirements creates a production challenge. As with most crops, variations in yield can result from variations in genetics (variety), soil, weather, and other growing conditions.

- **Testing.** State Departments of Agriculture conduct field and greenhouse inspections for THC levels, which is the only way to separate hemp from illegal cannabis. Crops that test >0.3% THC will be destroyed.

Wide Range Of Returns On CBD

There is little data on economics for hemp CBD cultivation given wide range of outcomes that can result on the seed vs clone decision (CBD levels vary for each and will impact cost), as well as the type of production model used. The University of Kentucky (College of Agriculture) recently published six budget models for industrial hemp producers. Four of the six budgets address CBD hemp, with a separate budget for grain and another for fiber. We highlight the University of Kentucky's CBD Plasticulture budget model below since it is the most profitable and will likely be the most commonly implemented. We note all four of the CBD hemp models indicate a positive return above variable costs per acre while hemp grain and hemp fiber do not reach breakeven due to low pricing for both harvestable components..

University Of Kentucky's Budget Assumptions For CBD Plasticulture:

- **Dry matter yield per acre:** UK estimates 1,200 lbs of dry matter yield produced per acre based on 1,500 plants per acre (recall 5 ft. 5ft. allows for up to 1,742 plant per acre) and 0.8 lb of dry matter yield per plant (yield per plant can range from 0.5 lb-1.5 lbs).

- **Gross return per acre:** CBD concentration and price per % are the factors that determine the price of dry matter yield/lb. In the below example, 6% CBD% * $5.00 per % = $30/lb. Gross return per acre is then calculated by multiplying dry matter yield/lb by dry matter yield/acre (1,200).

- **Variable cost per acre:** 72% of variable cost per acre is for clone transplants for 1,500 plants at $5.00 each. Other notable costs include planting, plastic to protect against weeds, drip line for water, harvesting costs, cash rent and application/test fees. We note clones currently can range from $3.50-$5.50 per plant. Clones have become more common than seeds in Kentucky as they offer an easy way to produce female plants. A seed mix may be cheaper but would include male seeds than can potentially pollinate female seeds and negatively impact CBD concentration which influences pricing for dry matter yield. Feminized seeds are an option but will likely be the most expensive option. We note that the model assumes outdoor production rather than greenhouse production since a greenhouse is efficient for clone production (then transplanted to the field) but prohibitive for plant production.

Figure 4 – CBD Plasticulture Model – University of Kentucky

	Quantity	Unit	Price	Total
CBD%	6%	-	-	-
Price per %	$5.00	-	-	-
Dry Matter Yield	1,200	lb	$30	$36,000
Gross Returns Per Acre	**-**	**-**	**-**	**$36,000**
Transplants (clone)	1,500	plants	$5.00	$7,500
Fertilizer				
-Nitrogen (urea)	100	unit	$0.47	$47
-Phosphorus (P2O5)	30	unit	$0.60	$18
-Potassium (P2O)	45	unit	$0.38	$17
Planting/Setting	1,500	plants	$0.20	$300
Black Plastic/Drip Line	1	acre	$515	$515
Harvest Cost	32.4	hrs	$12.50	$405
Cash rent	1	acre	$300	$300
Application & License Fee	1	per year	$400	$400
Lab Test	1	-	$300	$300
Other	-	-	-	$669
Total Variable Cost Per Acre	**-**	**-**	**-**	**$10,471**
Margin Over Variable Cost Per Acre	-	-	-	**$25,529**

Source: hemp.ca.uky.edu, Cowen and Company

Sensitivity Analysis For CBD Plasticulture Model. As shown below, there is a significant change in return for every $1 change in price per CBD%. A deterioration of this pricing with no corresponding change in cost would impact CBD production. Breakeven for the model above is ~$9/lb for dry matter yield compared to the $30/lb used to calculate the margin over variable cost per acre used. While price % CBD can fluctuate, the second factor determining the dry matter yield/lb price is CBD%.

Figure 5 – Sensitivity Analysis

Price per % CBD	Total Revenue	Returns Above Variable Costs
$6	$43,200	17,671
$5	$36,000	10,471
$4	$28,800	3,271
$3	$21,600	-3,929
$2	$14,400	-11,129
$1	$7,200	-18,329

Source: hemp.ca.uky.edu, Cowen and Company

CBD Hemp Clearly An Attractive Option For Growers. No other crop in the U.S. offers the type of return of the CBD Plasticulture Model. We would expect the two largest crops in the U.S.: corn and soybeans to lose some acreage to CBD hemp, though given corn and soybean area planted was 89.1M and 89.2M acres respectively in 2018. (Total planted acres in the U.S. is ~320M acres.)

Figure 6 – 2017 Production Less Operating Costs Per Acre (Cash Grower Margin/Acre)

per acre	Corn	Soybeans
Gross Value of Production	$620	$455
Operating Costs		
Seed	$99	$58
Fertilizer	$116	$25
Chemicals	$35	$27
Other Operating Costs	$85	$48
Total Operating Costs	$335	$158
Cash Grower Margin	**$285**	**$297**

Source: USDA, Cowen and Company

Kentucky Hemp Growth Provides An Indication For Near-Term Acceleration

Figure 7 shows hemp production in Kentucky under Kentucky Department of Agriculture (KDA) Industrial Hemp Research Pilot Program. The figure shows the increase in planted acres in 2018 (Sept) as well as the shift toward CBD as a percentage of total hemp (planted acres for CBD rising to 4,121 acres in 2018 from 864 in 2017). In 2018, there were 158 greenhouses in Kentucky representing 764,000 sq. ft., which is included in the 2018 acreage below. (Note 1 acre = 43,560 sq. ft.)

On January 22, 2019, the Kentucky Department of Agriculture approved 1,035 applications to cultivate up to 42,086 acres of industrial hemp in 2019, up from 16,100 acres in 2018 and 33 acres in 2014, which was the first growing year. (67 acres of greenhouse space was also approved for hemp cultivation.) We note that of the 16,100 acres approved in 2018, less than half (6,700) was planted.

Figure 7 – Kentucky Department of Agriculture Industrial Hemp Research Pilot Program

Production Year	Approved Processors	Approved Growers	Approved Acres	Planted Acres	Harvested Acres	% of Grain or Seeds	% Fiber	% CBD	% CBD & Grain	% Grain & Fiber
2014	9	20	-	33	-	47%	32%	21%	0%	0%
2015	29	99	1,742	922	500	47%	6%	47%	0%	0%
2016	45	137	4,600	2,300	2,000	34%	6%	60%	0%	0%
2017	49	204	12,800	3,200	2,300	36%	5%	27%	32%	0%
2018 (Sept)	72	210	16,100	6,700	TBD	18%	4%	62%	14%	2%
2019	N/A	N/A	42,086	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Source: kyagr.com/hemp, Cowen and Company

Outlook For Growth

The expected growth for hemp is supported by the economics offered. However, there are limitations related to required cultivation methods.

Conversations with industry experts estimate planted hemp acres in 2019 could reach 200,000, up from 78,176 in 2018. The growth is supported by expansion like Kentucky's and new states entering the market (only 23 states participated in 2018).

Figure 8 – U.S. Planted Hemp Acres – 2017 and 2018

State	2017	2018
Montana	542	22,000
Colorado	9,700	21,578
Oregon	3,469	7,808
Kentucky	3,271	6,700
Tennessee	200	3,335
North Carolina	965	3,184
North Dakota	3,020	2,778
New York	2,000	2,240
Nevada	417	1,881
Wisconsin	0	1,850
Vermont	575	1,820
Minnesota	1,205	710
Pennsylvania	36	580
Maine	30	550
Oklahoma	0	445
South Carolina	0	256
West Virginia	14	155
Washington	175	142
Virginia	87	135
Massachusetts	0	21
Indiana	5	5
Hawaii	1	2
Nebraska	1	1
Total	**25,713**	**78,176***

* Includes 232 acres of greenhouse or indoor cultivation

Source: votehemp.com, State Departments of Agriculture, Cowen and Company

Challenges For Growth

We see several issues that we expect will moderate growth of hemp CBD in years to come. As a commodity, we see economics diminishing as CBD supply rises with increased acres along with higher costs for seed from increased seed demand. We also see a lack of best practices for cultivation, storage restrictions and uncertainty about the consistency of seeds/clones available increasing the probability that yields are compromised.

Synthetic Cannabis (Schenkel)

The Broad Spectrum Of Cannabinoids

Cannabinoids fall into three main types: (1) endogenous cannabinoids, which are produced naturally in the bodies of humans and animals; (2) phytocannabinoids, which are isolated from plants; and (3) synthetic cannabinoids, which are produced in the laboratory and may have some structural deviations from the naturally occurring molecules.

Of the three types, phytocannabinoids have garnered a lot of interest because of their therapeutic and recreational potential. For example, Marinol and Syndros, which the FDA cleared for the treatment of anorexia associated with weight loss in AIDS patients, include the active ingredient dronabinol, a synthetic delta-9- tetrahydrocannabinol (THC) which is considered the psychoactive component of marijuana. In June 2018, the FDA approved an oral formulation of cannabidiol (CBD), Epidiolex, which GW Pharmaceuticals PLC developed for the treatment of seizures associated with two rare and severe forms of epilepsy in children.

In addition to THC and CBD, more than 100 other phytocannabinoids have been identified from the cannabis plant. This includes lesser-known compounds such as tetrahydrocannabivarin (THCV), cannabigerol (CBG), and cannabichromene (CBC).

The broad spectrum of phytocannabinoids can bind to a range of different receptors in the human body and induce a wide variety of pharmacological responses. However, due to the limited research into these varying effects, a full understanding of the role of each cannabinoid compound is still poorly understood. With that said, some of the most studied roles are listed in the table below.

Figure 9 Approved & Potential Medicinal Roles Of Selected Phytocannabinoids

Cannabinoid	Percent Of Total Cannabinoid Content	Role
Tetrahydrocannabinol (THC)	15-35%	• Psychotropic • FDA-approved as appetite stimulant for people with AIDS and antiemetic for people receiving chemotherapy • Alleviates neuropathic pain, spasticity, overactive bladder, and other symptoms
Cannabidiol (CBD)	1-12%	• FDA-approved for treating rare seizure disorders • Chronic pain treatment • Being studied for treatment of anxiety, post-traumatic stress disorder, pain, schizophrenia, Parkinson's disorder and Huntington's disorder
Tetrahydrocannabivarin (THCV)	<1%	• Potential anxiety relief • Potential appetite suppressant
Cannabigerol (CBG)	<1%	• Potential anti-inflammatory • Potential anti-cancer
Cannabichromene (CBC)	<1%	• Potential anti-inflammatory • Potential anti-cancer • Potential GI motility modulator

Source: Cowen and Company

Need For Alternative Methods To Produce Cannabinoids

Cannabis plants can exhibit wide variation in the quantity and type of cannabinoids they produce. However, cannabinoids are only produced in limited quantities regardless of the strain; in total, cannabinoids account for <1% of the dry weight of the cannabis plant.

Selective breeding has led to strains of the cannabis plant that produce relatively large amounts of the intermediary forms of THC and CBD. While THC content varies substantially among cannabis strains, it generally represents 15-35% of the cannabinoid content of the plant, and CBD is typically 1-12%. The relative abundance of these compounds have allowed them to be well studied and their diversity of applications have created a large commercial market.

After THC and CBD, the remaining cannabinoids are found only in trace amounts in the plant. Compounds such as THCV, CBG, and CBC have elicited therapeutic interest, but because they are only present in minute amounts they have been difficult to extract and purify and impossible to produce at commercial scale. This has limited their study up to this point.

Alternative Methods For Producing Cannabinoids

To combat the limited availability of cannabinoids using cultivation-based methods, alternative approaches have been developed that use chemical and biotechnological synthesis to produce cannabinoids.

Chemical Synthesis

Chemical synthesis methods use organic chemistry to produce cannabinoids; however, the process has several drawbacks. Chemical methods have largely failed to be cost effective for commercial scale cannabinoid production because of the complexity required to produce the cannabinoid molecules, and extensive purification is needed to obtain a high quality product. Commercial chemical synthesis also generates large amounts of organic waste, takes several weeks to produce kilogram quantities, and is expensive. As such, practical methods for the chemical synthesis of many cannabinoid molecules has not been developed.

Biotechnological Synthesis (Synthetic Biology)

An emerging alternative to traditional cultivation and chemical synthesis is the use of biotechnology-based approaches to produce cannabinoids. These synthetic biology approaches produce cannabinoids through modifying the metabolism of genetically engineered organisms. This converts the organism into a biological factory, producing the desired cannabinoid in large quantities.

Compared to chemical methods, biosynthesis methods are more cost effective, scalable, and environmentally friendly.

Compared to traditional methods, biosynthesis of cannabinoids is potentially more sustainable, more reliable, faster, and less expensive. Biosynthesis does not require as much water or energy input, is not subject to weather or other exogenous factors, takes ~3-5 days to yield an end product vs. traditional methods taking up to 4 months, and is theoretically less expensive. Additionally, growing cannabis often involves using several hard-to-remove impurities (e.g., pesticides), that could potentially create significant safety issues and other undesirable dynamics. Furthermore, purity and regulatory

controls can be implemented when producing compounds with a biosynthesis method similar to the processes in place for pharmaceutical regulation.

The many perceived advantages of synthetic cannabinoid creation have led to a series of companies entering the market, as described below.

Figure 10 Selected Synthetic Biology Cannabinoid Companies

Company	Notes
Cellibre	Cellibre is a next-generation cellular agriculture company. Employing an organism-agnostic approach, Cellibre turns cells into specialized, sustainable factories for the manufacture of globally significant products at scale.
Ginkgo Bioworks	Ginkgo is a Boston-based company that designs custom microbes for customers across multiple markets, developing new organisms that replace technology with biology.
Hyasynth Biologicals	Located in Montreal, Hyasynth Biologicals uses the technologies from traditional and modern biology combined with computational analysis to develop organisms at the fastest possible speed.
InMed Pharmaceuticals	InMed Pharmaceuticals is a biopharmaceutical company that specializes in the discovery and development of novel, cannabinoid-based therapeutics for the treatment of diseases with high unmet medical need.
Librede	Librede has developed a yeast-based cannabinoid production and drug discovery platform to create chemical compounds that target the endocannabinoid system. Librede's modular technology enables large scale production of natural cannabinoids in a more economic and environmentally sustainable way
Renew Biopharma	Renew Biopharma harnesses the biological pathway to produce natural and novel cannabinoids that cross the blood brain barrier and target specific receptors associated with neuroinflammation and chronic pain.
Teewinot Life Sciences	Tampa-based Teewinot combines its biosynthetic processes with sophisticated chemical synthesis to produce proprietary cannabinoid analogs and prodrugs at commercial scale.
Amyris	Amyris is an industrial biotechnology company that has used sugarcane fermentation to create hydrocarbon molecules and produces an array of specialty ingredients and consumer products.

Source: Cowen and Company

Producing Cannabinoids Using Synthetic Biology

Synthetic biology methods use fermentation to produce cannabinoids with identical chemical structures to those found in plants.

Biocatalytic Cannabinoid Pathways

The first step of the synthetic cannabinoid production requires identification and extraction of the desired cannabinoid biosynthetic pathways from a cannabis varietal. The biosynthesis of cannabinoid molecules in a microbe could require four or more cannabinoid metabolic pathways. When the pathways are selected, their corresponding DNA sequences need to be cloned from the cannabis varietal and spliced into the microbial DNA.

Cannabinoids could be produced biocatalytically using the following mechanism:

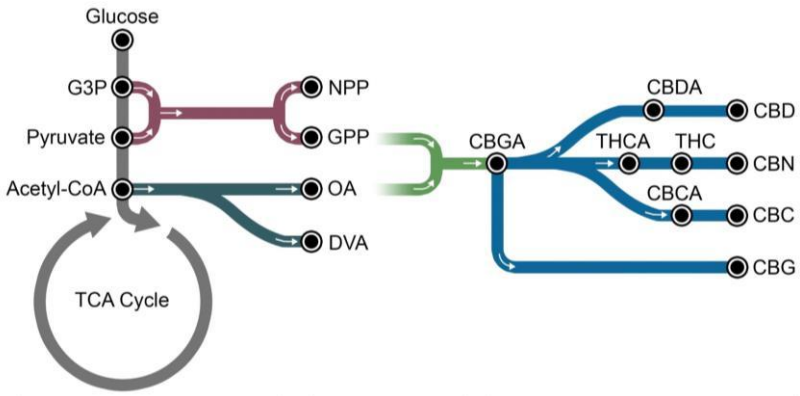
i. In the first pathway, glucose is converted into G3P and pyruvate via glycolysis. These two compounds are then utilized to produce the precursors geranyl pyrophosphate (GPP), and/or neryl pyrophosphate (NPP).

ii. Glycolysis of glucose also produces Acetyl CoA, which can catalyze biosynthesis of the second group of precursors: olivetolic acid (OA) and divarinic acid (DVA).

iii. Various combinations of the aforementioned precursors then combine in the third pathway to yield parent cannabinoid molecules (e.g., cannabigerolic acid or CBGA).

iv. These parent cannabinoids are then modified in the fourth pathway to produce cannabinoids such as tetrahydrocannabinolic acid (THCA) and cannabidiolic acid (CBDA). These acids can be transformed into a non-acid form using synthases, producing the terminal cannabinoid form.

Figure 11 Biosynthetic Cannabinoid Production Pathways



Source: Cowen and Company

Cannabinoid Production Using Fermentation

To power the aforementioned pathways, water and glucose (or a cannabinoid substrate) are added to the microbe (e.g., yeast) in a bioreactor. Under fermentation, the yeast will consume the glucose and produce the desired cannabinoid.

This culture is incubated for ~3-5 days to produce sufficient cannabinoid intermediaries. Afterwards, the fermentation mixture is separated and combined with a non-toxic solvent to extract and purify the cannabinoids.

Recent Cannabinoid Partnerships In Synthetic Biology

With the recent legalization of cannabis in several countries and U.S. states and growing acceptance of its utility, many recent notable partnerships have been created on the potential of synthetic cannabinoid production. We highlight two such agreements from the past few months below.

Amyris / Undisclosed Partner (February 2019; Valued Up to $255MM)

In February 2019, Amyris announced that it has signed an agreement for cannabinoid development, licensing, and commercialization in a partnership valued at up to $255MM (not including royalties for commercial products) with an undisclosed partner. The $255MM in payments include an upfront payment and the remainder is linked to milestones that are expected over the next 12-36 months. The partner is expected to provide initial, lab-based and later commercial-scale milestone cash payments in tranches for the development and scaling of technology to produce CBD.

Cronos Group / Ginkgo Bioworks (September 2018; Valued Up to $122MM)

Cronos Group is a vertically integrated Canadian cannabis company that operates two licensed producers. In addition, the company has developed an assortment of cannabis varietals and has amassed an extensive database on various cannabinoids and their properties. Boston-based Ginkgo Bioworks is a synthetic biology company that has developed a cutting edge, automated platform for biological engineering and fermentation. Using synthetic DNA to modify yeast and other organisms, the company endeavors to produce large amounts of various rare strains through this more efficient, lower-cost, novel process. Indeed, as we asserted in the MO/CRON note (link), we believe that this strategic partnership was integral in informing the entry of the largest tobacco player in the U.S., into the legal global cannabis market.

By way of background, in September 2018, Cronos and Ginkgo announced an agreement to produce cultured cannabinoids. Ginkgo is tasked with developing strains of yeast that can produce eight target cannabinoids. Cronos would then handle large scale production and distribution of those cultured cannabinoids. The total agreement is valued at $122MM; this includes $22MM to fund R&D, and up to $100MM of CRON common shares in tranches in accordance with production milestones. More specifically, the tranches will be issued once each of the target cannabinoids can be produced for less than $1,000/kg of pure cannabinoids at a scale of >200 liters as follows: THC (20%), CBD (15%), THCV (15%), CBC (10%), CBG (10%), CBGV (10%), CBDV (10%), and CBCV (10%). Cronos and Ginkgo expect to reach the milestone for these eight strains within three years.

Figure 12 Cronos and Ginkgo Partnership to Produce Eight Targeted Cannabinoids at Scale

	Milestone Shares Issued	
Target Cannabinoid	Shares	%
THC(A)	2,934,981	20%
CBD(A)	2,201,235	15%
CBC(A)	1,467,490	10%
CBG(A)	1,467,490	10%
THCV(A)	2,201,235	15%
CBGV(A)	1,467,490	10%
CBDV(A)	1,467,490	10%
CBCV(A)	1,467,490	10%
Total	**14,674,903**	100%

Source: Cowen and Company

Life Science Tools Participation In The Legal Cannabis Market (Schenkel)

Life science tools companies currently participate in the cannabis market primarily through providing instruments and equipment that: (1) extract active cannabis ingredients from leaves and seeds and (2) analyze cannabis products for potency and contaminants. According to one of our consultants who runs a cannabis testing laboratory, separations instrumentation including liquid chromatography (LC) and gas chromatography (GC), and mass spectrometry (primarily single quadrupoles, triple quadrupoles, and inductively coupled plasma mass spectrometers) are the primary technologies used in cannabis testing. We note that the cannabis testing opportunity is not limited to LC, GC, and mass spec technologies – other technologies including genetic analysis tools (DNA sequencers, microarrays, and PCR) could have a greater role in the cannabis industry in the future.

Cannabis Testing Details

There are three major categories of tests used to measure and monitor the quality of recreational and medicinal cannabis products: potency testing, terpene profiling, and contaminant testing. Contaminant testing typically includes testing for the following: (1) pesticides; (2) residual solvents; (3) heavy metals; (4) moisture content; (5) mycotoxins; and (6) microorganisms.

For the most part, standards and regulations for cannabis potency and contaminants testing are still in the infancy stage and vary widely by state – accordingly, testing of cannabis products vary greatly by locality. The aforementioned tests (also in Figure 13) are the most commonly performed tests. These tests are primarily performed using separations instruments and mass spectrometry (see pages 22-23 for details on these instruments and a list of vendors). Figure 13 lists commonly used instruments associated with a specific cannabis test.

Figure 13 Overview Of Cannabis Testing Technologies

Test	Common Analytical Instrument(s) Used
Potency	LC (HPLC or UHPLC), GC
Terpene Profile	GC-MS, LC-UV detector
Pesticides	LC-MS (triple quad), GC-MS (single or triple quad)
Residual Solvents	GC-MS
Heavy Metals	ICP-MS
Moisture Content	Moisture balances, weight loss methods
Mycotoxins	LC-MS (triple quad) or immunoassays
Microorganisms	Mostly culturing, some PCR, few MALDI-TOF
Actives Extraction	Supercritical Fluid Extraction (SFE)

Source: The Analytical Scientist and Cowen and Company

Background On Separations Technology And Market

Liquid Chromatography And Gas Chromatography – How Does It Work?

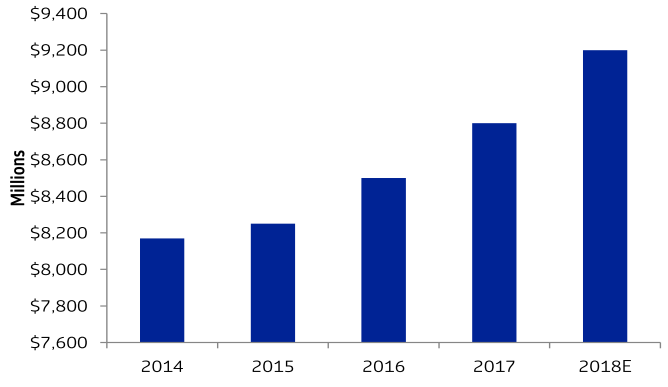
LC instrumentation is generally composed of: (1) solvent delivery system, (2) sample injector, (3) separation column, (4) detector, and (5) data acquisition unit. The solvent delivery unit pumps the solvent through the LC system while the sample injector introduces the sample into the solvent flow (known as the mobile phase). The chromatography column then separates the sample into its components for analysis by the detector, which measures the presence and amount of constituents. The data acquisition unit then records and stores the information from the detector. The underlying principles of GC are similar to those of LC, with the key difference being that the mobile phase is a gas instead of a liquid.

LC Is Often Combined With Mass Spec

To obtain the mass spectrum of a single compound in a mixture, the individual components must be separated prior to MS analysis. Separation is necessary for unambiguous identification because multiple compounds present simultaneously create an overlapping or mixed spectrum. The most common separation techniques used in combination with MS are gas chromatography (GC) and liquid chromatography (LC). LC and MS from different vendors can be combined. LC is more commonly used as high temperatures required for GC make it incompatible with the compounds under analysis - this is a key reason why some cannabis testing labs prefer testing THC using liquid chromatography (to be clear, analysis using gas chromatography requires heating THC which changes its properties).

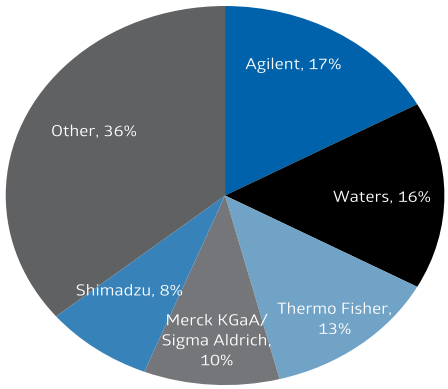
Chromatography Market Estimates

Figure 14 Overall Chromatography Market ($MM)



Source: Company reports and Cowen and Company

Figure 15 Chromatography Market Shares



Source: Company reports and Cowen and Company

Figure 16 Chromatography Market by Configuration

	Market	H/UPLC	GC	IC	LPLC	Flash	Other
Market Share	100%	60-65%	22%	6%	6%	1%	4%
Growth Rate	3-4%	4%	3%	4%	5%	3%	3%
Market Leaders		WAT A	A Shimadzu	TMO Metrohm	GE BIO	Teledyne Biotage	

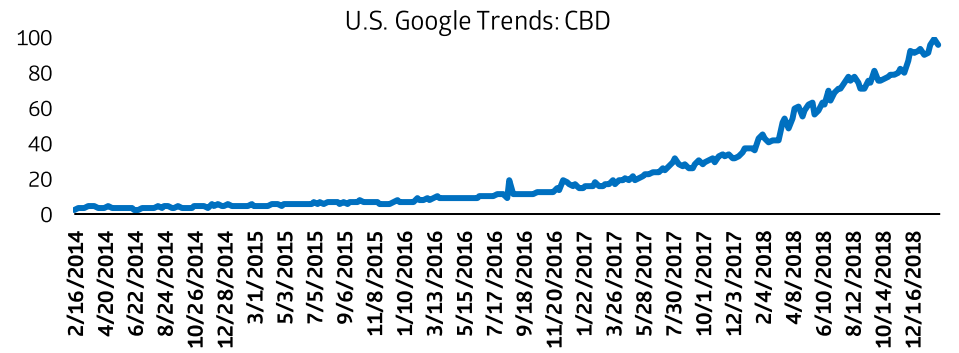
Source: Company reports and Cowen and Company

Consumer Products Opportunities (Azer)

In 2018, the CBD market in the U.S. has been estimated to have generated revenues ranging from ~$600 mm to as much as $2 bn. In our 2019 global cannabis outlook report (here), we had believed the CBD purchases in the U.S. likely skewed to the lower-end of that range. However, with new survey data from Cowen's proprietary consumer survey, we can see that among our ~2,500 respondents (18+) in January 2019 nearly 7% reported using CBD as a supplement. Coupled with the diverse form factors reportedly being used (including close to 20% for beverages, which was surprising to us), we are now inclined to size the current market at closer to $2 bn.

Indeed, looking at Google search trends, we can see that interest looks to have climbed steadily in 2016 and 2017, and accelerated meaningfully in 2018, which has continued into 2019.

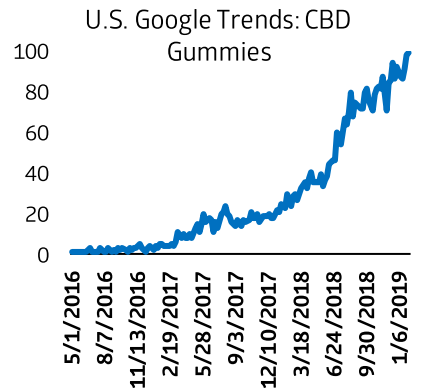
Figure 17 CBD Interest Has Been Increasing



Source: Google Trends and Cowen and Company

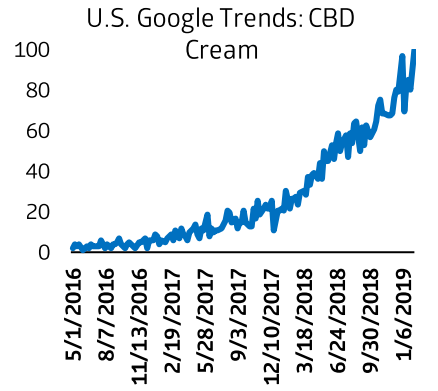
Encouragingly, interest has been rising consistently among different form factors, ranging from supplements like CBD gummies, to topicals and oils. The rising interest and popularity in this broad range of CBD offerings should support a diverse category and multiple competitors that cater to a large base of consumers with different needs, requiring various applications.

Figure 18 Interest Broad Based from Edibles...



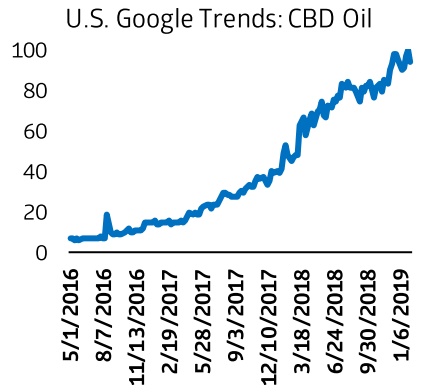
Source: Google Trends and Cowen and Company

Figure 19 ...to Topicals...



Source: Google Trends and Cowen and Company

Figure 20 ...To Oil



Source: Google Trends and Cowen and Company

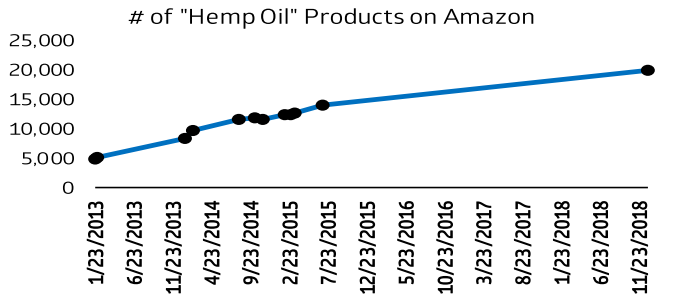
To further reinforce how CBD has been gaining interest over time, we analyzed the historical number of hemp oil products offered by Amazon (AMZN, John Blackledge), where we can see a continued increase in the number of products sold. Indeed, six years ago, Amazon had been offering roughly 5,000 products, which has quadrupled to over 20,000 products today.

Figure 21 Over 20K Hemp Oil SKUs Offered by Amazon Today…

# of Hemp Oil Products on Amazon			
Date	# of Products	Date	# of Products
1/23/2013	4,975	11/8/2014	11,587
2/1/2013	5,039	2/7/2015	12,370
1/10/2014	8,507	3/2/2015	12,430
2/10/2014	9,642	3/20/2015	12,741
8/10/2014	11,694	7/7/2015	13,963
10/12/2014	11,904	1/2/2019	> 20,000

Source: Amazon and Cowen and Company

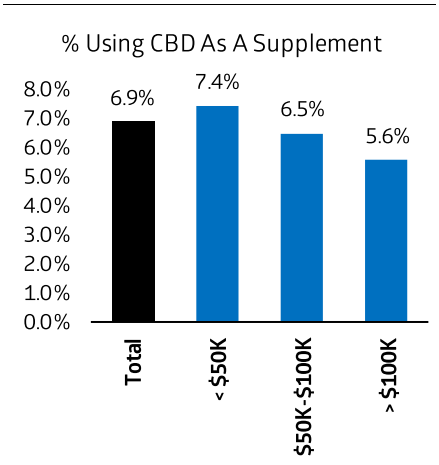
Figure 22 …Which Has Increased 4-Fold Over the Past 6 Years



Source: Amazon and Cowen and Company

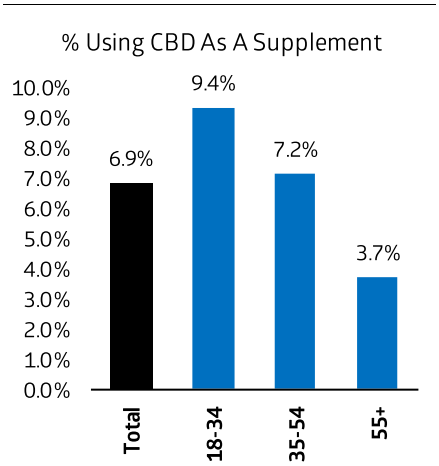
With reported CBD use skewing toward younger consumers, it is perhaps not surprising to see that CBD also over-indexes to lower-income consumers (where younger consumers generally have lower household incomes). What is more, CBD seems to be the most popular among Caucasians, following by Hispanic / Latino consumers. Meanwhile, CBD use is slightly more popular among women (7.0% incidence), vs. men (6.7% incidence).

Figure 23 CBD Over-Indexes with Low-Income…



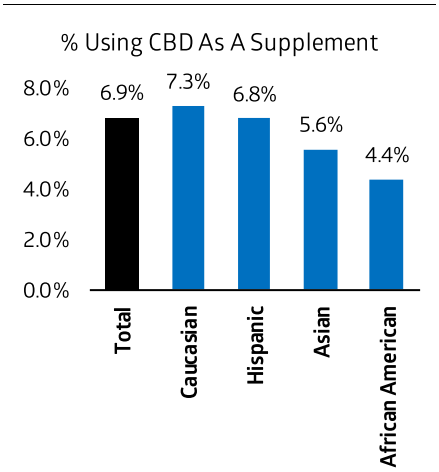
Source: Cowen Survey, N=~2500, January 2019

Figure 24 …Young Consumers (Ages 18-34)…



Source: Cowen Survey, N=~2500, January 2019

Figure 25 …And Caucasians



Source: Cowen Survey, N=~2500, January 2019

Given increasing interest, younger consumer demographic trends, and a lack of paid advertising within the space, below we offer a snapshot of the Instagram landscape as a proxy for current company social media activity. We would caveat that this is not an exhaustive list, nor does the below chart factor in the impact of influencer marketing, which is a popular trend in order for these companies to drive brand momentum. That said, we believe the below chart reflects the competitive nature of the category as we are already starting to see momentum from less known, emerging brands.

Of the companies analyzed, the below chart reflects the top 17 brands by absolute Instagram followers, while also providing data on the absolute number of posts over the month of January, as well as the average number of likes per post.

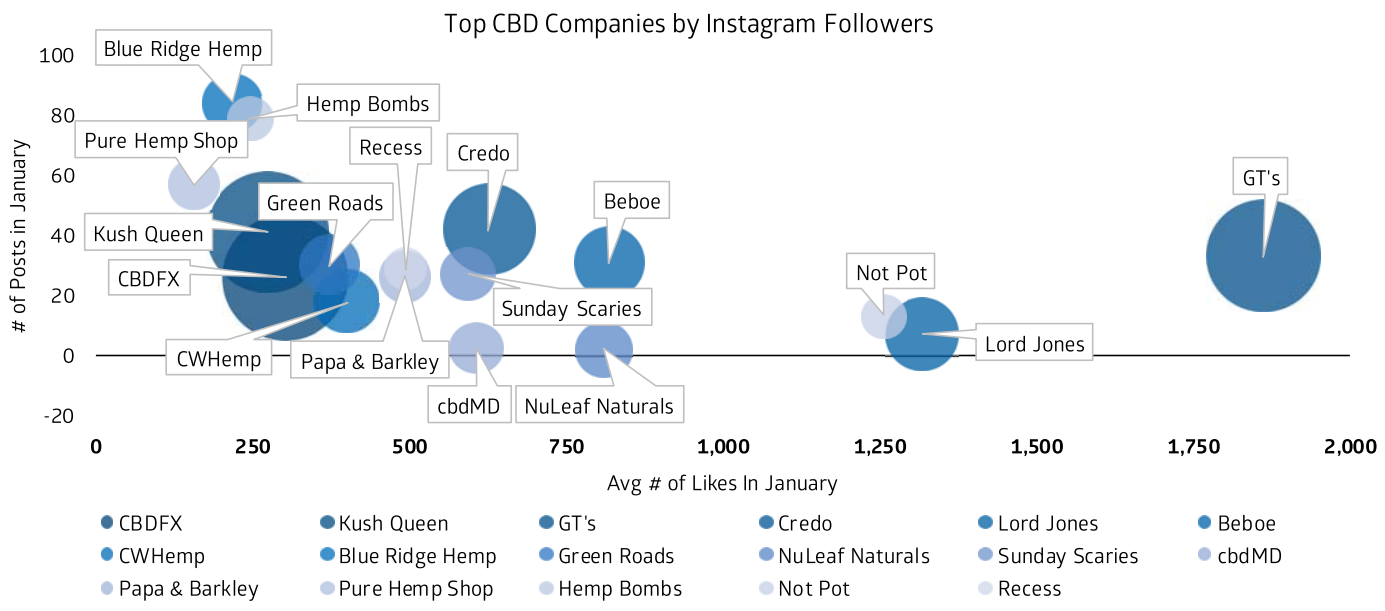
Absolute Followers. As it currently stands, three companies have an Instagram following of over 100K people, with CBDFX leading the pack at 181K. Kush Queen and GT's Kombucha also look to be well positioned with 168K and 145K followers, respectively.

# of Posts. Blue Ridge Hemp was the most active over the month of January with 84 posts, followed closely by Hemp Bombs (79 posts) and Pure Hemp Shop (57 posts). Across the competitive set, the average number of posts for the month of January was 32.

Avg Likes Per Post. In addition to having one of the largest number of absolute followers, GT's Kombucha also led the way in average likes per post (1,863). This was followed by super premium CBD company, Lord Jones, with 1,318 average likes per post. Not Pot rounded out the top three with 1,257 average likes per post.

We would note that while we consider the below analysis useful in terms of analyzing social media activity, it should not be used as a proxy for market leadership. Publicly traded companies such as Charlotte's Web, CV Sciences and Elixinol have established themselves as market leaders within CBD, based on distribution / market penetration, consumer awareness, and brand equity.

Figure 26 Instagram Analysis Reflects Competition From Emerging Brands



Source: Instagram and Cowen and Company
Note: Bubble size reflects relative number of Instagram followers

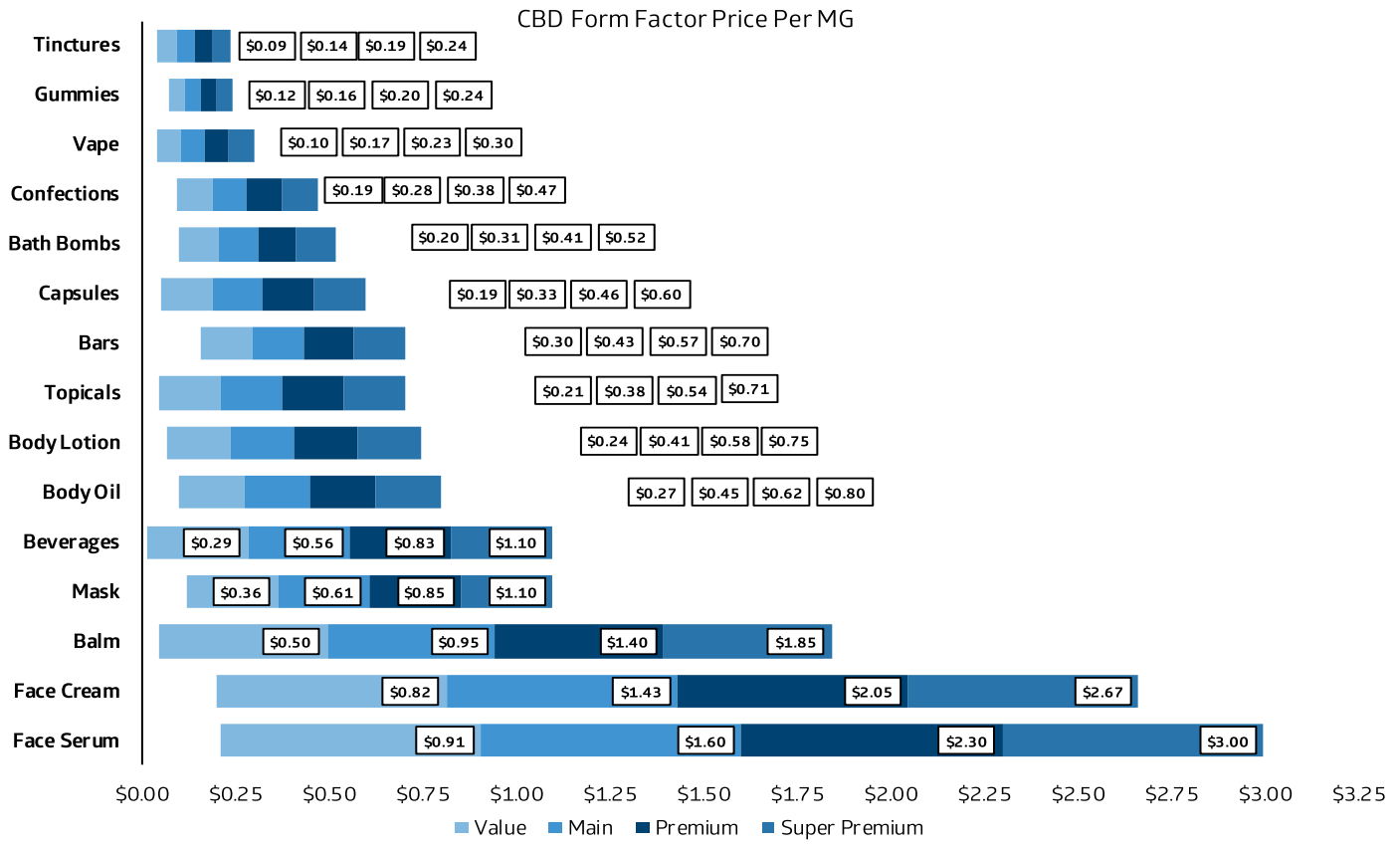
From a consumer staples perspective, we see innovation across a host of form factors. To analyze the category's potential, we focused on six specific consumer product categories, including:

i. Nutraceuticals (tinctures, capsules, sprays, and gummy vitamins)
ii. Topicals (for targeted pain relief, like Tiger Balm)
iii. Beverages (water, energy drinks and beer)
iv. Food (including confections and bars)
v. Vapor
vi. Beauty (including skin care, serums, lotions, and bath products)

While our analysis was far from exhaustive, below we:

i. Break down the above product categories by sub-segment to benchmark pricing, which we define as value, main, premium and super-premium,
ii. Forecast run rate revenues by vertical over the next two years,
iii. Offer company-specific detail on numerous private and public companies as part of our research on the CBD opportunity (primarily in the U.S.).

Figure 27 Beauty Products Carry the Most Premium Pricing, While Tinctures and Gummies Offer the Best Value Proposition in Terms of Price / MG of CBD

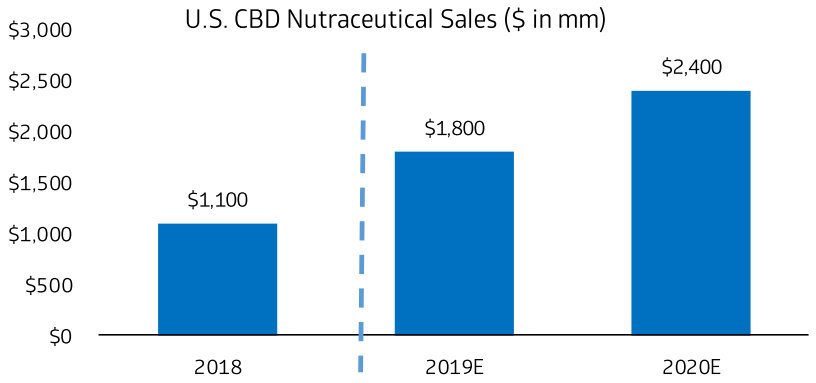


Note: Price boxes represent the high-end of the form factor's respective price segment.
Source: Company Websites and Cowen and Company

Nutraceuticals

Given robust consumer interest in CBD products, we estimate that over the next two years, the nutraceuticals category (which includes tinctures, capsules, gummy vitamins, etc.) can generate revenues of $2.4 bn. Uncertainty around the timing of this revenue ramp reflects a lack of clarity on how quickly retailers, in particular mass market retailers, will begin to stock the products following the passage of the 2018 Farm Bill.

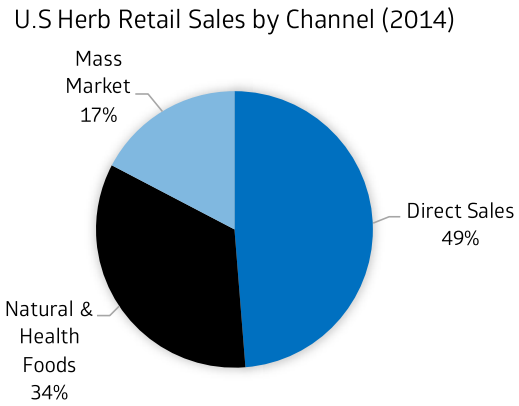
Figure 28 We Estimate CBD Nutraceuticals Can Generate ~$2.4 BN in Sales Going Forward



Source: Cowen and Company

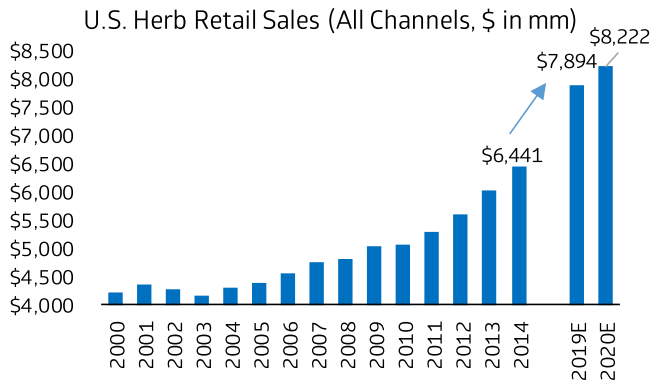
Our $2.4 bn estimate is benchmarked against the herbal supplement market in the U.S. According to the American Botanical Council, herbal supplement retail sales were $6.4 bn in 2014, posting the 11th year of consecutive growth. Between 2004-2014, the herbal supplement category grew its revenues at a ~4.2% CAGR. Extrapolating that growth out to 2019 would imply a total herbal supplement market of ~$8 bn over the next two years. Our $2.4 bn estimate for the CBD market would imply almost a 30% share of this market by 2020. The importance of retail adoption is reflected in the category makeup of the herbal supplement market, where we can see that over 17% of sales come from mass market retailers.

Figure 29 Mass Market Makes Up ~17% of Herb Retail Sales



Source: American Botanical Council and Cowen and Company

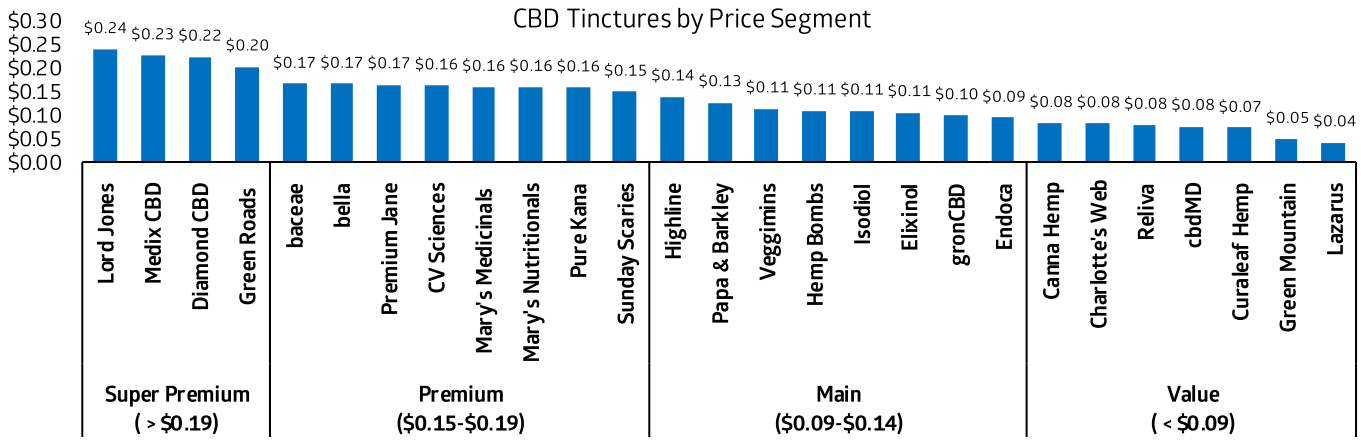
Figure 30 Herb Retail Sales To Exceed ~$8 BN Assuming 4.2% CAGR



Source: American Botanical Council and Cowen and Company

Tinctures are the market leading form factor within CBD, which is reflected in the absolute number of companies that play across different price segments. On a price / mg CBD basis, Lord Jones leads the pack on premium pricing, with its tincture priced at $0.24 per mg of CBD. Lazarus falls at the opposite end of the price spectrum at $0.04 per mg of CBD. The vast number of price points throughout this segment reflects an abundance of choice for the consumer, providing options for all income cohorts.

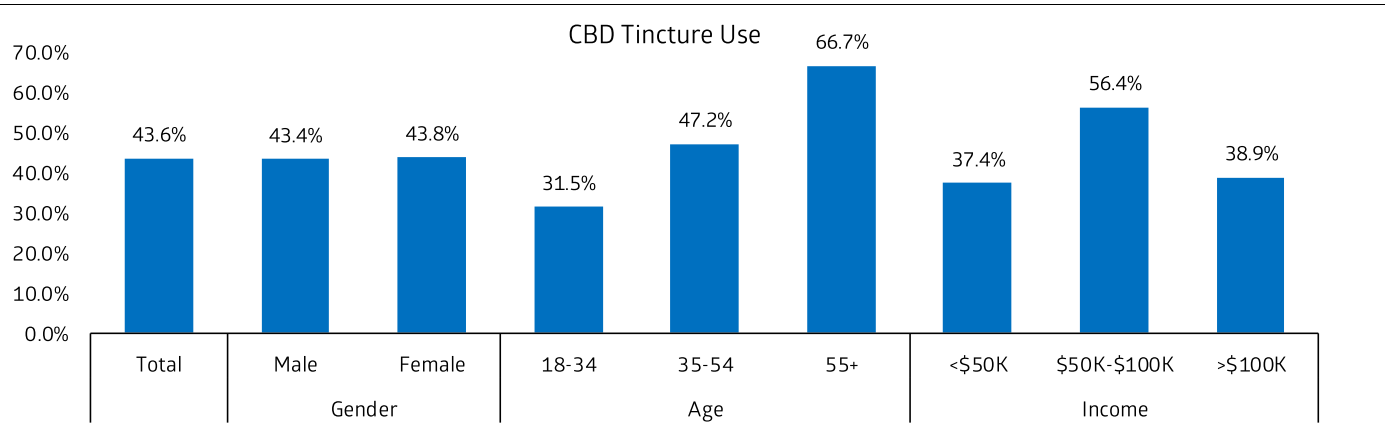
Figure 31 Notable Competition Within Tinctures Segment



Source: Company Websites and Cowen and Company
Note: Reflects price per mg of CBD; For companies with multiple SKUs, we used a straight line average

In our consumer survey, of respondents who use CBD, 44% of people use tinctures as a form factor, which looks to be equally popular among both male and females. Interestingly, tincture use looks to be the most prevalent form factor among older consumers, as two-thirds of respondents within this cohort indicated use of a tincture. Tinctures look to be the most popular form factor across all income demographics, with over 50% of people using within the $50K-$100K segment.

Figure 32 Tinctures Are The Most Popular Form Factor



Source: Cowen Survey, N=~2500, January 2019

Figure 33 Lord Jones Price Point Reflects Premium Positioning

Source: Company Reports

Figure 34 CV's Plus CBD Oil Competitively Positioned Within Premium

Source: Company Website

Figure 35 Papa & Barkley Currently Offer Tinctures Only

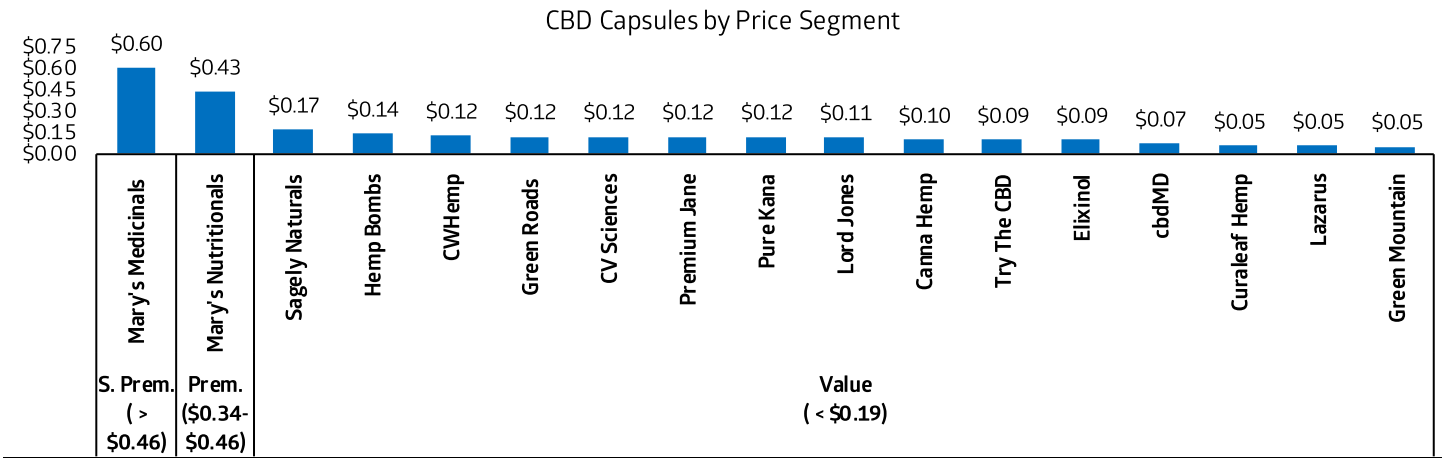
Source: Company Website

Figure 36 Reliva Tinctures Compete On Value

Source: Company Website

Along with tinctures, capsules represent one of the more mature form factors within CBD. Mary's looks to be squarely positioned as the most premium brand across all companies analyzed, in particular for their Elite capsule line, which offers 150 mgs of CBD and retails for $90. For context, the closest price point to Mary's comes from Sagely Naturals at $0.17 per mg. Brands look to be very competitively priced in terms of value, with seven of the brands coming in at $0.10 or below.

Figure 37 Capsules Competitively Priced On Value

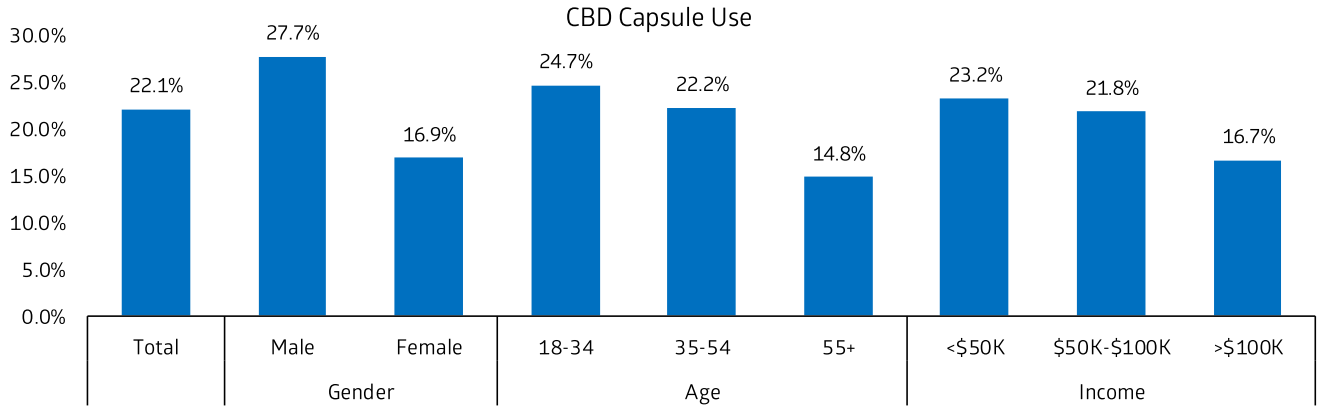


Source: Company Websites and Cowen and Company

Note: Reflects price per mg of CBD; For companies with multiple SKUs, we used a straight line average

Utilizing our proprietary consumer survey, CBD capsule use looks to over-index with males, which shows over a 10 pt delta relative to women. In addition, on a relative basis to other form factors, CBD capsule use is more popular with younger, lower-income consumers, which perhaps explains the notable competition seen within the value segment.

Figure 38 Capsule CBD Use Over-Indexes To Males And Skews Younger And Lower Income



Source: Cowen Survey, N=~2500, January 2019)

Figure 39 Mary's Capsules Are Priced At A Premium

Source: Company Reports

Figure 40 CWeb is One Of The More Well Known CBD Capsule Providers

Source: Company Website

Figure 41 Elixinol Offers Differentiated Packaging

Source: Company Reports

Figure 42 Lazarus Competes At The Low-End of Value

Source: Company Website

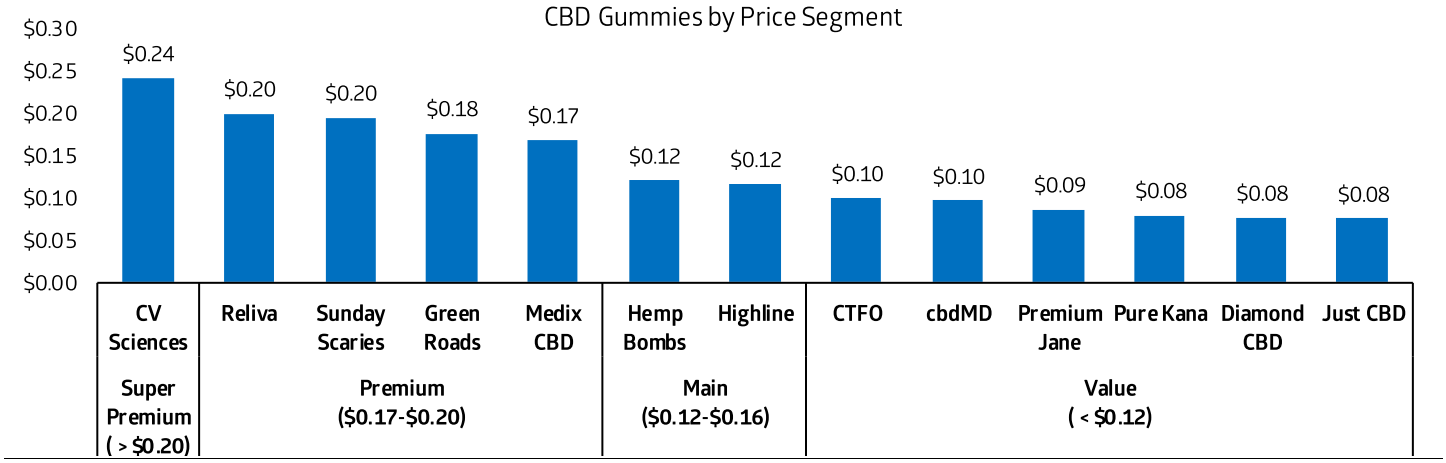
For gummies, we analyzed 30 SKUs across 13 brands. Our analysis shows that CV Sciences' CBD Oil Gummies are the most premium priced at an average $0.24 per mg of CBD. CV Sciences offers two SKUs with their 30 capsule bottle providing 150 mgs of CBD for $39.95, while their second SKU offers a slightly better value proposition, with a 60 count bottle providing 300 mgs of CBD for $64.95 ($0.22 per mg).

Hemp Bombs had the largest number of SKU's relative to the other brands analyzed (7), while also having the highest absolute price point ($139.99 for a 60 gummy bottle with 1,500 mgs of CBD), though the average price per mg of CBD positioned the brand within the main segment.

Similar to its tincture offering, we would note that Highline falls broadly in the middle of its peers, as their direct-to-consumer business model allows the company to offer competitive pricing across its portfolio.

Almost half of the brands analyzed fell into the value segment, all priced at $0.10 per mg of CBD or lower. Across all 30 SKUs, average retail price was ~$50 per offering, with an average 450 mgs of CBD offered per bottle.

Figure 43 Almost Half Of The Brands Analyzed Fall Into The Value Segment



Source: Company Websites and Cowen and Company

Note: Reflects price per mg of CBD; For companies with multiple SKUs, we used a straight line average

Figure 44 CV Sciences Gummies Are Priced At A Premium

Source: Company Website

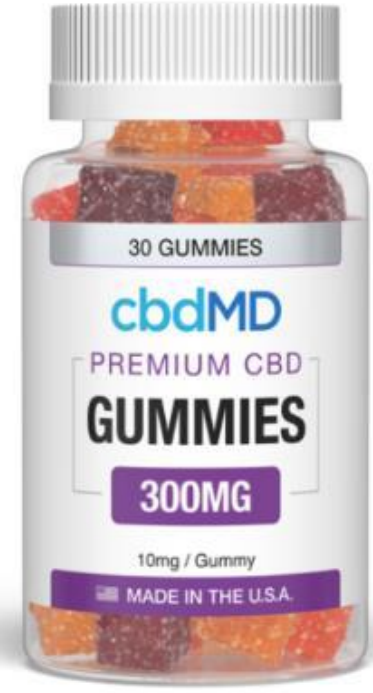
Figure 45 Green Roads' 300 MG Gummies Retail For $55

Source: Company Website

Figure 46 Highline Is Priced Competitively

Source: Company Website

Figure 47 cbdMD Offers Two 30 Count SKUs (300 mgs and 750 mgs)



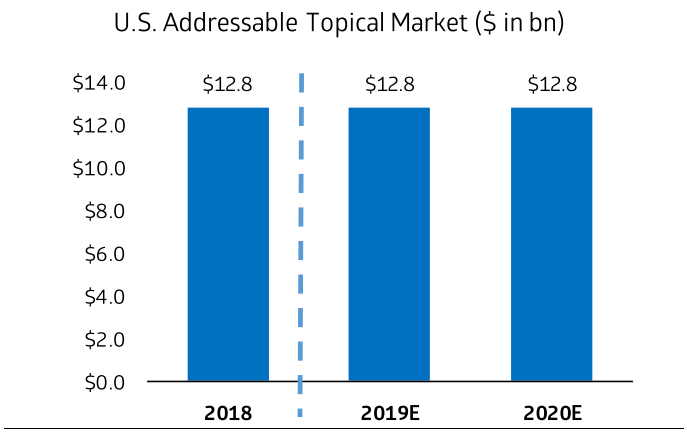
Source: Company Website

Topicals

Outside of nutraceuticals, we expect the topical CBD market to provide the largest contribution to industry sales. We believe the non-ingestible nature of the product makes it more attractive to consumers looking to experiment in CBD and can provide a source of trial into the category. While the CBD market clearly needs more clinical research into the benefits of the cannabinoid, it has been suggested that two of the primary benefits are anti-inflammation and muscle recovery, which can cater to a large and diverse consumer base.

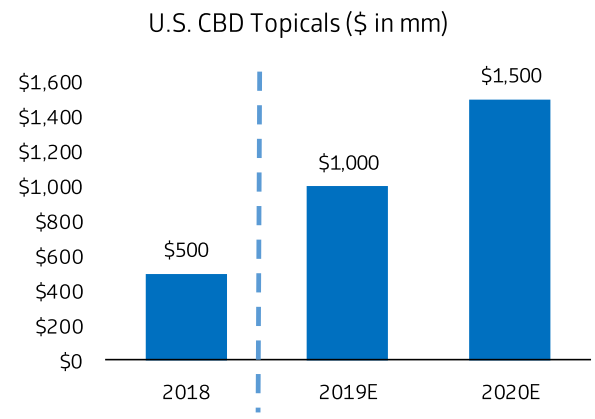
Over the next two years, we expect the topical CBD market to grow to $1.5 bn (almost $1 bn less than our outlook for nutraceuticals). We estimate that in 2018, the total addressable U.S. topical market, which includes both OTC and rx offerings was ~$12.8 bn. If we assume no growth in the category base, a $1.5 bn CBD category by 2020 would imply a ~12% share of the market, the largest market share among all of the categories analyzed, excluding nutraceuticals.

Figure 48 U.S. Topical Category Generates ~$13 BN In Revenue



Source: Company Reports and Cowen and Company

Figure 49 We Believe CBD Topicals Could Be A $1.5 BN Market in 2 Years



Source: Cowen and Company

Our below scenario analysis provides a wider incremental range of market share outcomes relative to other categories. We can see that every 5 pts of market share capture is worth over $600 mm in revenues. While our analysis contemplates a 2% share of the topical market, we believe that this is unlikely and view the floor at ~7%, which would imply almost $900 mm in revenues by 2020. Given the number of companies providing topical solutions, coupled with what we expect to be robust consumer demand, a market share between 12-17% is not unrealistic.

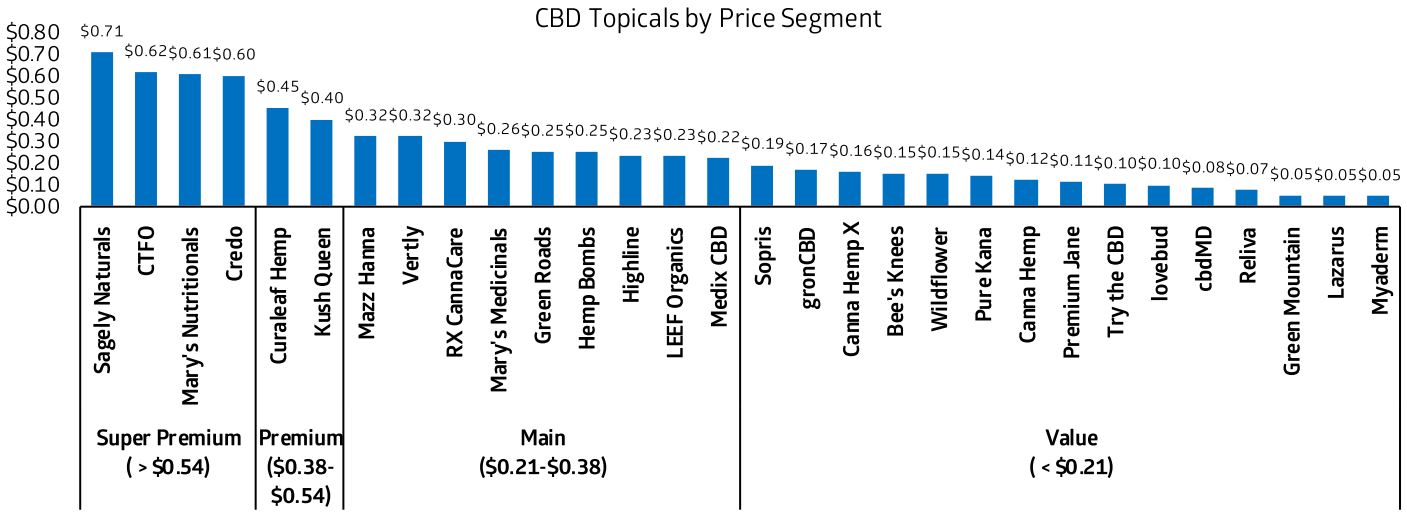
Figure 50 Topicals Expected To Be a Major Contributor to CBD

2020 Market Share Scenario Analysis					
Market Share	2%	7%	12%	17%	22%
Absolute Sales ($ in mm)	$220	$860	$1,500	$2,140	$2,780

Source: Cowen and Company

Benchmarking across the topical market, we would highlight the absolute number of brands offering a product, which while not exhaustive, provides context on the popularity of the form factor. Similar to most other verticals, Mary's topicals fall into the super-premium segment, which we define as anything above $0.54 per mg of CBD. Of all the SKUs analyzed, the premium segment looks to be the narrowest, while mainstream and value segments are the most popular price point among the competitive set.

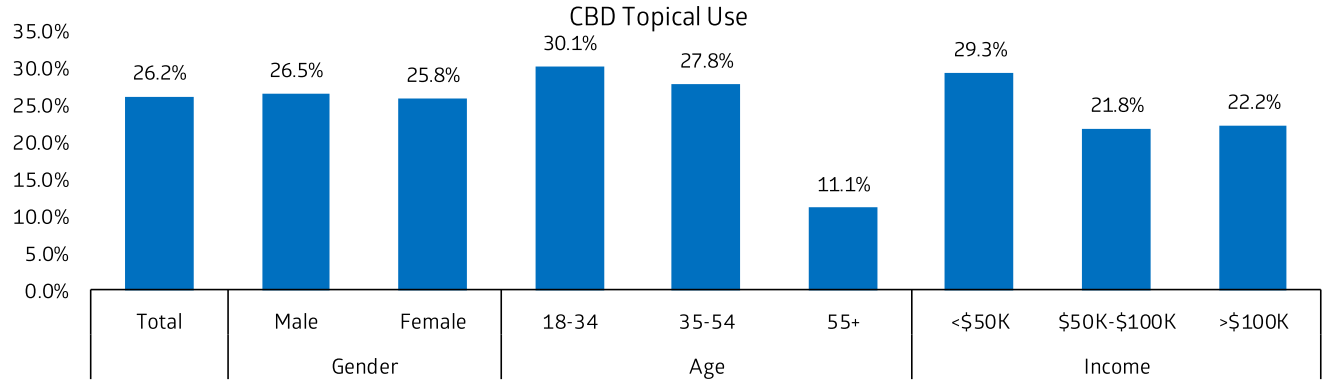
Figure 51 Popularity in Topicals Are Reflected In The Overall Number Of Brands Playing Within The Segment



Source: Company Websites and Cowen and Company
Note: Reflects price per mg of CBD; For companies with multiple SKUs, we used a straight line average

According to our proprietary Cowen consumer survey, of respondents who use CBD, 26.2% of people use topicals as a form factor, which is the highest level seen after tinctures. Usage among men and women look to be similar, though younger, lower income use looks to be more prevalent when benchmarking to older, higher income cohorts. Similar to capsules, this could reflect the large number of brands we see playing in the value segment.

Figure 52 Topical Use Is More Prevalent Among Younger, Lower Income Consumers



Source: Cowen Survey, N=~2500, January 2019

Figure 53 Mary's Provides A Range Of Topicals, Including Muscle Freeze

Source: Company Report

Figure 54 Curaleaf Hemp Lotion Priced On The Premium Side

Source: Company Website

Figure 55 Highline Positioned Within Mainstream

Source: Company Website

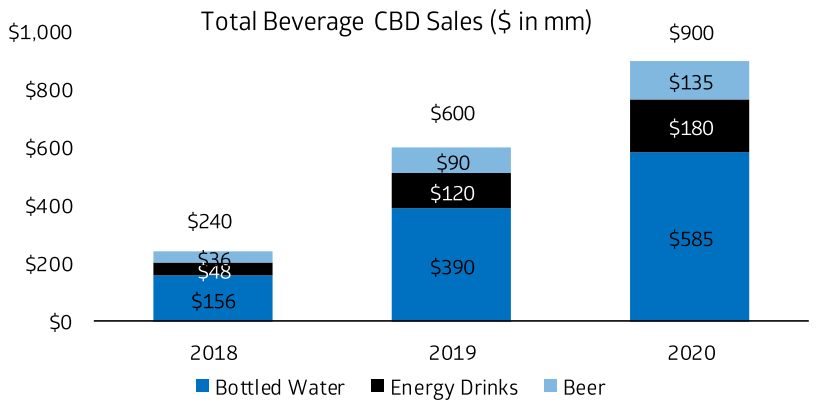
Figure 56 Reliva's Pain Cream Retails For $19.99

Source: Company Website

Beverages

Over the next two years, we believe that the beverage category can grow to a $900 mm revenue opportunity. Our conviction in this category is underscored by our proprietary consumer survey, which shows that almost 20% of CBD users consume beverages, which we view as an encouraging sign. For 2019, we are forecasting a notable acceleration in growth, with revenues more than doubling to $600 mm. Assuming growth moderates in 2020 (to 50%), we believe revenues will approach the $1 bn mark.

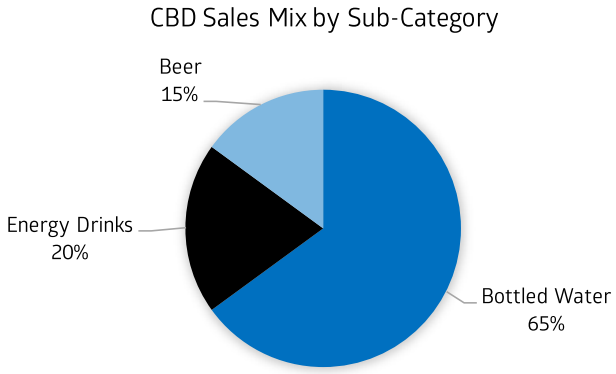
Figure 57 Sales for Beverages Can Approach $1 BN Over the Next Two Years



Source: Cowen and Company

Below we provide a sub-segment build by category, where we believe CBD water will represent the lion's share of sales at 65%. Energy drinks have been focused on health and wellness and we believe that CBD-infused energy drinks will represent a niche segment in a category that continues to see more competition. We expect CBD beer to have a place in the category, though should admittedly be smaller in scale, given less interest from a lack of THC.

Figure 58 CBD Water Should Have An Outsized Contribution On Category Sales



Source: Cowen and Company

Bottled Water

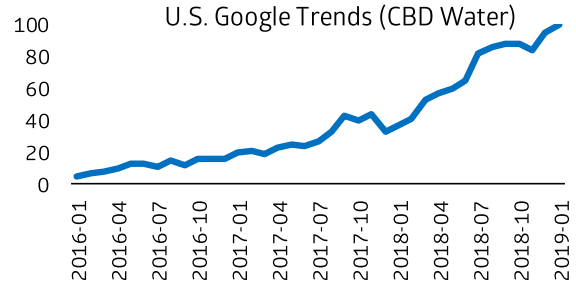
Consumer interest in CBD continues to gain momentum. For beverages, in particular water, this is evidenced by analyzing current Google Trends, where interest rose considerably over the course of 2018 and looks to still be achieving new highs, which is not surprising, given the recent passage of the U.S. Farm Bill.

Figure 59 Bottled Water Should Be The Most Popular CBD Beverage

2020 Market Share Scenario Analysis							
Market Share	0.6%	1.1%	1.6%	2.1%	2.6%	3.1%	3.6%
Absolute Sales ($ in mm)	$159	$301	$443	$585	$727	$869	$1,011

Source: Cowen and Company

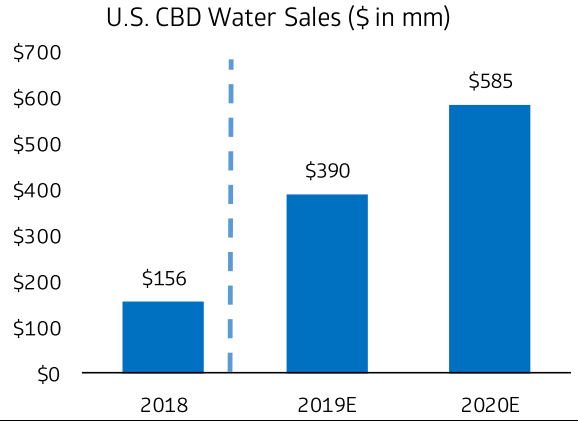
Figure 60 Increasing Interest Reflected In Google Search Trends



Source: Google Trends and Cowen and Company

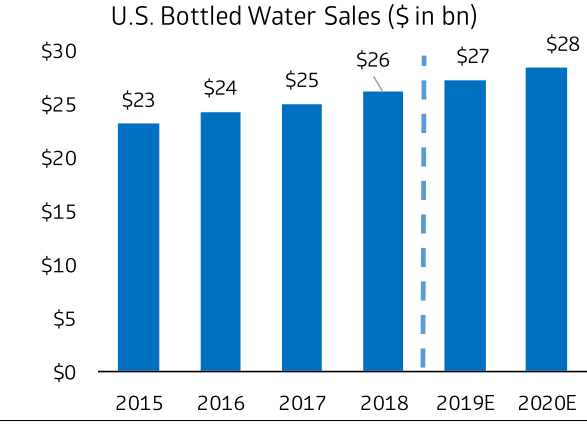
Over the next 2 years we believe that the U.S. CBD water category can generate close to $600 mm in revenues. In Nielsen, U.S. bottled water generated just over $13 bn in 2018. Assuming Nielsen channels account for 50% coverage of the category implies total revenues of over $26 bn. Applying the 4.2% CAGR the category has grown over the last 3 years and extrapolating out results in total revenue surpassing $28 bn by 2020. Our estimates are premised on CBD water achieving a ~1.5% market share in 2019 and a conservative ~2% market share of the U.S. bottled water category in 2020. We would note that a ~2% share of the bottled water category compares to a ~3% share for coconut water. With the amount of consumer interest and potential functional benefits that come along with CBD, we believe that a modest 2% share of the category is reasonable, in particular if multiple larger players within the beverage space enter the category and drive distribution. Above, we provide a scenario analysis on the revenue opportunity assuming different market share levels.

Figure 61 A 2% Share Implies Over $500 MM In Revenues



Source: Cowen and Company

Figure 62 Bottled Water Category Growth Remains Healthy



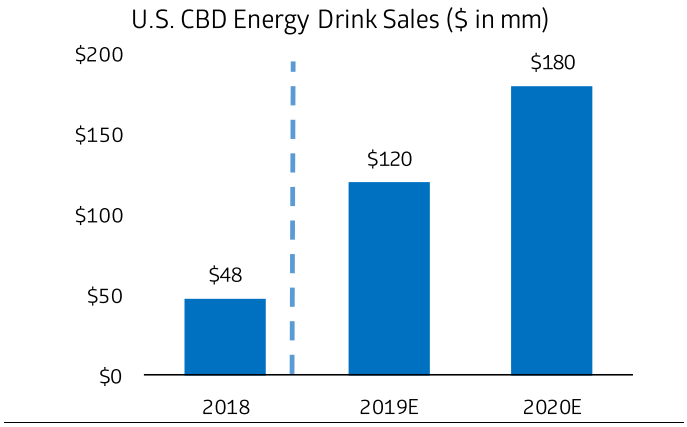
Source: The Nielsen Company and Cowen and Company
Note: Assumes 50% coverage in Nielsen

Energy Drinks

Energy is another beverage category that we feel is ripe for CBD inclusion, as it continues to expand towards health and wellness propositions. This has been reflected in consistent strong growth from MNST's Ultra line, which offers functional benefits without the sugar, Muscle Monster, which is high in protein, as well as the emergence of Bang, which contains BCAA. At their recent Analyst Day, MNST indicated that they will be launching a new product called Reign, which will offer 5x the amount of BCAA as Bang. As the lines between core energy drinks and health and wellness offerings continue to blur, we would expect all of the major players to come to market with offerings that contain CBD and provide incremental functional benefits (such as muscle recovery).

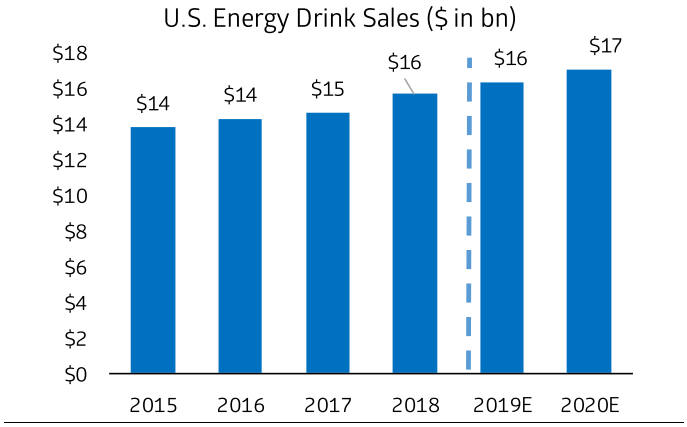
We believe that by 2020 it is reasonable for CBD's share of the energy category to reach ~1%, which we view as conservative as it is below the current market share run rate that Bang has already been able to achieve. A 1% share would imply revenues of ~$180 mm for the CBD segment, assuming that the category continues to grow at the same 4.3% CAGR it has delivered over the past three years. We can see below that implied category revenues for total energy would grow by over $1 bn over the next two years to ~$17 bn.

Figure 63 Almost $200 MM In Revenues Assuming 1% Share By 2020



Source: Cowen and Company

Figure 64 Extrapolating 4.3% CAGR Results In Category Revenues Surpassing $17 BN In 2 Years



Source: The Nielsen Company and Cowen and Company
Note: Assumes 75% coverage in Nielsen

Below we provide a scenario analysis on CBD energy revenues associated with market share gains. We would note that a 0.3% share by 2020 would be at the low-end of our expectations and result in revenues of ~$50 mm. As a point of reference, recall that Mutant, which did not perform to expectations and has essentially been de-prioritized by MNST, has a current market share of ~0.2%.

Figure 65 Blurred Lines Between Core Energy And H&W Make CBD Ripe For Entry Into Category

2020 Market Share Scenario Analysis							
Market Share	0.3%	0.6%	0.8%	1.1%	1.3%	1.6%	1.8%
Absolute Sales ($ in mm)	$52	$95	$137	$180	$223	$265	$308

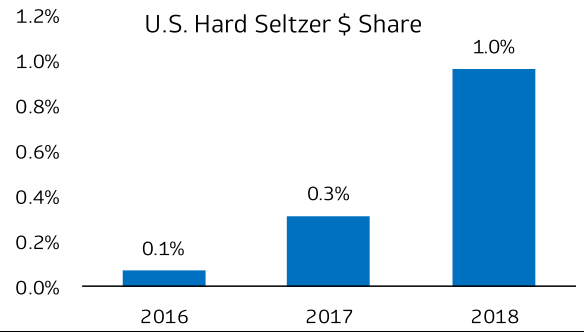
Source: Cowen and Company

Beer

We believe CBD infused beer can serve as a niche segment in a rapidly evolving beer category. With core beer under pressure, a continued theme from the key manufacturers within the space has been a focus on innovation, as well as a move away from alcohol into low and no-alcohol offerings (ABI is targeting 20% of portfolio to be low / no alcohol by 2025).

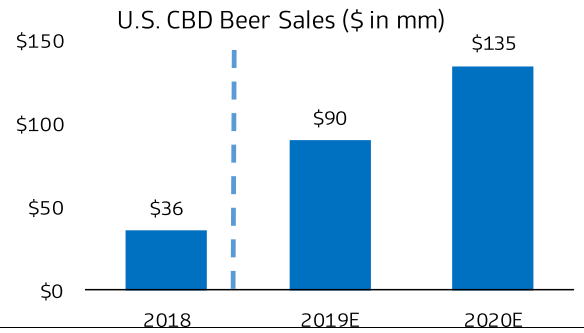
On the innovation front, hard seltzer looks to be resonating with consumers, which we believe is sticky, as it offers consumers a new product and opportunity to drive incremental drinking occasions, while checking the box from a health and wellness standpoint. In 2018, the hard seltzer category achieved a 1% market share of the combined beer category, which includes, core beer, cider and FMBs. If we assume that CBD-infused beer is able to capture a modest fifth of that amount of share by 2020 (~20 bps), that could result in a revenue opportunity of over $130 mm. We have been hearing growing interest in companies looking to combine CBD in alcoholic beer to offer potential hangover relief.

Figure 66 Hard Seltzer Achieved A 1% Dollar Share In 2018



Source: The Nielsen Company and Cowen and Company

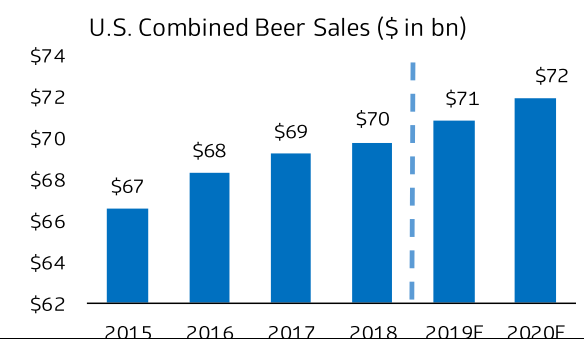
Figure 67 Assuming ~20 Bps Of Share For CBD Beer = $135 MM



Source: Cowen and Company

These estimates are benchmarked to a category that has grown sales at a 1.6% CAGR over the past three years. If we assume Nielsen provides 50% coverage of the total category and extrapolate that growth out, total off-premise revenues should approach $72 bn by 2020. We provide a sensitivity analysis below on the 2020 revenue opportunity based on different levels of market share capture. We estimate every 5 bps of share is worth $36 mm.

Figure 68 1.6% Growth Should Result In Category Revs Of ~$72 BN



Source: The Nielsen Company and Cowen and Company
Note: Assumes 50% coverage in Nielsen; off-premise sales only

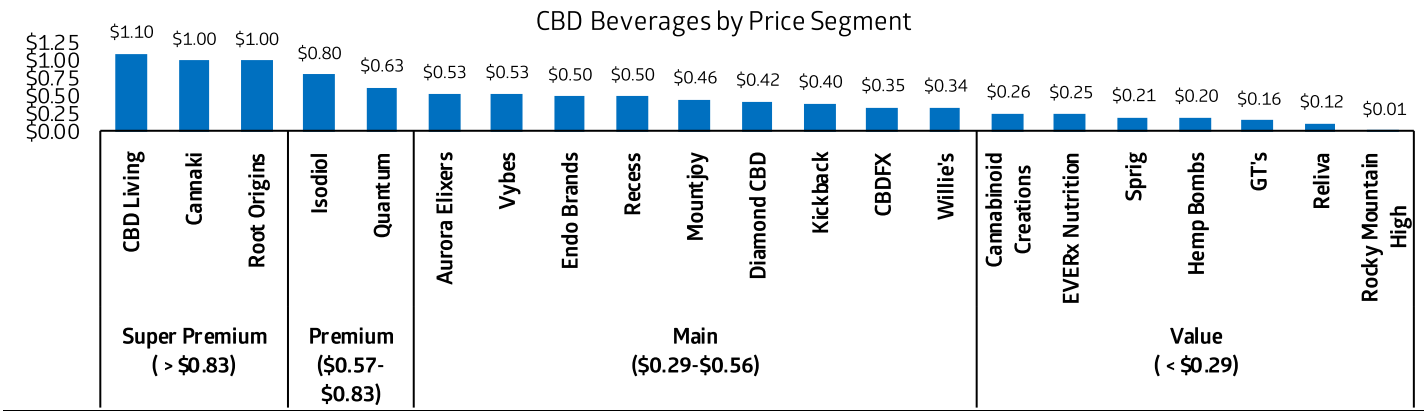
Figure 69 Each 5 bps Of Share Is Worth $36 MM In Revenue

2020 Market Share Scenario Analysis					
Market Share	0.09%	0.14%	0.19%	0.24%	0.29%
Absolute Sales ($ in mm)	$63	$99	$135	$171	$207

Source: Cowen and Company

There are a solid amount of beverage companies currently playing within the space, largely price positioned within the mainstream and value segments of the market. We would highlight that on a price per mg basis, beverages skew higher across the board, relative to tinctures, capsules and gummies.

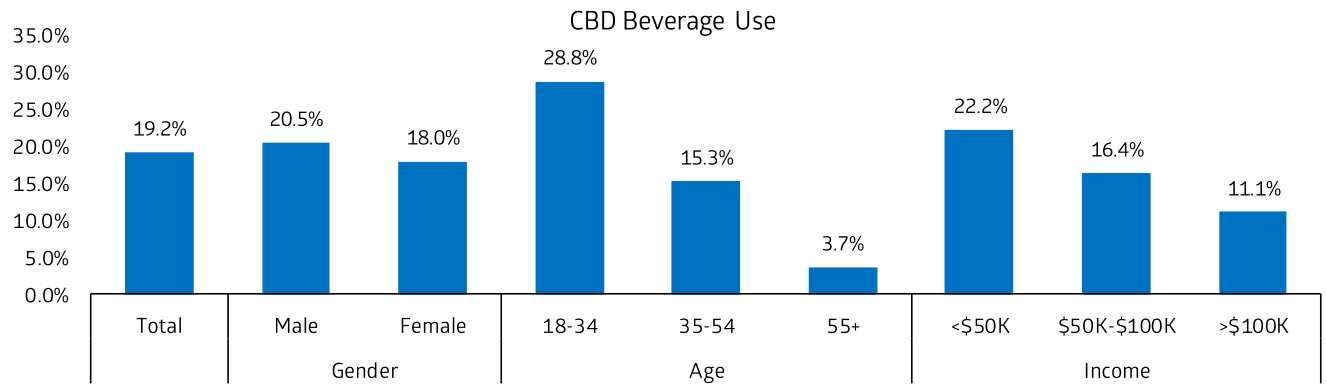
Figure 70 Beverage Price Points Are Premium Relative To Tinctures, Capsules, Gummies, And Topicals



Source: Company Websites and Cowen and Company
Note: Reflects price per mg of CBD; For companies with multiple SKUs, we used a straight line average

Based on our survey, of respondents that use CBD, 19.2% use beverages as a form factor, which is admittedly higher than we would've expected given the nascent stage of the category. Similar to both capsules and topicals, beverage use is a more popular choice among younger, lower income consumers (by a wider margin relative to other age cohorts compared to the other categories). This leaves us optimistic on the future prospects of the category as a waterfall effect can result in an increase in category mix.

Figure 71 Popularity Among Younger Consumers Can Result In A Waterfall Effect Over Time



Source: Cowen Survey, n=~2500, January 2019

Figure 72 Recess Offers Impressive Packaging

Source: Company Reports

Figure 73 Sprig Offers A Variety Of Flavor Options

Source: Company Website

Figure 74 Shots May Overlap with Energy Over Time

Source: Company Website

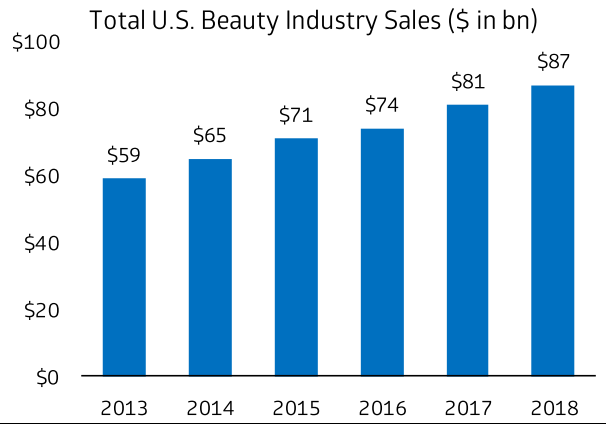
Figure 75 Willie's Recently Came to Market with a Coffee

Source: Company Website

Beauty

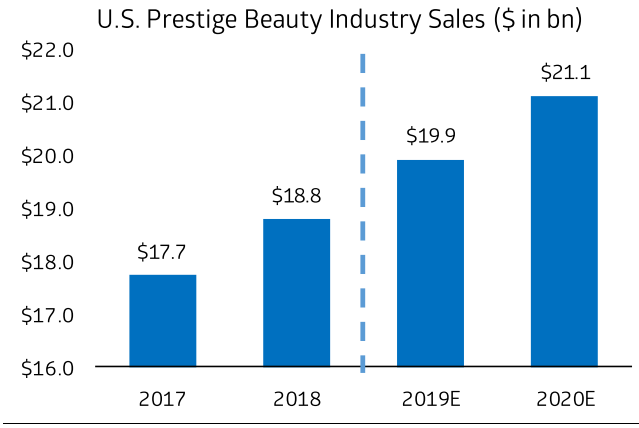
The U.S. beauty category, which is inclusive of skin care, cosmetics, haircare, fragrance, bath & body, salon styling tools, and other toiletries, is a ~$87 bn industry according to Euromonitor International and IBIS World Inc. Within mass beauty, the prestige segment grew 6%, accounting for almost $19 bn in revenue in 2018 according to NPD. If we extrapolate the 6% growth in prestige beauty out through 2020, that would result in segment revenues surpassing $21 bn over the next two years.

Figure 76 Total U.S. Beauty Is A ~$87 BN Industry



Source: Company Reports and Cowen and Company

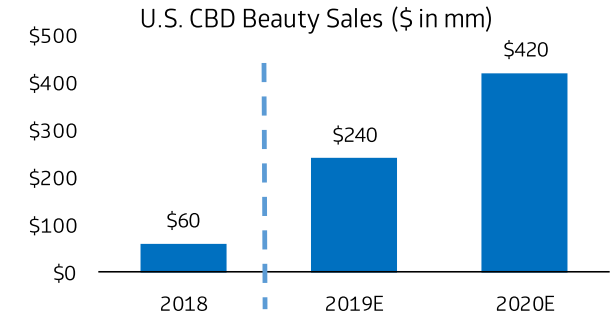
Figure 77 Prestige Can Grow To Over $21 BN By 2020



Source: NPD and Cowen and Company

We expect that CBD beauty will become more of a focus for consumers, as large-scale manufacturers and retailers begin to roll out more products, which will presumably generate positive mix and result in a step-change in market share capture. As such, we believe that a ~1% share of the prestige market is achievable in 2019, doubling to 2% in 2020, which would equate to over $400 mm in sales. The below analysis provides a scenario of revenue outcomes based on share capture, ranging from ~$200 mm to over $600 mm.

Figure 78 CBD Beauty Sales Can Surpass $400 MM By 2020



Source: Cowen and Company

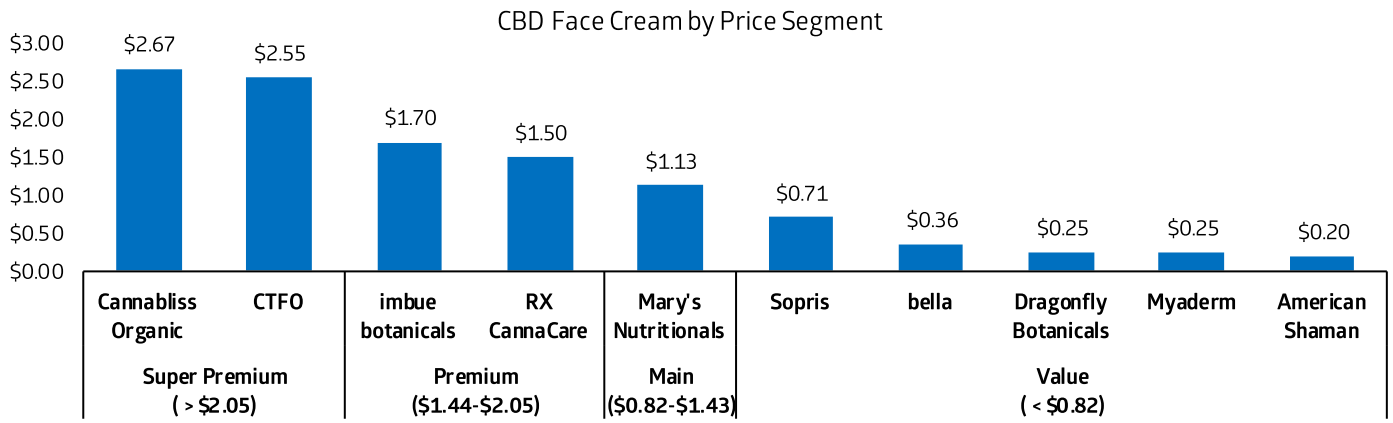
Figure 79 Each 50 bps Of Share Is Worth Over $100 MM In Revenue

2020 Market Share Scenario Analysis					
Market Share	1.0%	1.5%	2.0%	2.5%	3.0%
Absolute Sales ($ in mm)	$209	$314	$420	$526	$631

Source: Cowen and Company

Beauty products, and face treatments in particular, command price points notably above other form factors across the space, which will presumably offer by far the highest gross margins. Among high-end face creams, Cannabliss Organic and CTFO provide 30 mgs and 20 mgs of CBD respectively, while commanding price points ranging from $50-$80.

Figure 80 Beauty Facial Products Command Meaningfully Higher Price Points

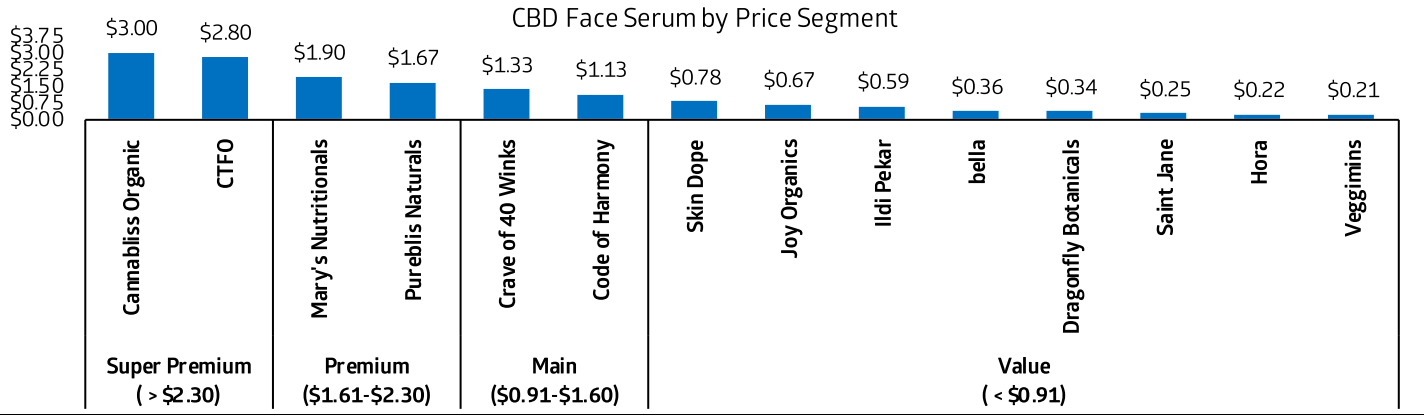


Source: Company Websites and Cowen and Company

Note: Reflects price per mg of CBD; For companies with multiple SKUs, we used a straight line average

Face serums look to be even more expensive across all segments, with price points from mainstream through super-premium ranging from over $1 to $3 per mg of CBD.

Figure 81 Face Serums Are The Most Expensive On A Price/MG Basis

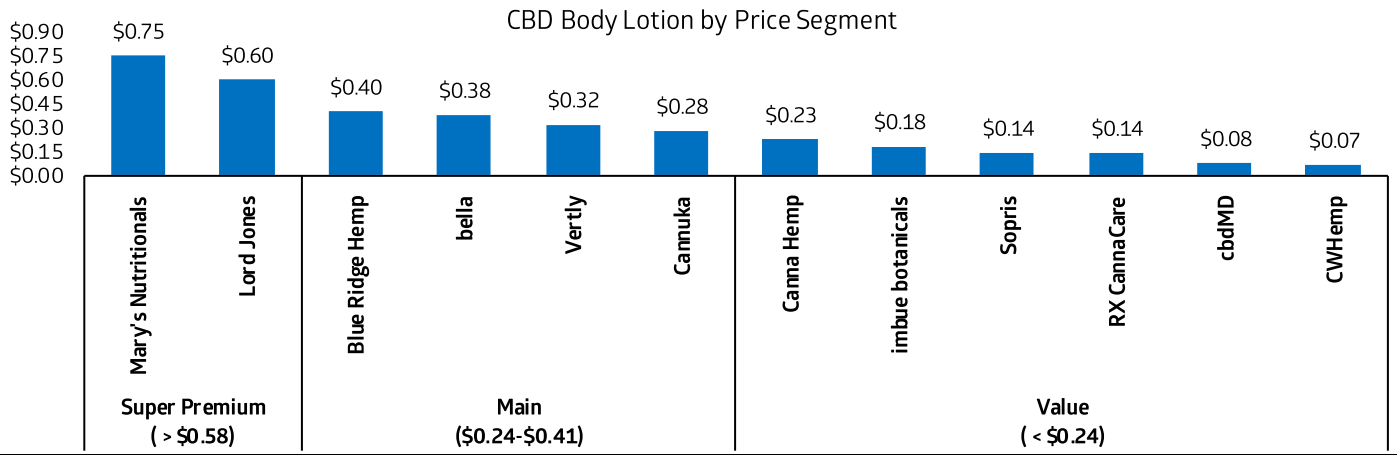


Source: Company Websites and Cowen and Company

Note: Reflects price per mg of CBD; For companies with multiple SKUs, we used a straight line average

Body lotions offer more value per mg of CBD, relative to facial beauty products, with Mary's and Lord Jones positioned at the high-end of the competitive set. To segment from the broad topicals market, we would note that we classified beauty creams as products offering soothing and moisturizing characteristics (as opposed to targeted pain relief).

Figure 82 Body Lotions More Moderately Priced Relative To Facial Beauty Products

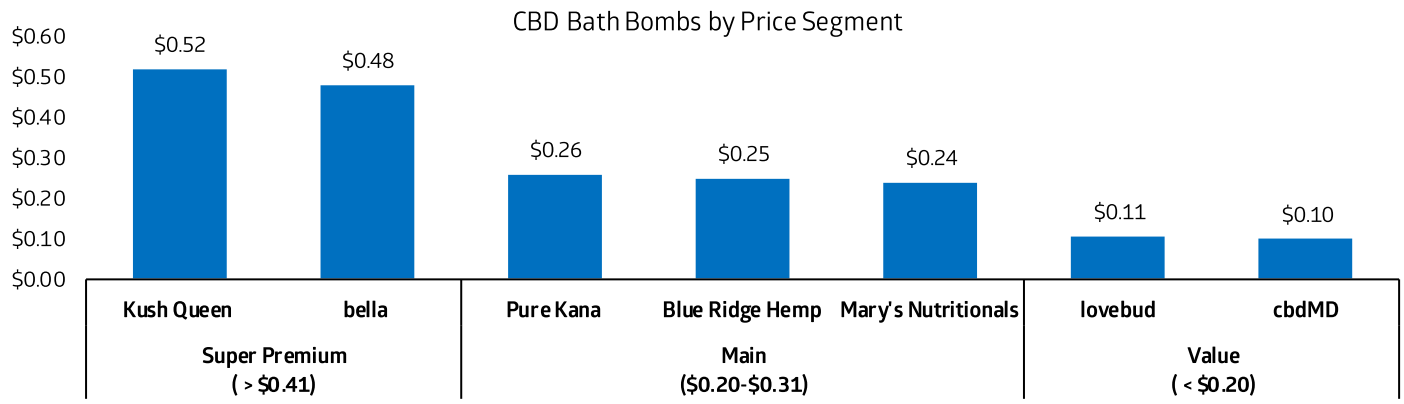


Source: Company Websites and Cowen and Company

Note: Reflects price per mg of CBD; For companies with multiple SKUs, we used a straight line average

Bath products are not surprisingly the most reasonably priced within beauty. We would note that cosmetics are still a niche category within CBD, which is reflected in the lower number of products and SKUs currently offered. That said, we believe the multiple sub-categories offering CBD products will appeal to a broad range of consumer demographics.

Figure 83 Bath Bombs Are A Niche Segment



Source: Company Websites and Cowen and Company

Note: Reflects price per mg of CBD; For companies with multiple SKUs, we used a straight line average

Figure 84 Mary's Offers Multiple Beauty Products

Source: Company Reports

Figure 85 Through its Recently Announced JV With Dixie Brands, Khiron Will Eventually Roll Out Its Kuida Line In The U.S.

Source: Company Website

Figure 86 Lord Jones Packaging Reflects Premium Nature Of The Brand

Source: Company Reports

Figure 87 In Addition To A Lotion, They Also Offer A Body Oil

Source: Company Reports

Figure 88 CWEB Offers Creams...

Source: Company Website

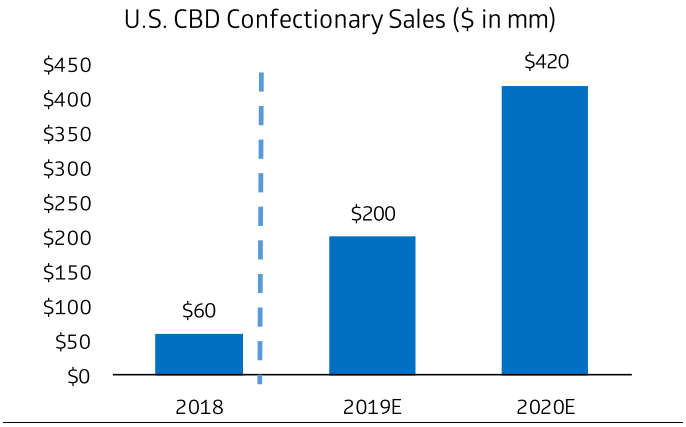
Figure 89 ...And Balms

Source: Company Website

Food (Confections)

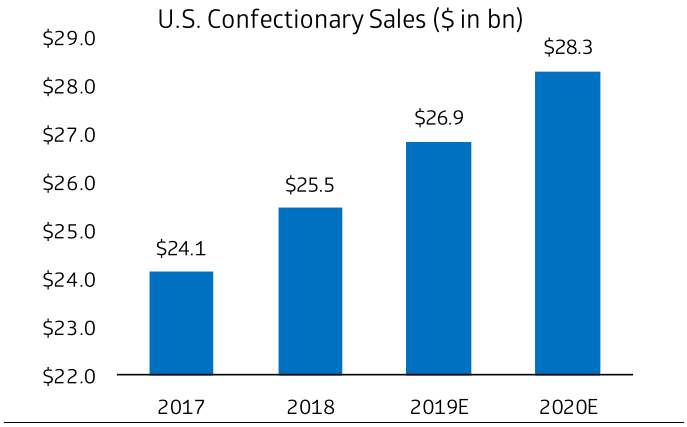
The food category, which we classify as confections, including gum drops, chocolates, baked goods, and bars, is expected to be one of the smaller revenue opportunities relative to nutraceuticals, topicals and beverages. That said by 2020, we believe the sales can surpass $400 mm, should the category increase its share of overall CBD to 7% by 2020. In the U.S., we estimate that the confection category (chocolate, non-chocolate and gum) grew to $25.5 bn in 2018, reflecting a 5.5% YoY growth rate. If we extrapolate that growth out over the next 2 years, the total implied confection market would surpass $28 bn. A $420 mm CBD food category would reflect just a 1.5% share of the total confectionary industry.

Figure 90 Confectionary CBD Sales Can Surpass 400 MM By 2020



Source: Cowen and Company

Figure 91 Extrapolating 5.5% Growth Results In Category Revenues Surpassing $28 BN In 2 Years



Source: IRI and Cowen and Company
Note: 2018 sales reflect latest 52 weeks ended 3/25/18

The below sensitivity contemplates the overall revenue opportunity based on CBD confections share of the overall category. While we believe a 1.5% share is reasonable and achievable, the revenue outcomes range from ~$100 mm to $700 mm based on the level of market share gains achieved over the next two years.

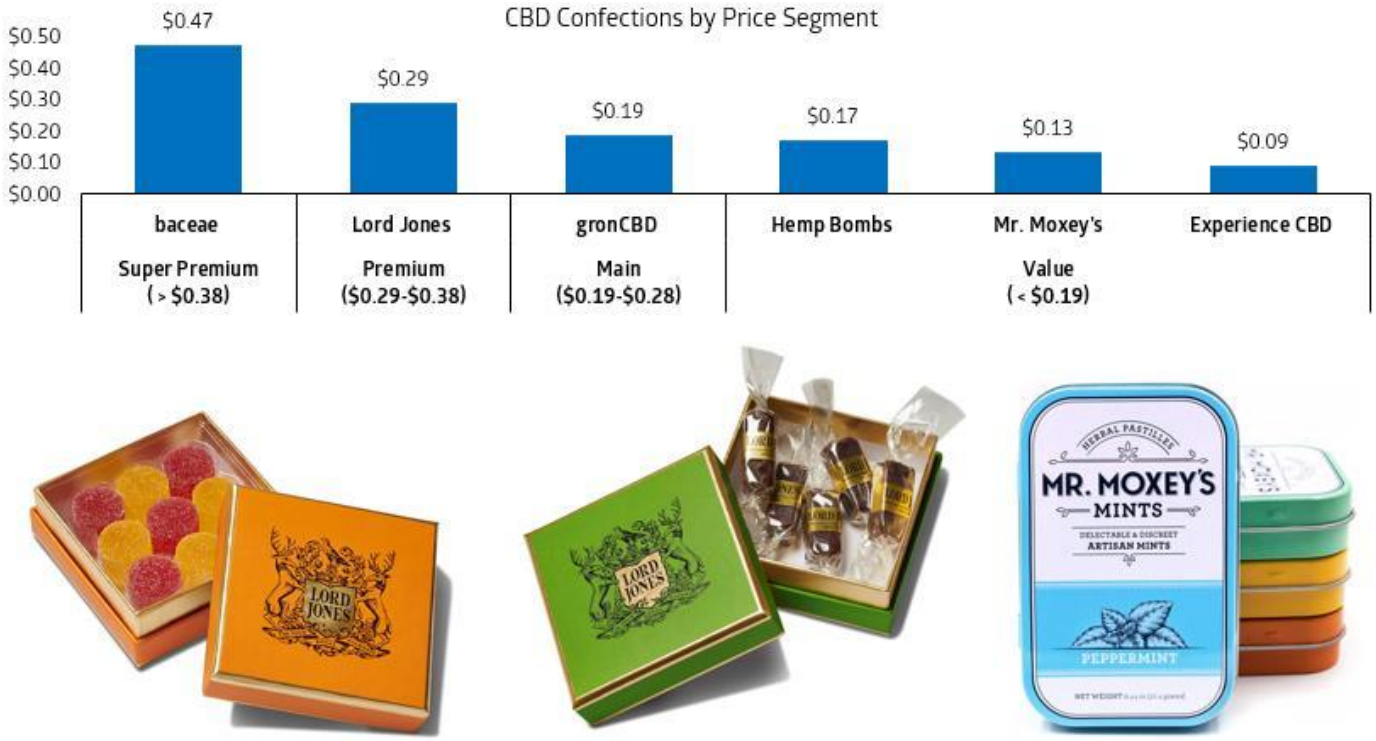
Figure 92 We Believe Sales Can Range From Over $100 MM To ~$700 MM Based On Level Of Share Capture

2020 Market Share Scenario Analysis					
Market Share	0.5%	1.0%	1.5%	2.0%	2.5%
Absolute Sales ($ in mm)	$137	$278	$420	$562	$703

Source: Cowen and Company

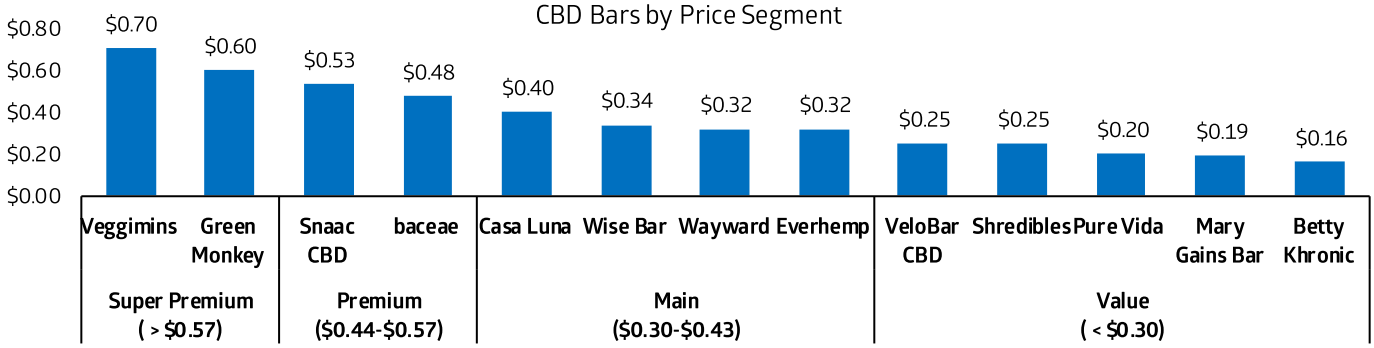
Confection products are diverse, which we classify as essentially any edible food falling outside of gummy vitamins. Of the brands analyzed, super-premium brand, beceae offered by far the most SKUs (15), which largely consist of chocolates and other baked goods. We would caveat that although Lord Jones products fall into the premium segment as part of this analysis, if we were to benchmark them against the broad gummies category, they would've been at the top of the super-premium range.

Figure 93 Confections Are Broad Based



Source: Company Websites/Reports and Cowen and Company
Note: Reflects price per mg of CBD; For companies with multiple SKUs, we used a straight line average

Figure 94 CBD Bars Broadly Comprised Of Protein, Power, Energy And Granola Offerings

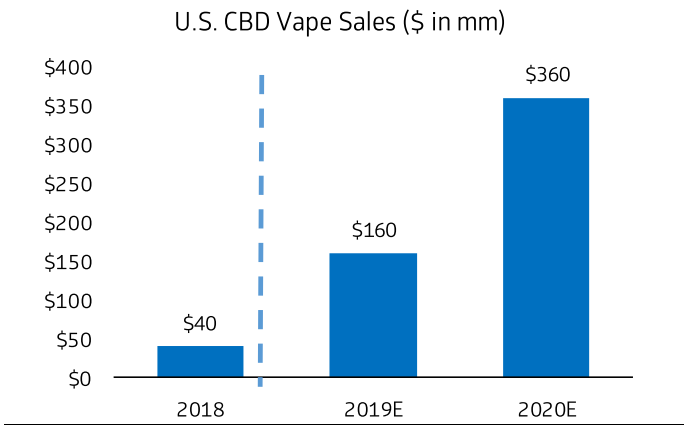


Source: Company Websites and Cowen and Company
Note: Reflects price per mg of CBD; For companies with multiple SKUs, we used a straight line average

Vapor

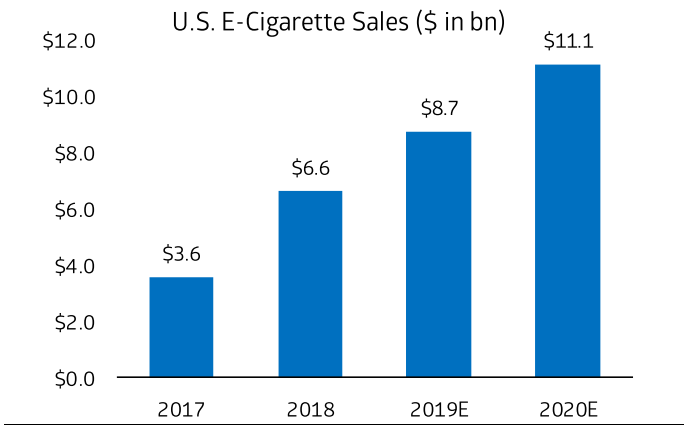
While vapor remains the major market share gainer across adult use cannabis, CBD only offerings are much smaller, but represent a solid growth segment. Over the next two years, we believe the category can generate over $350 mm in revenues, with upside if consumer adoption of this particular form factor resembles the adult use market for THC, or the growing popularity of nicotine vapor. We benchmark the market opportunity against the U.S. e-cigarette category, which we are forecasting to grow ~32% in 2019 and ~27% in 2020, resulting in revenues surpassing $11 bn in 2020. In addition to e-commerce, we believe there will be distribution channel overlap with e-cigs, with a focus on vape shops and convenience stores (as opposed to just dispensaries). If vapor generates $360 mm in revenues in 2020, that would result in an implied market share of 3.2%, roughly 10% of JUUL's current U.S. market share.

Figure 95 Vapor Will Be Smaller, But Can Grow To Almost $400 MM



Source: Cowen and Company

Figure 96 Our E-Cig Model Assumes Revenues Of ~$11 BN By 2020



Source: Cowen and Company

The below scenario analysis shows that every 50 bps of market share capture is worth ~$56 mm in revenues. While we are forecasting CBD vape to be ~3% of the market, we believe there is upside to these numbers and that strong consumer adoption can result in revenues surpassing $500 mm.

Figure 97 $360 MM In Revenue Implies A ~3% Share Of The Category

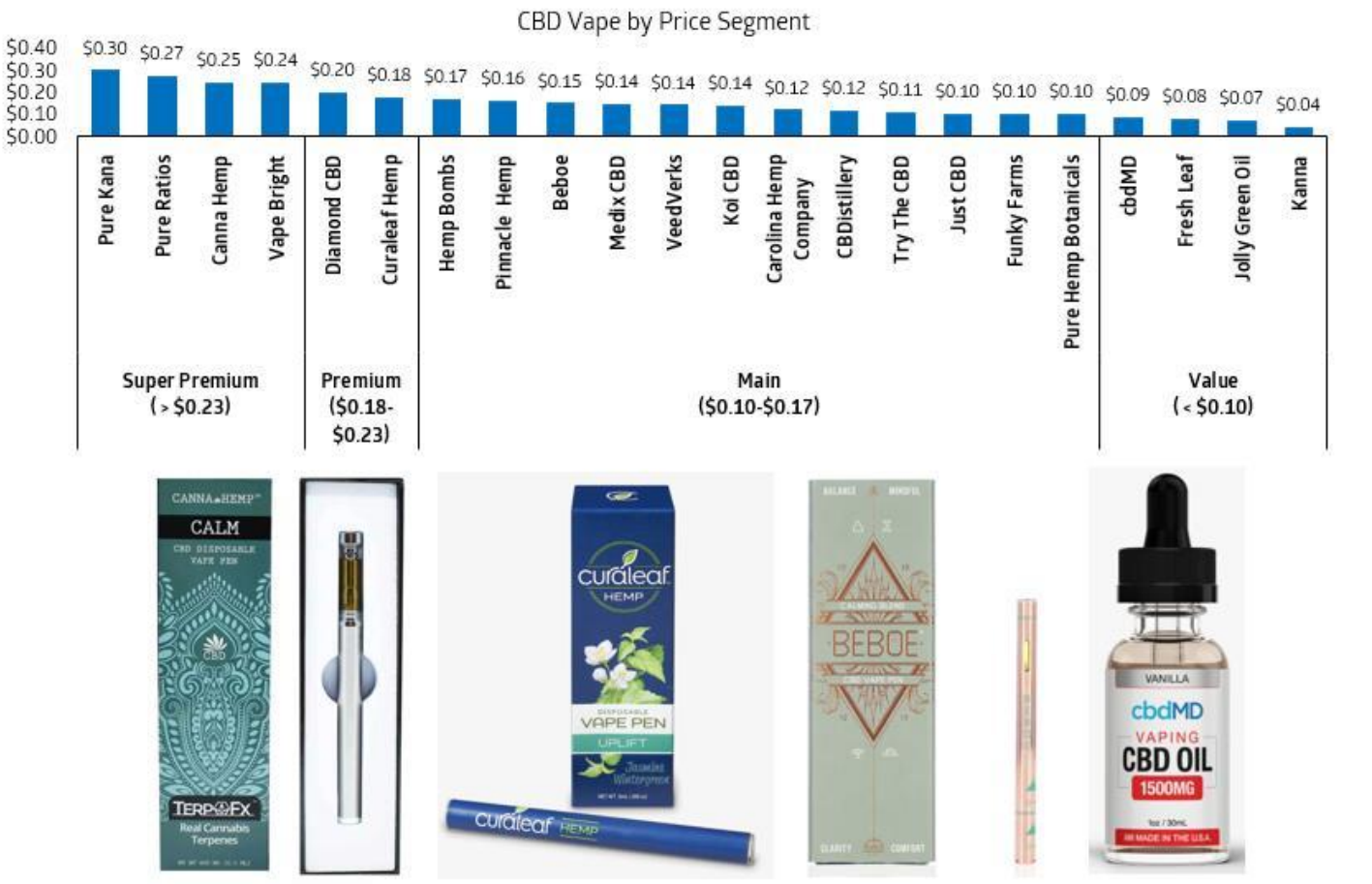
2020 Market Share Scenario Analysis							
Market Share	1.7%	2.2%	2.7%	3.2%	3.7%	4.2%	4.7%
Absolute Sales ($ in mm)	$193	$249	$304	$360	$416	$471	$527

Source: Cowen and Company

The below figure reflects the notable competition seen within vape as more companies continue to enter the space. In addition to CBD only-focused companies, we are starting to see crossover from adult-use / medical focused companies including Green Thumb Industries and Curaleaf Hemp. Indeed, GTI recently announced the acquisition of Beboe, which will offer a CBD vape pen with a focus on gaining distribution in high-end retail stores. Curaleaf will offer their pen through its e-commerce platform and dispensaries.

Notably, crossover does not pertain solely to cannabis companies, as Turning Point Brands recently announced a minority stake in CASH, a privately held CBD extraction and production company. With a rapidly growing vapor infrastructure in place already (from Vapor Beast, Vapor Shark and Vapor Supply), TPB has a number of avenues and distribution points, both B2B and B2C, to introduce CBD vapor products to complement its portfolio. As such, we look for new CBD product introductions from TPB over the next year, with vapor as a logical entry point and key focus area.

Figure 98 Competition Expected to Heat Up Across Vapor



Source: Company Websites and Cowen and Company
Note: Reflects price per mg of CBD; For companies with multiple SKUs, we used a straight line average

The below chart provides a condensed visual snapshot on company pricing in the preceding category discussions. We would highlight the broad number of categories that multiple emerging private companies are actively competing in, which is expected to increase as the category continues to gain momentum.

Below we provide company descriptions on some of the more notable public and private companies currently competing within the space.

Figure 99 Condensed Pricing Heat Matrix By Company And Category

CBD Price/MG Summary Matrix									
	Tinctures	Capsules	Gummies	Confections	Balm	Bath Bombs	Topicals	Vape	Beverages
baceae	$0.17			$0.47					
Beboe								$0.15	
Canna Hemp	$0.08	$0.10			$0.33		$0.12	$0.25	
Casa Luna									
cbdMD	$0.08	$0.07	$0.10			$0.10	$0.08	$0.09	
Charlotte's Web	$0.08								
CV Sciences	$0.16	$0.12	$0.24		$0.62				
Diamond CBD	$0.22		$0.08					$0.20	$0.42
Elixinol	$0.11	$0.09			$0.24				
Green Roads	$0.20	$0.12	$0.18				$0.25		
Hemp Bombs	$0.11	$0.14	$0.12	$0.17			$0.25	$0.17	$0.20
Highline							$0.23		
Lazarus	$0.04	$0.05			$0.05		$0.05		
Lord Jones	$0.24	$0.11		$0.29					
Mary's Medicinals	$0.16	$0.60			$0.50	$0.24	$0.26		
Mr. Moxey's				$0.13					
Papa & Barkley	$0.13								
Premium Jane	$0.17	$0.12	$0.09				$0.11		
Pure Kana	$0.16	$0.12	$0.08			$0.26	$0.14	$0.30	
Recess									$0.50
Reliva	$0.08		$0.20				$0.07		$0.12
Sprig									$0.21
Sunday Scaries	$0.15		$0.20						
Veggimins	$0.11								
Willie's									$0.34

Note: Blue highlight denotes higher price point, gray denotes lower price point. Balms and Bath Bombs for Mary's Medicinals represent Mary's Nutritionals.
Source: Company Websites and Cowen and Company

The CBD Competitive Landscape – Public/Private Company Discussions (Azer)

Publicly Traded Companies

1933 Industries. Publicly-traded 1933 Industries (CSE: TGIF; OTCQX: TGIFF) is a vertically integrated cannabis company with operations in both the U.S and Canada. 1933 operates through three subsidiary companies which includes Alternative Medicine Association (AMA), Infused MFG and Spire Global Strategy. AMA (91% ownership), is a licensed medical and adult use cannabis cultivation facility. Infused MFG (91% ownership) produces hemp-based CBD products and Spire Global Strategy (100% Ownership) is an advisory firm offering due diligence, security and intelligence services. The company was an early competitor having launched its first CBD brand in June 2017. The two main brands are Canna Hemp and Canna Fuze, which are distributed across 600 retail locations across the U.S. (largely focused on dispensaries), with 15% of sales coming from e-commerce. In 2018, 1933 delivered ~$12.6 mm in overall revenues, with a gross margin of 49%. Infused MFG specifically contributed 34% to revenues (~$4.3 mm), while achieving a gross margin of 71%.

Canopy Growth (Outperform, C$82 PT). Canopy Growth is a leader in global cannabis, with exposure to over a dozen countries spanning five continents. As the market share leader in the nascent adult use market in Canada, WEED generated sales of $83 mm in its most recent quarter. In addition, WEED was the first Canadian licensed producer to partner with a major consumer packaged goods company. In October 2017, they announced the initial relationship with Constellation Brands, which was meaningfully expanded with a $4 bn investment announced in August 2018. The company has announced its intention to invest $100-$150 mm in New York State (where STZ is headquartered), to construct a hemp industrial park focused on extraction and product manufacturing. More recently, management has noted a willingness to invest as much as $500 mm against U.S. CBD with the expectation that this infrastructure could ultimately be converted to capitalize on a U.S. adult use opportunity, when it materializes.

Charlotte's Web. Founded in 2013 and based in Boulder Colorado, Charlotte's Web is a publicly-traded, market leader within hemp-derived CBD (CSE: CWEB; OTCQX: CWBHF). The company has a vertically integrated business model, consisting of cultivation, manufacturing and distribution. Charlotte's Web products are sold in 3,680 retail locations, with an expanding channel footprint that includes national grocery, drug, mass market, pet, and natural / specialty retailers. Despite being well distributed, 55% of 9M18 revenue has been derived from the company's direct to consumer e-commerce model. Going forward, Charlotte's Web will continue to drive innovation and will look to improve their liquid delivery system to enhance efficacy, convenience and frequency of use. What is more, they will offer botanical blends to target consumer need states (sleep and cognitive function), upgrade bioavailability technology and focus on additional isolated cannabinoid products. To drive sustained growth, the company will look to build brand awareness through media events and social platforms, among others and introduce new, differentiated botanical products in the form of tinctures, capsules, powders, sports performance, topicals, cosmetics, beverages and pet products. Charlotte's Web will selectively pursue M&A to complement their current strengths and will also look to expand internationally, with a near term focus on the EU, South America and Asia. Through FY 9M18, Charlotte's Web has delivered revenues of $48 mm (+75%), with a gross margin of 77%.

Curaleaf Hemp. Curaleaf (CSE: CURA; OTC: CURLF) is a vertically integrated U.S. multi-state operator (MSO), based in Massachusetts that focuses on selling Curaleaf branded products in its company-owned dispensaries. In September, the company launched a separate CBD focused line called Curaleaf Hemp, which is currently sold in 47 states. Form factors currently offered include tinctures, capsules, topicals, patches, vape pens, and pet treats. With both ingestible and topical CBD products currently offered in select Wegman's stores, Curaleaf Hemp is focused on expanding into more channels and becoming a national CBD brand by the end of the year. Curaleaf Hemp products are mid-tier priced, coming in above value offerings, but below what would be considered super-premium. This allows them to competitively target pharmacy chains and grocery stores. Curaleaf believes women represent an outsized opportunity within CBD and will focus their efforts on positioning their products towards that specific cohort. This makes good sense to us as our proprietary survey indicated that women slightly over-index to CBD relative to men. Through FY9M18, Curaleaf has generated ~$45 mm in revenues (including adult use and medical) reflecting a 247% YoY growth rate, while delivering a gross margin of 57%.

CV Sciences. Headquartered in San Diego, CA, publicly traded CV Sciences (OTCQB: CVSI) has two distinct operating divisions, consisting of consumer products and specialty pharmaceuticals. Within consumer products, the company is engaged in the development, manufacturing, marketing, and distribution of hemp-derived CBD products, which are refined into its own *PlusCBD Oil™* brand. Form factors are broad based and include oils, capsules, sprays, balms, beauty products, and gummies, and are distributed nationally in health food stores and health care provider offices through select distributors and online. CV Sciences currently distributed to over 2,000 retail locations. CV Sciences has generated ~$34 mm in revenues though the first nine months of FY18, which reflects a 153% YoY growth rate. Over the comparable timeframe, the company reported gross margin of 72%, reflecting over 300 bps of expansion.

Elixnol. Elixinol (ASX: EXL; OTCQX: ELLXF) has a global presence in the cannabis industry, including hemp-derived CBD dietary supplements, food and wellness products, as well as the cultivation and manufacturing of medicinal cannabis products. Business segments include:

- **Elixinol USA.** Founded in 2014, Elixinol USA is a manufacturer and global distributor of industrial hemp-based dietary supplements and skincare products, with operations based out of Colorado.
- **Hemp Foods Australia.** Founded in 1999, is a leading hemp foods wholesaler, retailer, manufacturer and exporter of bulk ad branded raw materials and finished products.
- **Elixinol Australia.** Founded in 2014, to participate in the emerging Australian medical cannabis market.

In 2018, Elixinol revenues grew 121% YoY to ~$AUD 37mm (~$27 mm). The company's North America business contributes over 80% to total company revenues.

Green Thumb Industries (Beboe). As one of the more well-known U.S. multi-state operators (MSOs), Green Thumb Industries (CSE: GTII; OTCQX: GTBIF) recently announced the acquisition of Beboe, a premium cannabis brand, headquartered in California. Beboe products are sold in over 125 California and Colorado retail locations, and notably, the acquisition will give GTI access to the CBD market through Beboe's recently launched, direct-to-consumer line of hemp derived CBD products. Current CBD products offered from Beboe include a vape pen, called Calming, which contains 500 mgs cannabis oil, as well as a beverage called Dirty Lemon. In order to maintain the premium nature of the Beboe brand equity, GTI plans to ship the product into high-end luxury stores (which currently includes Barney's). In the first nine months of fiscal 2018,

GTI has reported revenues of ~$41.7 mm (which includes adult use and medical), reflecting a YoY growth rate of over 300% and gross margin of 45%. We would note that on a pro-forma basis including the acquisition of Essence, in the most recent quarter, GTI would have generated revenues of over $35 mm (vs. $17.1 mm reported).

Khiron Life Sciences Corp. Khiron is a publicly-traded (TSXV: KHRN; OTCQB: KHRNF), vertically integrated cannabis company currently focused on Latin America. Priority markets in the region include Colombia, Peru, Chile, Brazil, and Mexico. Earlier this year, they announced a 50/50 JV with U.S.-based Dixie Brands, which will result in the introduction of a full line of cannabis infused products to the Latin American market. Importantly, as part of the agreement, Dixie will manufacture and distribute Khiron's Kuida brand of CBD-based cosmetics in the U.S., where they will target the growing Hispanic population. Khiron will operate the JV from Bogota, Colombia, with a focus on regulation, cultivation, manufacturing, and distribution. Dixie will contribute IP, including its extensive brand portfolio, which includes over 100 SKUs spanning 15 different categories. Khiron recently recognized first sales in October 2018.

Level Brands. Originally founded as a consumer products company in 2015, Level Brands (NYSE American: LEVB) subsequently expanded into licensing and brand management prior to initiating an IPO in 2017. Most recently in 2018, the company completed the acquisition of cbdMD, a CBD consumer products brand with products available online and in over 1,000 retail outlets across the U.S. cbdMD offers 60 skus, 24 of which come in the form of oils, while 12 SKUs come in the form of topicals. Additionally, other cbdMD form factors offered include capsules, gummies, bath bombs, and pet products. In its first year, cbdMD delivered $7.5 mm in sales, while achieving a gross margin in excess of 70%. From a route to market perspective, 80% of revenues come from e-commerce, though the company started to build out a sales team to drive brick and mortar penetration.

Tilray (Outperform, $150 PT). Canadian-based Tilray (NASD: TLRY), is a licensed producer and distributor of cannabis across Canada, as well as internationally. Through the company's strategic partnership with Privateer, TLRY licenses established U.S. based cannabis brands including Marley Natural, Irisa, Goodship, Grail, and Dutchy. TLRY has been active on the M&A front, with previously announced acquisitions / partnerships with Novartis, Authentic Brands and AB-Inbev, among others. Most recently, the company announced a C$419 mm acquisition of Manitoba Harvest, the global leader in hemp-derived food products. The cash and stock deal gives TLRY access to Manitoba Harvest's broad range of food products that are currently distributed in 16,000 stores across North America.

Turning Point Brands (Outperform, $45 PT). Based in Louisville, KY, Turning Point Brands (NYSE: TPB) operates in the Other Tobacco Products (OTP) category and sells and distributes a wide range of products. These products include MST, loose leaf chewing tobacco, cigarette papers, cigar wraps, e-cigs, vaporizers, and herbal wraps. TPB recently announced a minority stake in CASH, a privately held CBD extraction and production company, which should complement its current infrastructure, which includes Vapor Beast, Vapor Shark and Vapor Supply. Additionally, we would note that TPB currently sits on the U.S. Hemp Roundtable Board of Directors. Through the first nine months of fiscal 2018, TPB has reported $238.4 mm in revenues, which reflects a YoY growth rate of over 12%. The company has achieved a run rate gross margin of ~44% over the comparable timeframe.

Canadian LP Commentary on CBD

In addition to the public companies already actively involved in the hemp / CBD market, we would note that all of the major Canadian public cannabis companies have been vocal in terms of expressing their interest in the space, as reflected in the below commentary.

Aphria (APH)

"Depending on the country, there is a lot of movement in Europe…with a CBD light. That CBD, that source from hemp, and what we are contemplating in certain countries, Portugal being one, Italy being one." **Chairman, CEO & President Victor Neufeld (1Q19 Earnings Call)**

Aurora (ACB)

"*I think the hemp industry, I tell a lot of the people here that I think it's going to be as big or bigger than the cannabis industry."* **Founder, CEO and Director Terry Booth (4Q18 Earnings Call)**

"We've got -- obviously, we're first mover in the hemp space out of any other of our competitors. And we'll enter when it's proper to enter and when it's legal to enter into the United States market." **Founder, CEO and Director Terry Booth (2Q19 Earnings Call)**

Canopy Growth (WEED, Outperform, C$82 PT)

"But CBD every day is moving through a progression where it's going to become part of the normal course available ingredient set…and I think we're doing a very good job of getting in front of that." **CEO Bruce Linton (1Q19 Earnings Call)**

"*[CBD is] going to come down to who gets the data to get the branded product that actually works. And I think we're doing a very good job on that and I believe we have a leadership position on that."* **CEO Bruce Linton (2Q19 Earnings Call)**

Cronos (CRON)

"At Cronos, we seek to build the world's most innovative cannabinoid company, where we develop and research efficient processes to effectively produce and formulate the full spectrum of cannabinoids, not just THC and CBD." **Chairman, President & CEO Michael Gorenstein (3Q18 Earnings Call)**

Emblem Corp (EMC)

On 8/1/18, Emblem and GreenSpace announced a strategic partnership to develop and commercialize CBD infused health and beauty products for the expected adult-use cannabis market. **(Press Release)**

"Emblem's partnership with GreenSpace Brands is an industry first and represents an incredible opportunity to capitalize on the growing CBD market in Canada." **CEO Nick Dean (Press Release)**

Emerald Health Therapeutics (EMH)

Emerald secured over 500 acres of hemp harvest in 2018 and has contracted for approximately 1000 acres in 2019 to 2022, with the objective of extracting low-cost cannabidiol (CBD). **(Press Release)**

On September 26, 2018 the Company entered into a long-term supply agreement to obtain harvested hemp chaff, plant material consisting of mainly flower and leaf. The supply agreement was signed with Emerald Health Hemp Inc. to purchase CBD containing hemp biomass for extraction into CBD oil. **(Press Release)**

The Green Organic Dutchman (TGOD)

"We are focused on becoming the Whole Foods of the cannabis industry and recognized as pioneers in the THC/CBD infused beverage industry." **CEO Brian Athaide (Shareholder Letter)**

HEXO Corp (Hexo)

"With respect to the United States, we are in the process of assessing adequate supplies for hemp-derived cannabinoids. Using our intellectual property, we believe we can offer a large range of CBD-based experiences." **HEXO Prospectus (1/25/19)**

Neptune Wellness Solutions (NEPT)

"CBD in the United States-and think about this for a moment where it was federally illegal in the DEA perspective as well as not permitted from an FDA perspective, it is today larger than the vitamin E sector, and it is on track to surpass the omega-3 supplement category very soon." **President, CEO & Director James Hamilton (3Q19 Earnings Call)**

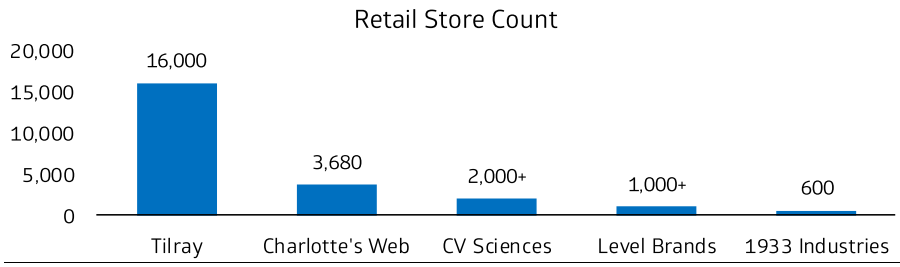
Organigram (OGI)

On 1/21/19, OGI entered an agreement with 1812 Hemp, a New Brunswick base industrial hemp research company to secure supply and support research and development on the genetic improvement of hemp through breeding methods.

Benchmarking

Below we provide a distribution benchmarking analysis on some of the notable publicly traded CBD companies, including Tilray's recently announced acquisition of Manitoba Harvest, which food products are distributed in 16,000 stores across the U.S. and Canada. Among core CBD companies, Charlotte's Web's retail store count of 3,680 stores is almost double that of CV Sciences' 2,000+ retail locations. Level Brands CBD products are in over 1,000 retail locations, while 1933 has a retail footprint spanning 600 stores and counting.

Figure 100 Companies Will Focus on Building our Distribution Footprint

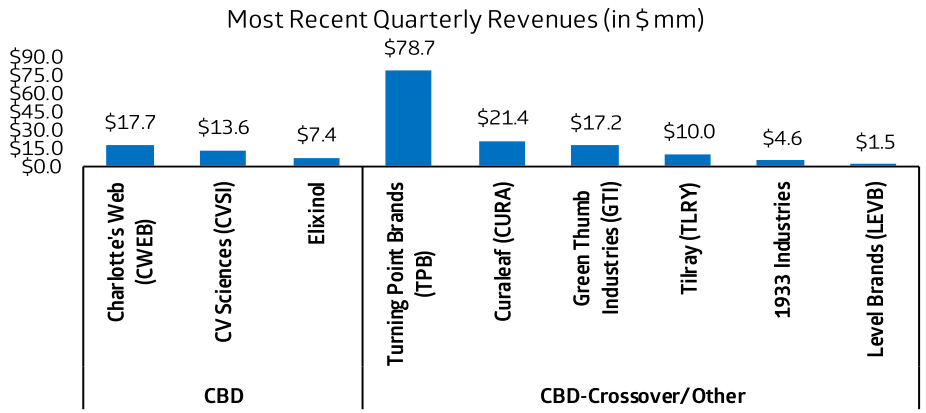


Source: Company Reports and Cowen and Company; Note: TLRY reflects acquisition of Manitoba Harvest

From a revenue perspective, Charlotte's Web is generating the most sales out of what we would classify as core CBD-focused companies. Indeed, in the most recent quarter, the company generated almost $18 mm, which was ~30% higher than number 2 positioned CV Sciences, while Elixinol delivered over $7 mm. We would highlight that for the cross-over brands, Turning Point Brands is currently delivering the highest revenues (consisting of OTP only), while reported revenues factor in adult use and medical sales of THC-infused products, which clearly favor Curaleaf and GTI as two of the more well-known MSOs in the U.S. Tilray revenues of $10 mm are expected to ramp over the

coming quarters, driven by adult use legalization in Canada. 1933 and Level Brands are smaller in scale but continue to post solid growth.

Figure 101 CWeb Leads Core CBD Companies; CBD Crossover Touches Multiple Industries

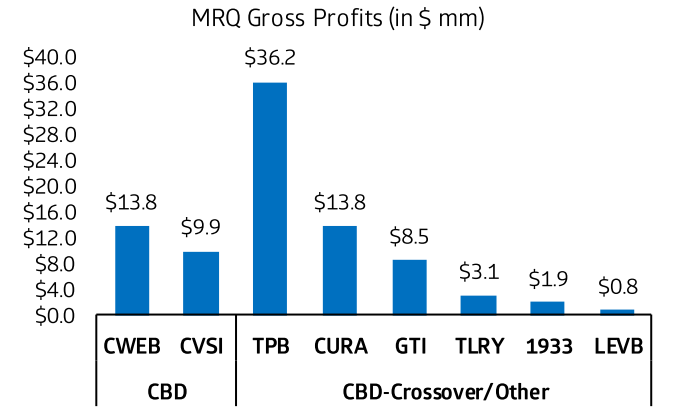


Note: 1933 = 1Q19 (ended 10/18), Level Brands = 4Q18 (ended 12/18), All others are 3Q18 (ended 9/18). AUD/USD = 0.72

Source: Company Reports and Cowen and Company

Nuances around different business models become increasingly apparent when benchmarking gross margins. Charlotte's Web and CV Sciences, which we would classify as finished goods producers, command the highest margins, while Turning Point Brands' unique positioning within OTP products generates margins lower than the level that would be seen for traditional cigarette companies. Core cannabis companies have to contend with being both vertically integrated and in many instances, servicing retail stores, which are lower margin.

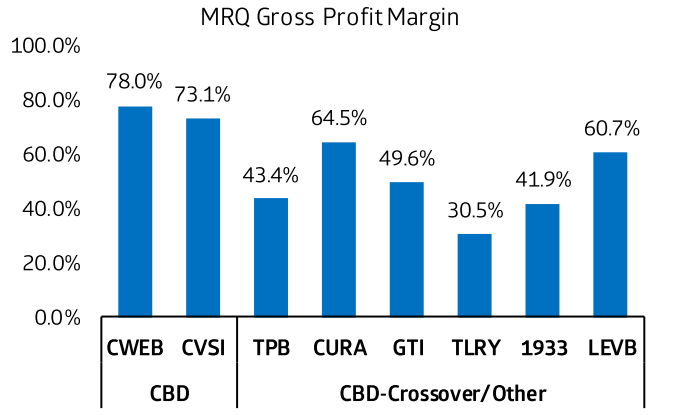
Figure 102 Finished Goods CBD Producers...



Note: 1933 = 1Q19 (ended 10/18), Level Brands = 4Q18 (ended 12/18), All others are 3Q18 (ended 9/18). AUD/USD = 0.72

Source: Company Reports and Cowen and Company

Figure 103 ...Command the Highest Gross Margin

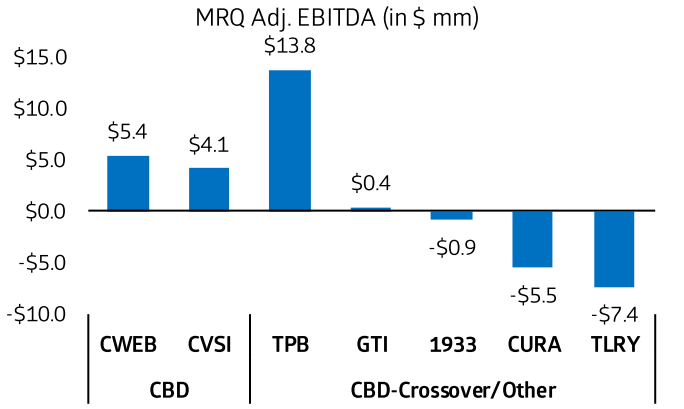


Note: 1933 = 1Q19 (ended 10/18), Level Brands = 4Q18 (ended 12/18), All others are 3Q18 (ended 9/18). AUD/USD = 0.72

Source: Company Reports and Cowen and Company

As evidenced by the above chart, in addition to offering very strong revenue growth prospects, CBD finished products are highly profitable. While it is still early days, both Charlotte's Web and CV Sciences are EBITDA positive, generating 30% margins in the most recent quarter, which is an encouraging sign. This intersects at a period where other companies across the broad cannabis landscape have been investing heavily in SG&A, which includes but is not limited to headcount increases and R&D.

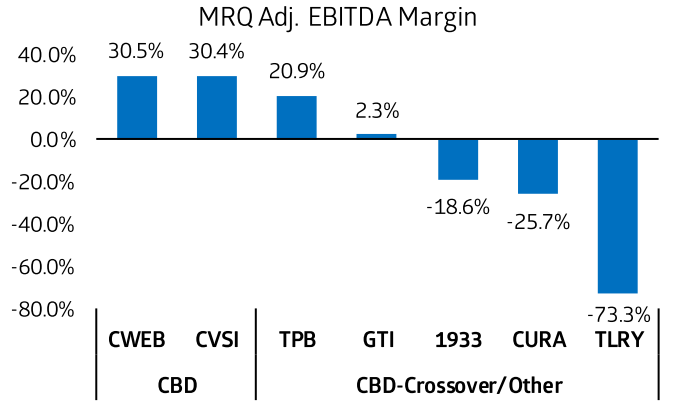
Figure 104 CWEB and CVSI Are Posting Strong EBITDA...



Note: 1933 = 1Q19 (ended 10/18) (ended 12/18), All others are 3Q18 (ended 9/18). AUD/USD = 0.72

Source: Company Reports and Cowen and Company

Figure 105 ...With Margins Exceeding 30%

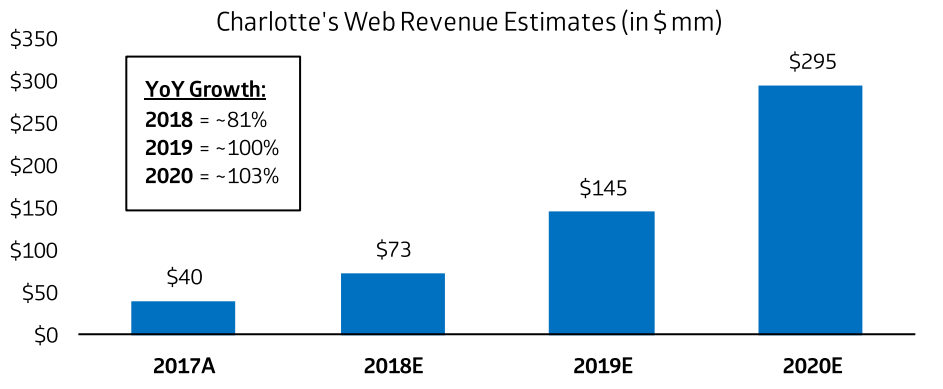


Note: 1933 = 1Q19 (ended 10/18) (ended 12/18), All others are 3Q18 (ended 9/18). AUD/USD = 0.72

Source: Company Reports and Cowen and Company

While Charlotte's Web generated 172% growth last year, we can see that sales are expected to remain robust. Charlotte's Web is guiding for 2018 revenues to be between $65-80 mm, which would represent ~81% growth at the midpoint of the range. For 2019, the company is guiding for $120-170 mm, which would represent 100% growth at the midpoint. Looking out to 2020, current consensus estimates of $295 mm would imply further robust growth at over 100%. With momentum in CBD expected to ramp on a go-forward basis, we would look for these more established, well capitalized companies such as Charlotte's Web, CV Sciences and Elixinol to consolidate market share in the form of distribution gains from new channels coming online as well as a from considerable amount of consolidation.

Figure 106 Charlotte's Web's Top-Line Outlook



Source: Company Reports, Bloomberg

Private Companies

Botanica. Best known for its portfolio of adult use edible brands, which includes Spot, Journeyman and Mr. Moxey's Mints, Botanica recently launched a CBD only line of Mr Moxey's Mints, following the passage of the 2018 Farm Bill. The products are currently offered in the U.S. and the U.K. and are available in one package format consisting of 60 mints at 5 mgs per CBD each. In the U.S., the mints retail for ~$40 per tin and going forward, the company will look to come to market with smaller / lower priced offerings to help drive immediate point of sale consumption across brick and mortar retail locations. Over time, management forecasts that ~40% of sales will come from e-commerce, with the balance coming distribution.

GenCanna. Based in Kentucky, GenCanna is a cultivator of premium hemp-derived CBD. Additionally, the company offers whole-plant hemp extracts in the form of full spectrum or isolated crystalline cannabinoid CBD for wholesale, available to customers in the form of powders and oils and can be prepared as a proprietary water dispersible powder to support large scale manufacturing needs. Their powders have a CBD concentration of 99.5%+, which is isolated using CO2 extraction and crystal precipitation (as is their bulk oil). GenCanna also offers a full range of packaged goods including bottled oil drops, capsules and topical creams. All GenCanna products are produced in an FDA registered and inspected, food-grade, GMP-compliant facility and are tested by third parties for safety and quality. In November 2018, MariMed (MRMD, not covered) invested $30 mm in GenCanna, which established a long-term supply agreement whereby GenCanna became MariMed's global hemp CBD supplier.

Highline Wellness. Co-founded by former Cowen alum Chris Roth and his business partner Chris D'Alberti, Highline Wellness is a NYC-based CBD company currently offering tinctures, chews (gummies) and topicals (pain cream). Highline products are manufactured in Florida and the company sells direct-to-consumer. According to the company, this provides for competitive pricing relative to their peers (which we would classify as broadly mainstream). While still early days, Highline has an active presence on social media platforms including a loyal group of followers on Instagram, which has resulted in top line momentum to start off the year.

Lazarus Naturals. Launched in 2014, Lazarus Naturals is an Oregon-based CBD company, which offers products ranging from tinctures and capsules, to topical oils and balms as well as isolates. Lazarus is value priced across the competitive set with one of the lowest price/mg of CBD relative to the companies that we benchmarked against. The company offers 60% discounts to veterans, individuals on long-term disabilities as well as for low-income households. All sales primarily come from e-commerce and products are shipped to all 50 states across the U.S.

Lord Jones. Founded by Robert Rosenheck and Cindy Capobianco, Lord Jones manufactures and distributes super-premium CBD infused products. The company provides a broad array of product offerings, including tinctures, confections, capsules, and skincare, among others. Clearly catered towards the premium-end of the market, Lord Jones has announced several high-profile partnerships over the past couple of years which includes collaborating with Equinox, partnering with luxury hotel group, The Standard, and most recently, being the first CBD brand carried by Sephora.

Mary's. Founded in 2013, Mary's produces and sells cannabis and hemp-derived CBD products across three main segments, which include:

- **Mary's Medicinals.** Cannabinoid infused products for relief, available in 11 U.S. states.
- **Mary's Nutritionals.** Hemp-derived CBD products for health & wellness, sold in retailers and online in the U.S. and international markets

- **Mary's Whole Pet.** Whole plant CBD remedies for pets, sold in retailers and online in the U.S. and international markets.

Mary's is a high-end brand, focused on clean delivery methods through its transdermal patches, topicals and patented gel pen technologies. In March 2018, Mary's Nutritionals was chosen as the preferred CBD vendor partner for all Ritz Carlton, Marriott, JW Marriott, W, and St. Regis Locations.

Mile High Labs. Based in Colorado, Mile High Labs is the largest extractor of CBD in the world. The company sources hemp from third party cultivation partners across four states, which include Colorado, Oregon, New York, and Kentucky. Mile High Labs extracts exclusively from industrial hemp flower material to create full spectrum extract, distillate and isolate. Their full spectrum extract contains a full range of CBD terpenes and over 60% CBD on average, making it useful for low concentration formulations in holistic and wellness applications, including tinctures and capsules. Mile High Labs distillate is refined using proprietary molecular distillation technology and contains ~85% CBD on average, making it ideal for vape pen cartridges, tinctures and other high potency formulations. The company's isolate contains ~99% CBD and is used as a main ingredient in bioceutical and nutritional product applications. Mile High offers end-to-end certified GMP hemp CBD manufacturing. In October 2018, Mile High Labs raised $35 mm in a Series A, which according to CEO Jason Roth represented a "record-breaking investment [which] is a reflection of the growth in demand for quality CBD products and Mile High Labs' unique ability to meet that demand." CFO Jonathan Hilley also recently noted that he believes "the CBD market is in the early stages of a 20-year secular growth trend."

Papa & Barkley. Papa & Barkley is based in California, with a diverse portfolio of products and lines. The company's *Releaf* line spans multiple form factors, including tinctures, capsules, patches, and balms, among others, which are comprised of different THC:CBD ratios. Papa & Barkley's *Essentials* line is specifically focused on CBD, and as it stands, they offer a tincture in both a 15 ml bottle (450 mg CBD) and 30 ml bottle (900 mg CBD) and will soon be rolling out capsules, as well as an extra strength pain balm. The company is only in California currently, but is looking at going to market in three other primary states, as well as three other secondary states.

Recess. Launched in October 2018, Recess is a wellness company currently specializing in beverages which are infused with full spectrum hemp extract. The company has positioned itself as a modern day lifestyle brand and daytime productivity enhancer that offers a universal message and idea instead of being anchored specifically to CBD. This strategy shares similarities with traditional CPG products, such as energy drinks and soda, which are not marketed for the active ingredient, but instead as the solution. While the current product portfolio includes sparkling beverages only, Recess plans on rolling out a plain water, as well as powders, which will cater to on-premise consumption occasions, such as coffee shops, juice shops and cocktail bars.

Reliva CBD Wellness. Reliva is a CBD-focused company, which form factors include tincures, shots, sprays, topicals, gummies, and pet care. The company is run by Miguel Martin, who previously served as the President and GM of Logic Technology Development, an e-cigarette manufacturer in the U.S. Reliva's products are focused on value from an absolute pricing perspective, as nothing sells for over $19.99 at retail. The company is unique insofar as they do not offer e-commerce, nor do they make and claims on efficacy or rely on testimonials or influencer marketing, which Martin believes will create a narrative on responsibility. Reliva focuses on independent c-stores and grocery channels and is expected to be in ~1,000 stores by the end of March, growing to 4,000-5,000 stores by the end of the summer with the goal of doubling that store count to ~10,000 locations by year-end.

Health Care: Drug Retailer Perspective (Rhyee)

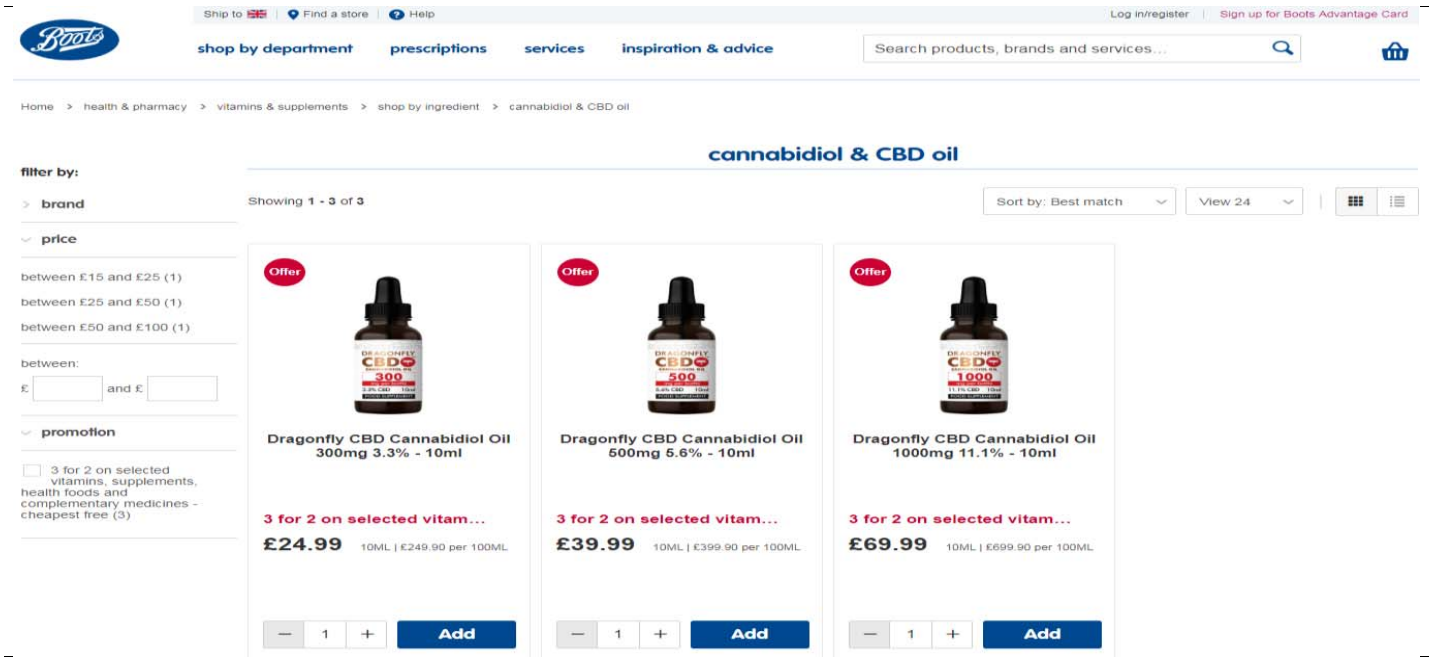
CBD Products Gaining Traction With Independent Pharmacies

CBD products appear to be gaining traction with independent pharmacies, many of whom are already selling or planning to sell CBD oils. We don't find this surprising given the high demand for and strong expected growth potential of CBD products, as well as the differentiation it affords independents relative to larger chain pharmacies. Independent pharmacies also likely find the high-margin profile of CBD oils attractive, which we suspect is similar to those of more traditional over-the-counter drugs. OTC drugs are a substantial profit driver for independent pharmacies. The greater acceptance of and improving sentiment towards CBD products as a viable business for independent pharmacies is evidenced by a panel held by the National Community Pharmacists Association (NCPA) at its annual convention in October 2018, which served to educate independent pharmacy owners of the legality, clinical uses, potential risks and marketing tactics of CBD oils. For those independent pharmacies that have decided to sell CBD oils, ensuring that they provide high-quality products is paramount, with a focus on looking at the bioavailability of CBD. Additionally, independent pharmacies emphasize the importance of patient education, in regards to treatment and potential side effects. Anecdotally, reports note that many independent pharmacies have received positive feedback from patients, attributing diminished opioid dependence and pain relief to CBD oils.

Large Pharmacy Chains Don't Appear As Quick To Offer CBD Oils

Large pharmacy chains, such as CVS Pharmacy and Walgreens, don't currently sell CBD oil. WBA management has noted that, while the company is monitoring the CBD market and the potential to sell it, WBA currently has no public stance on whether it plans to sell CBD products future. Interestingly, Boots, which is a pharmacy chain in the U.K. owned by WBA, sells CBD oil in three different doses (Figure 107). As such, we wouldn't be surprised if WBA decides to sell CBD products in the future.

Figure 107 Boots - Cannabidiol & CBD Oil Offerings



Source: Boots.com and Cowen and Company

Health Care: Payor Perspective (Rhyee)

Based on our conversations with managed care companies, whether CBD oils will be covered as a medical benefit by government sponsored health programs is determined by the Center for Medicare and Medicaid Services (CMS) and state governments. Currently, CBD products aren't a covered benefit or an extra benefit that has been approved by CMS or states, and it isn't known at this time whether CMS or states governments are considering reimbursement for CBD products. That said, based on our discussions with a number of payors, if a state government were to provide reimbursement for CBD products under Medicaid, it would have to add CBD oils as a covered benefit under the state plan, which may or may not require CMS approval. We note that CMS and states do provide reimbursement for non-traditional treatments, if they determine that there's some benefit, such as issues around social determinants, As such, we see the potential for CBD oils to become a covered benefit under CMS, even without FDA approval.

On the commercial side of the market, payors we spoke with noted that CBD oils aren't eligible for coverage under commercial health plans because they're not regulated by the FDA. There are a couple of exceptions, such as GWPH's Epidiolex, which is a prescription pharmaceutical formulation of highly purified, plant-derived cannabidiol for the treatment of seizures associated with Lennox-Gastaut syndrome (LGS), or Dravet syndrome in patients two years of age or older. Epidiolex is covered by commercial insurance as it is an FDA approved drug. Payors noted three factors complicating commercial coverage of CBD oils, including (1) legal issues, as CBD oils derived from THC (cannabis) aren't legal if they contain equal to or more than 0.3% THC; (2) lack of regulation by the FDA; and (3) their availability as OTC medications.

Health Care: Provider Perspective (Rhyee)

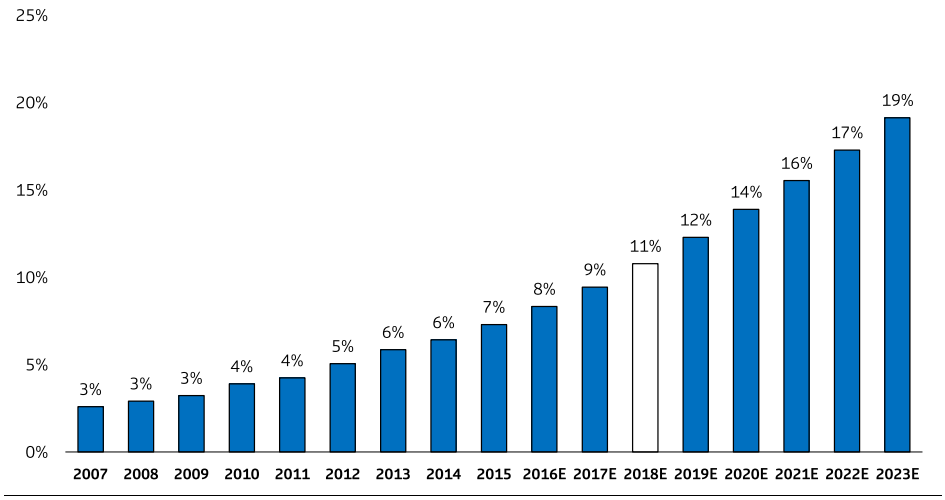
The certified use of medical marijuana appears to be gaining acceptance by the provider community, as evidenced by the recent distribution of a memo by the chief physician executive of Intermountain Healthcare, Utah's largest health provider, to its network of providers that the health system is lifting its prior directive that advised physicians not to write letters recommending cannabis treatments. However, it's difficult to assess providers' stance on recommending the use of CBD oils. With greater clinical evidence supporting the efficacy in treating various conditions, we may very well see doctors recommend CBD oils as well, which some claim to be effective in treating loss of appetite in cancer patients, chronic pain, epilepsy, Huntington's disease, sleep disorders, multiple sclerosis symptoms, schizophrenia, and glaucoma.

eCommerce To Be A Key Consumer Distribution Channel Long Term (Blackledge)

A significant portion of the CBD products that are currently available fall into the Personal Care / Beauty Products or Vitamins and Food Supplements verticals, both of which are part of the larger Consumables category. Consumables continues to be a highly under-penetrated eCommerce vertical in the midst of a progressive shift online, and we see an opportunity for these CBD companies to expand online as secular tailwinds continue to drive eCommerce growth for the larger Consumables market. For context, we forecast overall US Consumables eCommerce sales of $51BN in '18, or 11% eCommerce penetration, rising to $111BN in '23 or 19% eCommerce penetration.

Longer term, Consumables eCommerce market share, led by Amazon, should rise well above our 19% penetration forecast in '23, as the sector favors eCommerce vs. Brick & Mortar, for multiple reasons, namely (1) changing consumption trends, particularly with younger demographics, who would prefer to "Skip the Trip" for these high replenishment factor goods; and (2) rising smart speaker penetration, like AMZN's popular Echo device, driving gains in high replenishment re-ordering.

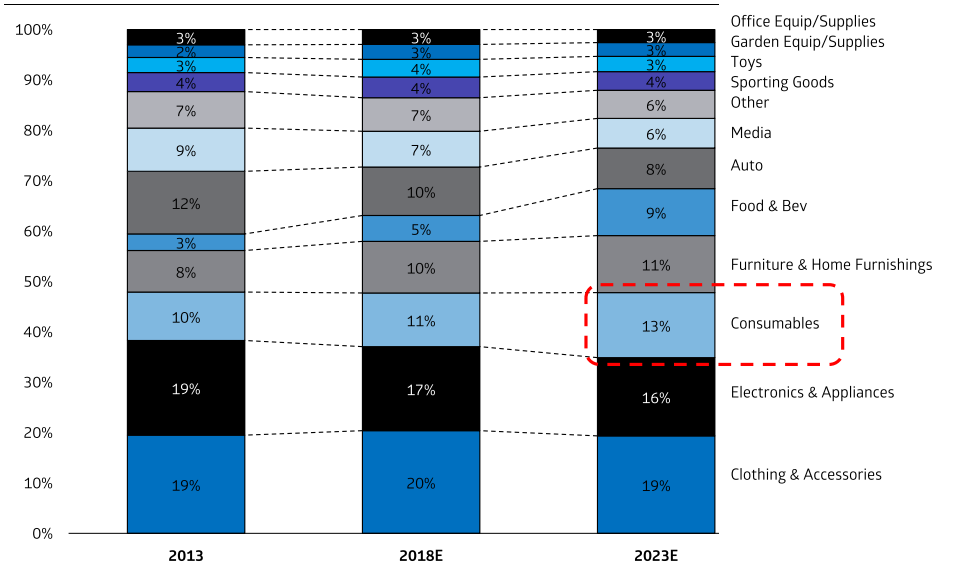
Figure 108 U.S. eCommerce Consumables Penetration '07-'23E



Source: Cowen and Company; U.S. Census Bureau

Due to the aforementioned macro factors, we view eCommerce as a major potential customer distribution channel for CBD longer term as consumers' spending habits continue to shift, and purchasing of Personal Care Products, Vitamins & Food Supplements and other Consumable items moves online at an accelerated rate. We expect growth within the Consumables (Personal Care, HH Goods, etc) and Food & Beverage verticals to consistently outpace overall eCommerce growth '18-'23, resulting in an increased share of U.S. eCommerce sales.

Figure 109 Share Of U.S. eCommerce Sales '13 vs. '18E vs. '23E



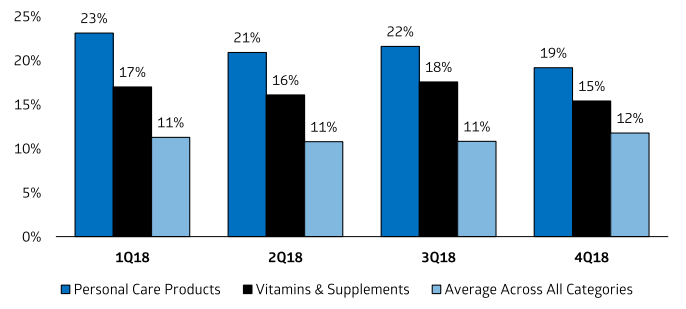
Source: Cowen and Company; U.S. Census Bureau

Analyzing Two Key Verticals for CBD Adoption

As part of our monthly survey of 2,500 US consumers, we ask Amazon.com purchasers to indicate which categories (out of a list of 30) they purchased on Amazon in the past 30 days. Our data shows that Personal Care Products and Vitamins & Supplements were more likely to be purchased (vs. the average across all categories) by both Prime and Non-Prime members throughout 2018.

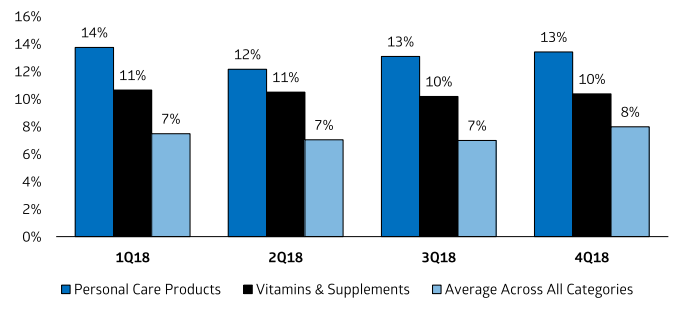
Taking a closer look at 4Q18, in each month (on average) 19% of all Amazon Prime Purchasers bought at least one personal care product and 15% purchased a Vitamin or Supplement, while the average purchase rate across all 30+ categories was only 12% of Prime purchasers. We noted a similar trend among Non-Prime Purchasers in 4Q18, with 13% who bought Personal Care Products and 10% who bought Vitamin or Supplements, compared to the average purchase rate across all categories of 8%.

Figure 110 Prime Member Purchaser % By Vertical, 1Q18-4Q18



Source: Cowen proprietary Consumer Internet Survey, n=~2500, Dec '18

Figure 111 Non-Prime Purchaser % By Vertical, 1Q18-4Q18



Source: Cowen proprietary Consumer Internet Survey, n=~2500, Dec '18

Amazon Has A Modest But Expanding Physical Footprint

For CBD companies, expansion through Amazon's retail locations and more importantly Whole Foods' expanding retail footprint are also attractive avenues for reaching new customers (assuming CBD companies can convince Amazon and Whole Foods to carry their products). While we currently lack insight into when CBD products may become available in Whole Foods stores, or what a regional or national rollout might look like, below we analyze Amazon's physical footprint to highlight the potential for distribution.

Amazon's expanding physical footprint is made up of a small number of Go Stores, Amazon Fresh Grocery Pickup in Seattle, Amazon Branded Book Stores and most notably its Whole Foods Market business. Whole Foods is a health focused supermarket chain based out of Austin TX that operates ~470 US locations and was purchased by Amazon in Aug '17. Since acquiring Whole Foods, Amazon has deeply integrated it with the company's Prime offering. In combination with Amazon's Prime Now platform, Whole Foods is now offering 2-hour delivery on thousands of in-store items in 63 cities, which account for over 50% of the US population and over 2/3rds of US GDP. Whole Foods also offers curbside pickup in over 20 markets.

Figure 112 Amazon Prime Now & Same Day Delivery Top 50 US Metro Areas By 2017 GDP (%)

2017 GDP Rank	U.S. Metropolitan Areas	% of '17 US GDP	% of '17 US Population	Amazon Prime Now Available	Amazon Prime Free Same-Day Delivery	WFM Delivery via Prime Now
1	New York-Newark-Jersey City, NY-NJ-PA	9.8%	6.2%	✓	✓	✓
2	Los Angeles-Long Beach-Anaheim, CA	5.9%	4.1%	✓	✓	✓
3	Chicago-Naperville-Elgin, IL-IN-WI	3.9%	2.9%	✓	✓	✓
4	Dallas-Fort Worth-Arlington, TX	3.1%	2.0%	✓	✓	✓
5	Washington-Arlington-Alexandria, DC-VA-MD-WV	3.0%	1.9%	✓	✓	✓
6	San Francisco-Oakland-Hayward, CA	2.9%	2.2%	✓	✓	✓
7	Houston-The Woodlands-Sugar Land, TX	2.8%	1.4%	✓	✓	✓
8	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	2.5%	1.9%	✓	✓	✓
9	Boston-Cambridge-Newton, MA-NH	2.5%	1.5%	✓	✓	✓
10	Atlanta-Sandy Springs-Roswell, GA	2.2%	1.7%	✓	✓	✓
11	Seattle-Tacoma-Bellevue, WA	2.0%	1.8%	✓	✓	✓
12	Miami-Fort Lauderdale-West Palm Beach, FL	2.0%	1.1%	✓	✓	✓
13	San Jose-Sunnyvale-Santa Clara, CA	1.6%	1.1%	✓	✓	
14	Detroit-Warren-Dearborn, MI	1.5%	1.3%			✓
15	Minneapolis-St. Paul-Bloomington, MN-WI	1.5%	0.6%	✓	✓	✓
16	Phoenix-Mesa-Scottsdale, AZ	1.4%	1.0%	✓	✓	✓
17	San Diego-Carlsbad, CA	1.3%	1.4%	✓	✓	✓
18	Denver-Aurora-Lakewood, CO	1.2%	0.9%	✓	✓	✓
19	Baltimore-Columbia-Towson, MD	1.1%	0.9%	✓	✓	✓
20	Charlotte-Concord-Gastonia, NC-SC	1.0%	0.7%	✓	✓	✓
21	Portland-Vancouver-Hillsboro, OR-WA	1.0%	0.9%	✓	✓	✓
22	St. Louis, MO-IL	0.9%	0.7%			✓
23	Riverside-San Bernardino-Ontario, CA	0.9%	1.4%		✓	
24	Austin-Round Rock, TX	0.8%	0.7%	✓	✓	✓
25	Pittsburgh, PA	0.8%	0.6%			✓
26	Tampa-St. Petersburg-Clearwater, FL	0.8%	0.9%	✓	✓	✓
27	Indianapolis-Carmel-Anderson, IN	0.8%	0.6%	✓	✓	✓
28	Cleveland-Elyria, OH	0.8%	0.7%		✓	✓
29	Cincinnati, OH-KY-IN	0.8%	0.6%	✓	✓	✓
30	Columbus, OH	0.8%	0.6%	✓	✓	✓
31	Nashville-Davidson--Murfreesboro--Franklin, TN	0.8%	0.7%	✓	✓	✓
32	Orlando-Kissimmee-Sanford, FL	0.8%	0.6%	✓	✓	✓
33	Kansas City, MO-KS	0.7%	0.7%		✓	✓
34	San Antonio-New Braunfels, TX	0.7%	0.6%	✓	✓	✓
35	Sacramento--Roseville--Arden-Arcade, CA	0.7%	0.7%	✓	✓	✓
36	Las Vegas-Henderson-Paradise, NV	0.6%	0.6%	✓	✓	✓
37	Milwaukee-Waukesha-West Allis, WI	0.6%	0.5%	✓	✓	✓
38	Bridgeport-Stamford-Norwalk, CT	0.6%	0.3%			
39	Virginia Beach-Norfolk-Newport News, VA-NC	0.5%	0.5%	✓		✓
40	Hartford-West Hartford-East Hartford, CT	0.5%	0.4%			✓
41	Salt Lake City, UT	0.5%	0.4%		✓	✓
42	Raleigh, NC	0.5%	0.5%	✓	✓	✓
43	Providence-Warwick, RI-MA	0.5%	0.4%			✓
44	Richmond, VA	0.5%	0.4%	✓	✓	✓
45	New Orleans-Metairie, LA	0.5%	0.4%			✓
46	Jacksonville, FL	0.4%	0.4%		✓	✓
47	Louisville/Jefferson County, KY-IN	0.4%	0.4%		✓	✓
48	Oklahoma City, OK	0.4%	0.4%		✓	✓
49	Memphis, TN-MS-AR	0.4%	0.4%			✓
50	Urban Honolulu, HI	0.4%	0.4%			
	Total	**72.6%**	**54.0%**	**34**	**40**	**46**
	Amazon Prime Now Markets	**62.3%**	**44.8%**			
	Amazon Same Day Delivery Markets	**66.0%**	**48.6%**			
	Whole Foods Delivery via Prime Now Markets	**69.2%**	**50.9%**			

Source: Company reports, Cowen and Company, US Bureau of Economic Analysis

Competition From AMZN Private Label Could Be A LT Concern, Offset By CBD's Established Brands

Should the market for CBD products expand rapidly over the next several years, one source for increased competition could be Amazon's own first party (private label) business. Amazon offers private label goods across the gamut of product verticals, including consumables and vitamins.

Per industry participants that have discussed AMZN's private label business with us, Amazon's approach is similar across most new product lines, most notably that the company is now focusing less on heavy discounting to take share from competition. By contrast, we believe that while any foray into CBD could start with a big push by AMZN to gain share, if sales and reviews aren't working, AMZN would likely reduce resources quickly. Additionally, Amazon Private Label tends to replicate top sellers for goods that are high replenishment, commodity-type products with undifferentiated branding, then add secondary brands over time. Amazon private label has in some cases captured huge market share early (anywhere from 25-40% market share by SKU within the first six months).

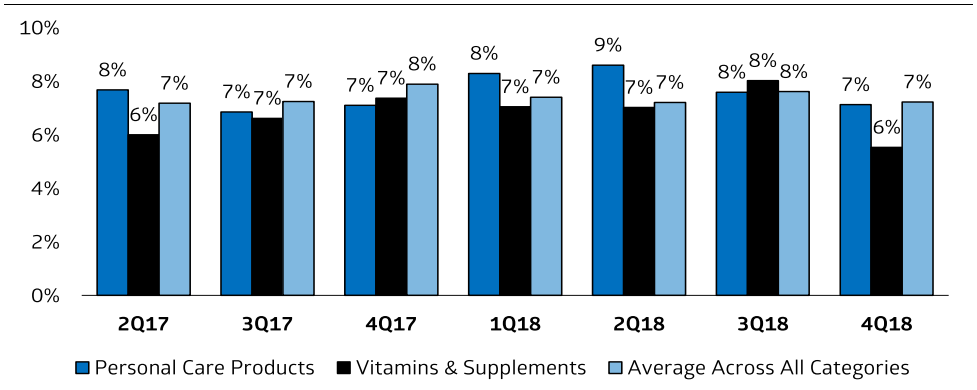
AMZN also tends to have the most success in verticals where branding is less important (a fact that could provide an advantage to more established CBD companies). The widespread availability and acceptance by a retailer such as Amazon could also help to drive mainstream adoption of CBD products and thus provide a benefit for the industry as a whole.

Other Potential Platforms: EBAY Has The Reach To Make An Impact

There are other platforms that may be easier to break into than Amazon that would also provide an avenue to reach a wide array of consumers. Ebay could be an alternative for CBD companies to tap into. EBAY has been losing share in eCommerce over the last several years, and developing a leading marketplace in a new product vertical such as CBD products could be an incentive to become an early adopter. Ebay currently has 179MM active buyers on the platform worldwide, and the company generated over $90BN in GMV in 2018.

Our survey indicates that unlike Amazon, EBAY has had less success in driving consistent purchasing in areas like personal care and beauty as well as in vitamins and supplements. Our data suggests that unlike Amazon, these two key verticals are purchased at about the same rate as any other category, which suggests that there is an opportunity for these verticals to grow meaningfully, in our view.

Figure 113 EBAY Purchaser % By Vertical, 2Q17-4Q18



Source: Cowen proprietary Consumer Internet Survey, n=~2500, Dec '18

Cannabidiol (CBD) Entrance Into Mass Retail May Start In Beauty Before Entering Broadlines (Chen)

Cowen's take is that first movers may predominantly consist of independent operators, followed by beauty, convenience, and other major chains. We believe that growth could take on a barbell dynamic, with early adopters being both high-end luxury players alongside lower-end local convenience shops, with middle-ground retailers including WMT, TGT, and COST likely being the last to sell CBD products after a test-and-learn phase is observed among the early adopters. We expect that CBD in beauty could be a ~$1bn opportunity within skincare specifically; the skincare category currently comprises ~23% of the overall $87bn beauty products market.

Luxury Department Stores Are Early Adopters. A number of independent retail operators have recently announced plans to expand their physical presence to incorporate CBD. For example, luxury department store Barneys New York is adding a 300-square-foot cannabis store-within-store concept called "The High End" to its flagship store in Beverly Hills, where it will sell CBD beauty products and vintage paraphernalia. Neiman Marcus also announced its "Trending Beauty" initiative, which includes carrying leading CBD brands (5 SKUs) online and within 5 of its 44 stores.

Another example is Green Growth Brands (CSE: GGB, not covered) recently announcing a deal with DSW Inc. (DSW, not covered) to sell its Seventh Sense brand within 96 US-based DSW stores; this announcement comes after a 10-week trial phase where 74.4% of product presented on shelves was reportedly sold. GGB also announced it will open 108 stores within Simon Property malls (SPG, not covered), starting in March 2019.

Beauty Could Be First Major Distribution Channel. Cowen believes that the future of beauty will increasingly emphasize clean, natural ingredients within products – in line with the broader health and wellness movement that is permeating into various other retail verticals. Therefore, we believe that beauty could be the first major distribution channel to adopt CBD given the compound's properties as a natural remedy to manage pain, inflammation, and anxiety.

Sephora.com currently carries 3 SKUs with CBD dosages (Lord Jones and Josie Maran), and a variety of hemp-based products. Meanwhile, ULTA only has hemp-based offerings but could adopt a comparable line to Sephora within its Prestige assortment. Average Unit Retail (AUR) for the three Sephora CBD SKUs is ~$70, or $1.85/mL, which supports our view that adopters will skew toward Prestige-cosmetics-oriented retailers such as specialty beauty players (Sephora, ULTA) and department stores (JWN, M), before Mass cosmetics carriers like grocery stores, pharmacies or broadline retailers adopt it, as price points are closer to $10/SKU.

Historically, broadline retailers, including WMT, TGT, and COST have shied away from entering controversial categories in their earlier innings, preferring to be last movers and not create controversies. We do note, TGT has previously made small inroads into CBD. According to AdAge, TGT briefly sold hemp and CBD oils in late 2017 before pulling all the products. Also, we note, WMT's website does sell several hemp oil products.

Figure 114 CBD Presence Is Limited In Mass Retail Outlets

	Broadline			Beauty		Pharmacy/Mass	
	WMT	TGT	COST	ULTA	Sephora (LVMH)	CVS	WBA
Carry CBD Products	✗	✗	✗	✗	✓	✗	✗
Carry Hemp Seed Products	✓	✗	✗	✓	✓	✓	✗
CBD SKU Count	n/a	n/a	n/a	n/a	3	n/a	n/a

Note: CVS and WBA are covered by Charles Rhyee

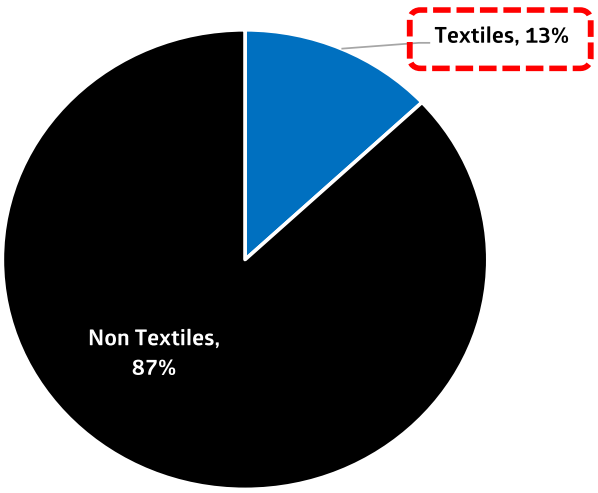
Source: Cowen and Company, company websites; Note: Search "CBD oil, CBD, Cannabis, Cannabis Oil"

Growing Application For Hemp And CBD Within The Apparel & Footwear Market (Kernan)

With the changing tide on marijuana legalization and hemp cultivation, the use case for and interest in CBD applications are rapidly expanding. We think there lies within this fervor potential for greater utilization of hemp derived textiles in apparel, footwear and accessories after largely being relegated to specialist brands with a few exceptions. The Western Producer, a Western Canada weekly agriculture publication, commented that "industrial hemp could reach whole crop utilization" in an article published on 1/10/19 "Revenue Streams Expand For Hemp Growers." We think this compliments the sustainability movement that is gaining ground in global apparel and footwear production and among Millennial and Gen Z consumers. Western Producer quotes Jan Slaski, senior researcher for InnoTech Alberta, that "textile applications have brought [about] the development of hemp-based uniforms, socks, underwear and other apparel..." as its properties, which Patagonia describes as "linen-like," provide a "quality suitable for fine textiles."

Approximately $820MM worth of legal hemp products were sold in the U.S. in 2017 and roughly 13% of those hemp-based products are textiles according to Entrepreneur's 9/4/18 article, "The Hemp Business Is Booming." The article's author Rose Leadem cites a history of the crop dating back "to the 1600s when growing hemp was encouraged for use in sails, ropes and clothing." This period was followed by years of back and forth regulation that alternately banned and unbanned hemp cultivation in the U.S. While the 2014 U.S. Farm Bill allowed for heavily restricted industrial hemp cultivation, the more recent 2018 U.S. Farm Bill, as described by the Brookings Instituted, offers a more "expansive" cultivation of hemp.

Figure 115 Textiles Have Low Penetration Among Legal U.S. Hemp Products (2017)



Source: Cowen and Company; Western Producer

To frame the market opportunity for greater hemp utilization as a textile in apparel and footwear from what is likely a nascent penetration currently, the U.S. clothing and accessories market reached store sales of $262 billion in 2017 as reported by the U.S. government, with potential to grow to $275B in 2018. We note that there are some global brands that offer hemp fiber, mostly but not all on a limited basis, in their clothing and footwear assortment. These brands include Patagonia, Columbia Sportswear's prAna brand, Orvis, Thought Clothing, Toad&Co, Jungmaven, Eartheasy, Sanuk, Toms,

Adidas and Nau. Nike offered a hemp-based SB Dunk Low sneaker in 2004, re-issuing the shoe in 2016 around Earth Day. Patagonia, a $1B global brand that encompasses a focus on the environment and social responsibility in its mission statement, views hemp as a "natural fiber that's cultivated with low impact on the environment." The brand's assortment includes some hemp-based products made with 100% hemp, which it imports from China, or blended with other fibers like recycled polyester, organic cotton, and spandex.

Figure 116 Patagonia Iron Forge Hemp Canvas Ranch Jacket (55% Hemp)

Source: www.patagonia.com

Figure 117 prAna Sharla Sweater (55% Hemp)

Source: www.prana.com

Figure 118 Men's (Hemp upper)

Source: www.sanku.com

There is also a growing market for apparel and footwear that provide recovery attributes. For example, Under Armour has its Recovery line of apparel that includes Celliant which is designed to "capture body heat and convert it to infrared light that is returned to your body, boosting localized blood flow and upping the amount of oxygen reaching your muscles." Celliant is described as "utilizing a proprietary mineral matrix that can be embedded into the core of a yarn or applied to a wide variety of fabrics." This demonstrates the ability to weave outside attributes into existing textiles to add beneficial components beyond just providing an item of clothing. With CBD being reported as having health and wellness properties, such as to combat inflammation, there could be potential for CBD to be infused into textiles. Canada's *Fashion* magazine recently highlighted Devan Chemicals in its 1/4/19 article, "CBD Is Everywhere. Will CBC-Infused Clothing Be Next?" Devan Chemicals is a Belgium-based company that has "added CBD to their textile solutions portfolio." The company's "R Vital" fabric reflects a weave of microcapsules of CBD that release when a person wears the clothing as demonstrated in their website's flow chart below. While still early stage, perhaps there will be demand for widescale CBD infused textiles, although, as the article points out, it is unclear how the "potency" holds up over time and after washing.

Figure 119 Devan Chemical's R-Vital – Flow Chart For A CBD-Infused Textile

Source: Cowen and Company; Devan Chemical

Tilray And ABG Sign Partnership

Privately held Authentic Brands Group (ABG) recently signed a deal with Tilray to capitalize on the general wellness capabilities of CBD. ABG's product portfolio includes athletic based names such as Muhammad Ali, Shaquille O'Neal, Dr. J, Nautica and Prince. The muscle recovery and wellness capabilities of CBD create branding opportunities within these brands. CBD oil also has wellness characteristics beneficial for skin care products. ABG's Nine West Brand will offer wellness products containing CBD powered by Tilray.

Figure 120 Nine West Products Powered By Tilray

Source: Cowen and Company; Sourcingjournal.com

Tilray will also gain exposure to ABG's 150MM followers through its micro-influencer network, Winston. Tilray will have the ability to display its name on ABG cannabis products. Tilray will initially pay ABG $100MM and up to $250MM in cash in stock. In return ABG will pay TLRY 49% of revenues from any cannabis products with any ABG brand name, with a minimum of $10MM/year for 10 years, essentially guaranteeing TLRY will receive a return on its initial $100MM investment. This type of deal opens the door for CBD products to partner with IP ownership to expand brands and CBD use partnerships.

DSW And Green Growth Brands

Green Growth Brands' CBD infused Seventh Sense products, including foot creams and muscle balms, will be sold at 96 DSW stores nationwide out of DSW's 500-store base. As the sale of CBD wellness products become widely acceptable and stigma around once illegal products subsides, opportunity should increase to move into other nationwide retailers. Under our coverage universe, Dick's Sporting Goods may have the potential to offer wellness products containing CBD. DKS has a total of 864 stores nationwide. If DKS were to offer products in a similar percentage of stores as DSW, this would provide 166 incremental distribution points for CBD wellness products.

We Would Expect Starbucks To Be First Under Our Active Coverage To Pilot CBD Oil, Though Not In Near Term Plan (Charles)

Under our active coverage, we would categorize Starbucks as the most forward thinking with beverage innovation relative to Dunkin', Tim Hortons and McDonald's McCafe. Starbucks has launched matcha and nitro cold brew on a widespread basis in recent years, among other wellness-based offerings. During an interview with CNBC last month, Starbucks CEO Kevin Johnson cited no plans to introduce CBD-based beverages in the near term, but did not dismiss the notion of ultimately piloting the ingredient.

Despite early traction with craft/independent coffee shops, regulators in several states recently banned CBD as an additive. The dynamics are fluid, likely delaying adoption from major coffee players like Starbucks in the near term. That said, we acknowledge a longer-term opportunity if coffee shops are able to properly measure and disclose the CBD levels in their coffee, as bottled CBD beverages that disclose CBD oil levels in packaging are not restricted under the current ban.

Should the regulation of CBD oil as an additive to food/beverage change or craft/independent coffee shops find a way to comply with the existing regulation, we could envision Starbucks ultimately piloting the ingredient. We believe Starbucks would need to better understand the science behind the ingredient, in addition to the standard evaluation of any new SKU around supply chain availability as well as meeting Starbucks' high speed of service standards. Furthermore, given Starbucks' heavy reliance on the drive-thru business at more than 50% of sales and 80%+ of ongoing development, SBUX would need to gain clarity around potential liability this entails around selling cannabis-infused beverages before introduction. We note in 2010, Starbucks launched an Evenings program that sold beer and wine inside of participating restaurants. The initiative ultimately scaled to over 400 locations before the program was terminated in 2017.

Regulatory Considerations For CBD (Assaraf – Washington Research Group)

2018 Farm Bill

The Agricultural Improvement Act of 2018 (also known as the 2018 Farm Bill) was signed into law by President Donald Trump on Dec. 20, 2018. The main CBD-related changes in the law are that it: 1) declassifies industrial hemp as a Schedule I substance under the Controlled Substances Act, 2) shifts regulatory authority over hemp from the Drug Enforcement Administration to the Department of Agriculture, and 3) provides autonomy for states to regulate the industry.

However, the 2018 Farm bill does not change the FDA's oversight authority over CBD products intended for human consumption. The statutory language emphasizes that "nothing in this subtitle shall affect or modify ... the authority of the Commissioner of Food and Drugs ... under the Federal Food, Drug, and Cosmetic Act [FDCA] ... to promulgate Federal regulations and guidelines that relate to the production of hemp."

FDA Implications

FDA Commissioner Scott Gottlieb issued a statement and FAQ immediately following the signing of the 2018 Farm Bill, essentially reminding CBD manufacturers of FDA's continued regulatory authority over CBD products.

On the positive side, Gottlieb indicated that the FDA is open to engaging with industry players early to clarify uncertainty and to help develop a clear and consistent pathway for bringing legal CBD products to market. To that end, the FDA intends to hold a public meeting "in the near future" to gather stakeholder input on CBD products, including the perspectives of consumers and manufacturers. The FDA will use this meeting to inform an "efficient regulatory framework for allowing product developers that meet the requirements under [FDA] authorities to lawfully market these types of products."

On the other hand, Commissioner Gottlieb expressed concern over the proliferation of CBD products making drug claims. According to Gottlieb, "the FDA requires a cannabis product (hemp-derived or otherwise) that is marketed with a claim of therapeutic benefit, or with any other disease claim, to be approved by the FDA for its intended use before it may be introduced into interstate commerce. This is the same standard to which we hold any product marketed as a drug for human or animal use. Cannabis and cannabis-derived products claiming in their marketing and promotional materials that they're intended for use in the diagnosis, cure, mitigation, treatment, or prevention of diseases (such as cancer, Alzheimer's disease, psychiatric disorders and diabetes) are considered new drugs or new animal drugs and must go through the FDA drug approval process for human or animal use before they are marketed in the U.S."

Even before the passage of the Farm Bill, the FDA has kept a close watch on certain health claims being made by CBD manufacturers. A simple web search on the FDA's website turns up dozens of previous warning letters to CBD manufacturers making such claims (see below for links to FDA warning letters). According to Gottlieb, "the FDA will continue to evaluate and take action against products that are being unlawfully marketed and create risks for consumers."

In his statement, Gottlieb also presented the following warning for CBD additives to food and beverages:

"Additionally, it's unlawful under the FD&C Act to introduce food containing added CBD or THC into interstate commerce, or to market CBD or THC products as, or in, dietary

supplements, regardless of whether the substances are hemp-derived. This is because both CBD and THC are active ingredients in FDA-approved drugs and were the subject of substantial clinical investigations before they were marketed as foods or dietary supplements. Under the FD&C Act, it's illegal to introduce drug ingredients like these into the food supply, or to market them as dietary supplements. This is a requirement that we apply across the board to food products that contain substances that are active ingredients in any drug."

In response to Gottlieb's statement, Sens. Ron Wyden (D-Ore.) and Jeff Merkley (D-Ore.) sent a letter to the FDA on Jan. 15 urging the agency to update federal regulations governing the use and interstate sale of certain hemp-derived ingredients in food, beverages or dietary supplements. The two senators, who authored the 2018 Farm Bill's Hemp Farming Act provision, indicated that it was "Congress' intent to ensure that both U.S. producers and consumers have access to a full range of hemp-derived products, including hemp-derived cannabinoids." They requested feedback from FDA within 30 days on the agency's specific plans regarding implementation of the 2018 Farm Bill.

Sample Of FDA Warning Letters On CBD Products:

https://www.fda.gov/ICECI/EnforcementActions/WarningLetters/ucm616278.htm

https://www.fda.gov/ICECI/EnforcementActions/WarningLetters/2017/ucm583192.htm

https://www.fda.gov/ICECI/EnforcementActions/WarningLetters/2017/ucm583197.htm

Notable State-Level Events

California

California has historically been more aligned with the FDA's stance that industrial hemp-derived CBD cannot be used in food or dietary supplements. However, that state does permit the sale of food products with cannabis-derived CBD in licensed dispensaries. The Food and Drug Branch of California Department of Public Health (CDPH) issued an updated FAQ on CBD in food products in July 2018 indicating that its definition of "food" does not include cannabis products like edibles, which are legal in California. CDPH also technically bans the sale of CBD oil outside of licensed cannabis retailers, though it isn't always enforced.

Separately, California Governor Jerry Brown signed a law in late September 2018 (Assembly Bill 2914) that bans the addition of CBD or THC to any cocktail at a public establishment. The new law "prohibit[s] an alcoholic beverage licensee from, at its licensed premises, selling, offering, or providing cannabis or cannabis products, including an alcoholic beverage that contains cannabis or cannabis products, and would provide that no alcoholic beverage shall be manufactured, sold, or offered for sale if it contains tetrahydrocannabinol or cannabinoids, regardless of source."

Maine

Despite being one of 10 states to legalize marijuana for recreational use, health officials in Maine recently ordered businesses in the state to remove CBD-infused edibles from store shelves according to an article in the *Portland Press Herald.* Similar to California, the Maine Department of Health and Human Services appears to be following the FDA's lead in determining that CBD is an unapproved food additive.

State health inspectors in Maine have reportedly told businesses to remove "all foods, tinctures and capsules" containing CBD from their shelves; however, business owners can still sell "CBD products that can be smoked, vaped, worn as a patch or applied as a lotion, and all medical marijuana patients can still buy oral CBDs from licensed caregivers or dispensaries."

New York

In response to the 2018 Farm Bill, the New York State Department of Agriculture and Markets issued a FAQ dated Dec. 18, 2018 on the manufacture and sale of hemp-derived CBD products. The department indicates that its current guidance is subject to change and that it will likely be issuing additional regulations as the industry evolves.

The FAQ suggests that New York will allow the sale of CBD products sold as a topical or dietary supplement (pill or tincture), the latter of which runs counter to FDA's current position. However, the guidance appears to restrict CBD products for vaping/inhalation.

Additionally, New York will require licensure and prior written approval to produce and sell certain food and beverages under the New York State Industrial Hemp Research Pilot Program. Licensees under the program can sell products that are "(1) listed in your Research Plan and (2) produced in a facility meeting dietary-supplement GMP standards and (3) properly labeled and packaged for sale pursuant to FDA regulations for dietary supplements, and (4) in compliance with all provisions of the Research Partner Agreement."

Otherwise, New York will restrict the manufacture and sale of ready-to-eat food and beverage products with added CBD infusions or CBD extracts and lists products such as "CBD chocolate syrup, CBD soda, and CBD-infused frosting drizzled cookies." In early February, the *New York Times* reported that the New York Department of Health and Mental Hygiene was beginning to more aggressively enforce this restriction in New York City restaurants and eateries.

North Carolina

The North Carolina Department of Agriculture and Consumer Services recently announced its intent to issue warning letters to manufacturers and retailers who sell products containing CBD oil in the state. According to a Feb 8 press release, North Carolina will follow current federal laws, meaning that "CBD cannot legally be added to any human food or animal feed that is for sale," as CBD is the active ingredient in an FDA-approved therapy and cannot be considered a dietary supplement.

North Carolina intends to take an "educate before regulate stance with industry," according to the release. However, the state will "reserve the right to be more assertive" to ensure consumer health and safety, likely meaning product embargoes and seizures.

Ohio

State and local health officials in Ohio have also begun cracking down on retailers selling CBD products, according to a recent report from the *Cincinnati Enquirer*. The Ohio Department of Agriculture is reportedly ordering the "embargo" of products containing CBD, which has forced some businesses to remove products from store shelves.

Like most states, Ohio has not yet set up regulations for hemp, which the 2018 Farm Bill requires from each state before the manufacture and sale of certain hemp-derived products. In the meantime, CBD sales are technically limited to one of the Ohio's 56 licensed dispensaries, under the state's medical marijuana program.

Global CBD Landscape (Azer)

International Drug Conventions (UN)

There are three international conventions that are core to the drug control system: (1) 1961 Single Convention on Narcotic Drugs, (2) 1971 Single Convention on Psychotropic Substances and (3) 1988 Single Convention Against Illicit Traffic in Narcotic Drugs and Psychoactive Substances.

Under the 1961 Convention, cannabis extracts and tinctures are currently classified as Schedule I substances based on high abuse and dependence potential. Resin and herbal cannabis are classified as Schedule IV, the most prohibitive category, including dangerous substances that have little to no medical benefits. THC is classified as a Schedule II substance in the 1971 Convention. CBD does not currently have its own scheduled class in the Conventions. Based on recent recommendations from the World Health Organization (WHO), these classifications are likely to change in the short term.

Although the cannabis plant, as a whole, is scheduled under the conventions, there is not a distinct separation between marijuana and hemp at the moment. However, there is an exemption in the conventions for industrial uses of hemp, permitted there is no potential for abuse. The language in the treaties is vague and has allowed member states to interpret the conventions in a way that permits the use of hemp to fit their national legislation. This is a principle based on the practice of "good faith."

Cannabis Recommendations (WHO)

Beginning in November 2017, CBD was subject to its first pre-critical review conducted by the WHO at the 39th meeting of the Expert Committee on Drug Dependence (ECDD). Following the critical review of CBD at the ECDD's 40th meeting, it was recommended that "pure CBD should not be scheduled in the International Drug Control Conventions." Further clarifications were recently added outlining that CBD preparations containing less than 0.2% THC should be removed from the drug conventions. The clarification does not specifically mention the difference between CBD preparations derived from hemp or marijuana. This outcome is based on expert consultations that found that CBD has no potential for abuse or dependence. CBD will be the first cannabinoid not controlled under international law.

The WHO also recommended that THC be removed from the 1971 Convention and listed under Schedule I. Similarly, it recommended that herbal cannabis and resin remain under Schedule I and removed from Schedule IV of the 1961 Convention. Extracts and tinctures were also recommended to be removed from Schedule I. This marks a historic decision because this was the first time cannabis has ever been subject to a critical review conducted by the WHO.

In March 2019, the Commission on Narcotic Drugs, comprised of 53 countries, will vote on the WHO's recommendations to schedule substances. A simple majority is required. However, it is uncertain whether the member states will vote on cannabis and its derivatives since the WHO delayed the announcement of the recommendation by two months. This may postpone the vote until 2020.

When the vote is passed to remove pure CBD and CBD preparations, countries that permit the use of pure CBD and preparations of CBD will not be in violation of any international treaties. Although countries would no longer be obliged to enforce any control on CBD, national jurisdictions may still implement measures to regulate or prohibit CBD use.

European Landscape

European Parliament Resolution

In February 2019, the European Parliament passed a significant resolution to create harmonized policies and standardized practices for medical cannabis products in the EU. The Parliament stressed the importance of conducting clinical trials, which requires a formal assessment of socio-economic and regulatory barriers that have prohibited access to research in the past. This is not a legislative, binding resolution; the European Commission will need to consider a regulatory framework that permits access and availability to cannabis medicine, therapies and scientific studies.

The European Parliament explicitly stated support for the WHO's recommendations to institutionalize the medical and scientific uses of cannabis. Having these two international institutions aligned on standardizing medical cannabis policies will facilitate support for interstate agreements and trade, and paves way for rapid legislative change and growth.

EU Standards And Regulations

There is not a supranational regulatory framework for cannabis in the EU. However, general standards, such as Good Manufacturing Practice (GMP), Good Agricultural and Collection Practice and Good Distribution Practice, are now significant for cannabis compliance. Licenses and authorization must be obtained for certification. This is especially required for pharmaceutical grade cannabis, which is why many Canadian LPs can export to Europe and made investments to build GMP-certified facilities. Although not necessary for non-prescribed cannabis, products with GMP-certification have trusted quality recognition across the EU.

In the EU, the legal limit for THC content is less than 0.2%, in comparison to North America where it is less than 0.3% THC. There are some disparities across the continent with higher margins in Italy (up to 0.6%) and various import requirements country to country. Outside of the EU, Switzerland permits up to 1% THC content, which is treated as a tobacco substitute.

EU Novel Food

Recently, CBD has been added to the European Union's (EU) Novel Food Catalogue. Foodstuff may be supplements, ingredients or other substance forms. A "novel" food is a product not previously consumed in the EU, to a significant degree, prior to May 15, 1997, such as for example, foods that enter the market through new technology or agricultural products normally consumed and grown outside of the EU (e.g. chia seeds, vitamin K, UV treated food).

Amendments to the Catalogue occur frequently and provide a regulatory framework for EU Member States (MS) to follow. Some MS (i.e. UK, France, Germany, Italy, and Holland) requested to update the catalogue with CBD and hemp-derived products. The European Food Safety Authority (EFSA) is now conducting a risk assessment for CBD. This categorization includes pure CBD extracts and products that contain CBD extracts. The EFSA's assessment is limited to a daily intake of 130 milligrams. The outcome of the review is expected in March 2019. By October 2019, the European Commission will release a draft act to authorize CBD in the updated Catalogue.

While the EFSA assesses CBD, some countries have already banned the sale of CBD and removed product from the shelves (e.g. France, Austria). MS may have their national food or health agencies provide further guidance for CBD products and preparations. Obtaining authorization for CBD and hemp-derived products (e.g. tinctures, edibles,

beverages) will be imperative. This regulatory framework does not affect skincare, cosmetics or topicals with CBD or hemp ingredients.

Europe

UK

The UK legalized prescription based medical cannabis in November 2018. Medical cannabis treatments that are advertised with specific medical claims must obtain authorization from the Medicines and Healthcare Regulatory Agency (MHRA). Currently, licensed medical cannabis products are Sativex, Dronabinol and Nabilone. Epidiolex, medical grade pure CBD produced by British pharmaceutical company, GW Pharmaceuticals, is undergoing the licensing process. "Unlicensed" products may be able to be obtained, such as products from Tilray or Bedrocan, under special circumstances which are unmet by other licensed products. Canopy and Aurora announced at the beginning of 2019 that it plans to export to the UK later this year. Despite changes in legality, the number of patients who have been prescribed medical cannabis treatments is quite limited.

While pharmaceutical grade products are difficult to obtain, CBD products are widely available across the UK. Pure CBD is not a controlled substance under the Misuse of Drugs Act 1971. Therefore, as long as CBD products are not authorized by the MHRA, medical claims on labeling and packaging cannot be made. There are also no enforced regulations for testing or packaging. These loopholes in the legislation have led to an increasing number of CBD products marketed as health supplements or wellness products. Due to the growing trend, CBD products have been widely available across the UK, primarily sold in boutique shops, cafes, health stores and online. Holland and Barrett, a health foods store, was the first High Street store to carry CBD products in 2017. Other mainstream outlets now sell hemp-based beauty products, CBD tinctures, edibles, vapes, e-liquids and other forms of the substance. A handful of restaurants also offer CBD cocktails or hot drinks, and the number of kitchens and chefs using cannabis-based products is increasing across the country.

However, in January 2019, the UK Food Standards Agency (FSA) announced that it plans to conduct an investigation of CBD products for consumer safety. It is expected that the FSA will later provide requirements for authorization. This may take up to 18 months. Although enforcement is unclear at the moment, some CBD products have already been removed from the shelves. Since the FSA's assessment does not apply to cosmetics or skincare products with CBD, some CBD companies have expressed interest in launching beauty products now.

A license is required in order to cultivate hemp in the UK. There are restrictions on where the farm can be located that must be approved by the Home Office. Many companies still struggle to secure banking and payment options for their hemp-related businesses. A lobbying group, the British Hemp Association, was formed to educate and push for legislative changes, such as whole plant processing and financial support. Due to barriers of entry, the number of hemp farmlands is small, around 810 hectares.

Italy

Medical cannabis has been legal in Italy since 2013, yet access and supply remained restricted for years. In 2017, the Military Chemical and Pharmaceutical Plant (MCPP) received a license to cultivate medical cannabis, which supplemented the imported supply from the Netherlands (i.e. from Bedrocan). The MCPP cultivates a medical cannabis product, FM2, that contains 5-8% THC and 7.5-12% CBD. A high THC product (FM1) and a CBD product (FM0) will soon be available. The MCPP only produces 100-150

kg per year, which has led to a shortage of supply. In 2018, an import license was granted to Canadian licensed producer (LP), Aurora, for 100 kg of medical cannabis per year to help meet the demand.

Italy has a rich history of hemp cultivation and it used to be one of the main producers in the world prior to prohibition of the plant. The market opened up in 2016 when the government announced that a license to cultivate hemp for industrial, food, cosmetic and energy purposes was no longer required. Whereas the rest of the EU requires THC content to be below 0.2%, Italy permits a margin of up to 0.6%.

Based on the license exemption, many companies started producing and selling high CBD, low THC referred to as "cannabis light." Cannabis light products must state that the product is not for human consumption; however, once a person purchases the product the use is essentially up to their own discretion. These products are legally sold and branded as "collectors' items." Since it is a "collectors' item," imported "cannabis light" products are not taxed. However, it is necessary to have proper test and analytics when crossing the border to guarantee the product passes customs.

One of the first "cannabis light" companies, EasyJoint Project, launched in 2017 and is sold in hemp specialist shops. There are now around 1,000 e-commerce sites and other retail stores that sell CBD oil, capsules, CBD for pets, dried flower, vapes and cosmetics. Legally, the Health Ministry must approve products, yet this is not frequently enforced.

Foreign companies have invested in land over the last couple of years, including public Canadian companies Wayland, LGC Capital, Canopy and CROP. In 2018, Wayland entered a JV with CBD Italian Factory S.S. with plans to supply the local market with CBD for medical, therapeutic and veterinary purposes. LGC Capital entered an agreement with EasyJoint to acquire 47% of the company to gain access to the local "cannabis light" companies' 415 retail outlets and 11 branded stores. In February 2019, Canopy made an investment in Italian organic hemp producer and CBD extractor, Canapar Corp. CROP, a Canadian holdings company, acquired 30% of Italian company, Zhemplar, to cultivate and extract low THC, high CBD products, under a white label brand, Tiffany CBD and Hempire Italia. The company also has exclusive rights with Yield Growth Corp to over 55 wellness products that can be infused with CBD.

Switzerland

Switzerland is recognized for its progressive drug policies and evidence based approaches. Medical cannabis has been regulated since 2008 and continued to open with regulatory changes in 2017. The number of patients is relatively small, at around 3,000 people. Prior to June 2018, it was not possible to obtain pharmaceutical grade pure CBD for medical purposes. That changed once the Food and Drug Administration in the U.S. approved Epidiolex; subsequently, the Swiss law changed, too. Pharmacies can now prepare magistral formulas for CBD for patients who meet certain conditions

Although cannabis is controlled under the Narcotics Act, CBD is not included in that legislation. The country permits 1% THC to be cultivated, produced and used, which is regulated as a tobacco substitute. These products (e.g. pre-rolled joints, dried flower, and cannabis cigarettes) are regulated under the Tobacco Ordinance and can be purchased in supermarkets, specialty shops, kiosks and cafes. The first cannabis cigarette was available for purchase in 2017. These products are predominantly consumed by affluent businesspeople during breaks at work or the end of the day.

The Federal Office of Public Health (FOPH) provides regulatory oversight for tobacco and CBD products. Registration with the FOPH is required for tobacco substitutes to

guarantee quality control and compliance. However, this is practiced under "self-supervision" requiring the company to register products prior to market placement. In recent years, the FOPH has been removing CBD products from storefronts due to lack of self-compliance, transparency and false claims.

Swiss law also permits CBD to be used in pure or synthesized form for cosmetic products. The Federal Food Safety and Veterinary Office regulates cosmetic products as well as products that contain hemp-derived ingredients and CBD liquids for e-cigarettes. None of these products can make any pharmacological claims. The Federal Office for Agriculture regulates hemp seeds, oil, fiber, etc, and seeds must be certified and listed under the European Union's Common Catalogue of Varieties.

From 2017 to 2018 there was an influx in the number of cannabis companies in Switzerland, leveling off from around 500 companies to around 100 companies. While many are supplying the local market, a number of companies are exploring and exporting to neighboring markets (e.g. Italy, France, Germany). Beyond their geographical advantage, Switzerland also is recognized for its quality and sophisticated pharmaceutical sector.

At the end of 2018, LGC Capital entered a partnership with Viridi, a Swiss cultivator, processor and distributor of high-CBD products. Wayland acquired Haxon AG, a Swiss hemp producer of 1% THC products. Creso Pharma Limited entered into an agreement with Hempmate Zurich AG for further expansion into the European CBD market.

France

Medical cannabis has been legal in France since 2013 and Marinol has been the only product prescribed. In 2018, the ANSM launched an investigation to explore scientific data for therapeutic uses of the plants, type of eligible conditions and consider regulatory frameworks in other legal medical markets. An initial recommendation found that legal medical cannabis should be authorized and final recommendations are expected to be released by September 2019. Aurora has already announced plans to expand into France by investing in infrastructure prior to the market opening.

France is the leading hemp cultivator and processor in Europe, and the global leader in hemp seed production. In 2016, there was a total of 33,000 hectares growing hemp. Stalks and seeds can be processed, yet buds cannot be legally processed, unless for medical purposes. Synthetics are permitted for use. The country permits the cultivation of 20 strains, approved by the EU. There is one company, Hemp-it, that has received a license to grow different varieties.

Despite its leading position in hemp production, the French government has cracked down on the sale of hemp-derived products and CBD sold in stores, cafes and seed shops, as a response to public health and safety. Over the past few months, the Ministry of Social Affairs and Health and National Agency for the Safety of Medicines and Health products (ANSM) have been conducting a review on the uses and authorizations required for CBD. There are a number of CBD and hemp-derived skincare and cosmetic companies that sell lotions, cremes, pain balms, beard oils, etc. France's extensive history in the cosmetics industry positions the country well for CBD skincare.

Latin American Landscape

Chile

Medical cannabis has been legal in Chile since 2017 following a pilot program conducting scientific research that began in 2014. A consortium of non-for-profit organizations, most notably the Daya Foundation, ran this program. They treated over 1,000 patients in the first year of operations. Following the regulatory change in 2017, imported medical cannabis products were available from pharmacies.

Product authorization and cultivation licenses are required to grow and distribute medical cannabis products in country. The Agricultural and Livestock Service of Chile governs these licenses. Chile also permits home-grow, which is popular in the country and the region.

Dayacann (part of Daya Foundation) was the first company to receive a license to cultivate medical cannabis in Chile. Khiron Life Sciences entered an MOU with Dayacann in January 2019 to further expand into the Chilean market of around 1.8 million patients. In 2018, Tilray entered a partnership with Alef Biotechnology (now Tilray Latin America) for distribution in Chile and Brazil, and recently received a license to cultivate and process medical cannabis products. Two Tilray products, T100 and TC100 were approved for prescription in 2016. Canopy Growth's Spectrum Cannabis Chile is also operating in Santiago focused on medical research and patient outreach.

Hemp production has been part of Chile's history, dating back to the 1500s, and has remained legal. There have been provisions in Chilean law to differentiate between cannabis and hemp. Despite its legality, there are not many hemp farms in the country. Chile hosts Expoweed, a hemp trade show, that is Latin America's biggest hemp event. With the land and history, the country has positioned itself for growth as demand for hemp-based products increase.

Colombia

Colombia is becoming a Latin American hub for cannabis cultivation due to favorable climate and cost of production. The country permits exports of extracts only, with the exception of small quantities of dried flower that are exported for scientific reasons. Only permitting extracts for export is strategic to have traceability from seed to harvest and production. This is in order to curb organized crime and money laundering related to the country's history of drug trafficking. There have been trade agreements established between the EU and Canada in order to facilitate exportation of extracts.

The governments passed legislation for medical use in 2015, which was formally implemented in 2016, and a framework for medical cannabis cultivation was established in 2017. The country issues four types of licenses: 1. Cannabis Seeds (for scientific purposes) 2. Cultivation (psychoactive cannabis) 3. Manufacturing (cannabis derivatives) 4. Cultivation (non-psychoactive cannabis). Another license is required to export. Clever Leaves became the first Colombian company in February 2019 to export medical cannabis to Canada.

Many Canadian LPs have opened operations in Colombia, including Canopy, Aurora, Plena Global, Khiron Life Sciences, Blueberries Medical Corp, Pharmacielo and Wayland. Some of these companies are focused on cultivating strains for CBD. Pure Harvest Cannabis Producers recently entered a JV for land in Colombia to produce CBD from hemp and cannabis. Pharmacielo also secured a proprietary license to cultivate 10 strains, some CBD and some THC dominant. The company registered their seeds, which is now required following an amnesty period for seed genetics that ended December 31,

2018. Organto received a license to produce high-CBD strains and Foulimed intends to cultivate 70 tones of hemp and cannabis for medical purposes. Colombia enjoys an advantageous climate for cultivating cannabis at a low cost for production, which has attracted interest from many foreign companies.

Mexico

Medical cannabis has been regulated in Mexico since 2017. This regulatory change followed a favorable Supreme Court ruling for a young girl who treated her Lennox-Gastaut syndrome with CBD oil in 2015. It is permitted to have medical cannabis products with up to 1% THC content and these products are regulated by the Health Ministry. Aurora (through their subsidiary Farmacias Magistrales) recently received a license to import medical cannabis products containing over 1% THC. Pharamacielo recently announced a JV with Mexican pharmaceutical company MINO Labs S.A. de C.V. to distribute medical cannabis domestically.

Mexico is the second largest hemp producer in Latin America. The law changed in 2017 to permit the cultivation and processing of industrial hemp. In November 2018, the government released a list of 38 OTC products – 21 food supplements, 9 cosmetics, 6 edibles or beverages, 2 raw material – that have been approved for sale in the country. Seven companies received authorization for these products, which includes 2 American, 4 Mexican and 1 Spanish company. These products must contain no more than 1% THC. Products can be purchased through retail stores and e-commerce sites. The regulatory agency authorizing these products is the Mexican Federal Commission for Protection Against Sanitary Risks.

Mexico has announced plans to legalize cannabis for adult-use purposes in 2019, which would significantly change the shape of the market opportunities. The country would become the third in the world to implement a nationwide policy to legalize cannabis for all purposes. In the proposed legislation there would include six types of cultivation licenses – 1. Personal, 2. Scientific, 3. Therapeutic, 4. Recreational, 5. Pharmaceutical and 6. Industrial – five manufacturing licenses – 1. Personal, 2. Therapeutic, 3. Pharmaceutical, 4. Recreational and 5. Industrial – and three distribution licenses – 1. Therapeutic, 2. Pharmaceutical and 3. Industrial. These considerations are still pending. While this will bring many changes to the regulatory framework, home-grow has been legal for personal use since 2015.

Former President Vicente Fox has become a public figure in the cannabis industry by accepting a position at Khiron Life Sciences, one of the leading Latin American producers. The company launched a nutraceutical line, Kuida Life Mexico S.A., at the end of 2018. They receive approval to import CBD-based supplement products for sleep, digestion and muscle recovery. Khiron also entered a JV with American edibles company Dixie Brands for distribution in the Latin American market.

Uruguay

Uruguay was the first country in the world to legalize cannabis for all purposes nationwide in 2017. However, medical cannabis has been regulated in the country since 2013 and an industrial hemp program has been implemented since 2010. The Institution of Regulation and Control of Cannabis provides regulatory oversight for the medical market.

There are two licensed producers in Uruguay, and thus, the market has not opened to many foreign entities. This has led to a shortage of supply for the domestic market. Addressing supply issues, the country announced plans to rework the framework to permit more imports and opened applications for up to five more licenses.

The current licensed companies have already entered agreements with publicly traded cannabis companies. In 2018, Aurora acquired Uruguayan fully licensed ICC Labs Inc. (ICC) that operates a GMP-certified lab facility, indoor and outdoor grow operations and distributes CBD-based products under the brand BIDIOL. In January 2019, Khiron acquired NettaGrowth International Inc., which gives the company access to one of the two currently held medical cannabis licenses in Uruguay.

The amount of land cultivating hemp increased since 2016 but it not at the commercial scale yet. There are intentions to grow hemp in order to extract CBD for pharmaceutical and nutraceutical uses. Although cultivation of CBD with less than 1% THC is permitted, it is relatively difficult to access CBD products in Uruguay at the moment. In 2018, Auxly Cannabis Group acquired Uruguayan hemp cultivator and extractor Inverell S.A. with plans to develop and distribute CBD products.

Additional Applications / Implications (Nadeau & Osborne)

Epilepsy & Psychiatric Conditions (Nadeau)

For companies willing to invest in research and manufacturing, the development of FDA-approved cannabinoid-based drugs provides another path to market. GW's Epidiolex (highly potent, pure CBD) was approved by the FDA in 2018, and several other companies are dedicating resources to conducting the pre-clinical and clinical research necessary to follow in GW's footsteps. These companies are developing cannabinoids that differ by route of administration (oral capsule, oromucosal spray, sublingual pill, aerosol, topical cream, etc), formulation (level of purification, bioavailability, concentration), and dosing strategy (single agent or in combination). Below we summarize the clinical trial data from GW's Epidiolex in epilepsy and psychiatric indications, and Zynerba's transdermal CBD gel ZYN002 in Fragile X syndrome.

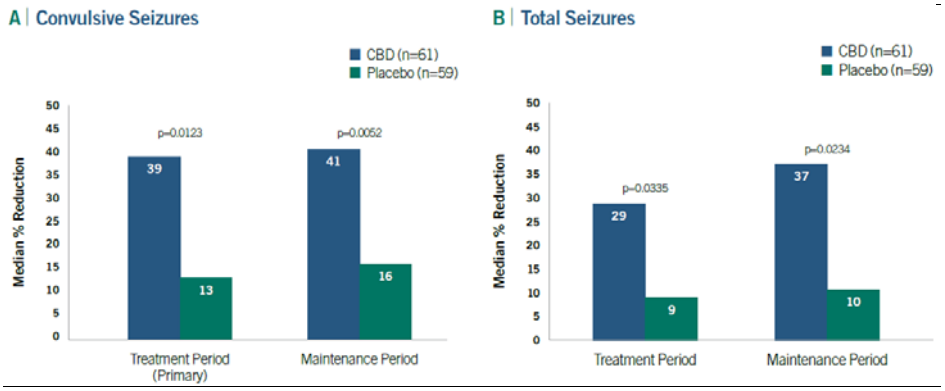
GW conducted a broad Phase III program for Epidiolex in epilepsy, consisting of two Phase III trials in Dravet, two Phase III trials in Lennox-Gastaut syndrome (LGS), a Phase III trial in tuberous sclerosis complex, and a Phase II/III trial in infantile spasms. The first three Phase III trials (one in Dravet and two in LGS) supported an NDA submission, leading to FDA approval in June 2018.

The Phase III efficacy portion of the first Dravet trial randomized 120 patients to either Epidiolex (20 mg/kg/day, n=61), or placebo (n=59). Epidiolex was added to background anti-epileptic drugs (AEDs). On average, patients were taking ~3 AEDS after previously having failed 4 or more. The average age of trial participants was 10 years and 30% of patients were less than 6 years of age. Patients entered the study with a median baseline convulsive seizure frequency of 13/month. The primary endpoint was the % change in monthly frequency of convulsive seizures during the 14-week treatment period compared with the 4-week baseline between Epidiolex and placebo.

On the trial's primary endpoint, Epidiolex achieved a highly statistically significant median reduction in monthly convulsive seizures of 39% compared with a reduction in placebo patients of 13% (p=0.01). The difference between Epidiolex and placebo emerged during the first month of treatment and was maintained through the entirety of the treatment period. Nine pre-specified sensitivity analyses of the primary endpoint confirmed the robustness of the primary endpoint result. These analyses dealt with statistical elements such as the data's normality, assumptions about discontinuations, and the time period over which the data were analyzed. A number of secondary endpoints were also assessed (responder analysis, seizure types, global impression of change).

Full data were presented at AES 2016. This presentation disclosed that during the maintenance period the reduction in seizure frequency was 41% for Epidiolex vs. 16% for placebo, p=0.0052. The median reduction in total seizures was 29% for Epidiolex vs. 9% for placebo during the treatment period, and 37% for Epidiolex vs. 10% for placebo during the maintenance period. There was a clear separation between Epidiolex and placebo in a continuous response analysis of convulsive seizures across all reductions in convulsive seizure frequency. In particular 43% of Epidiolex patients vs. 27% of patients taking placebo had at least a 50% reduction in convulsive seizures. 62% of Epidiolex patients vs. 35% of placebo patients were rated slightly improved, much improved, or very much improved on the Caregiver Global Impression of Change (CGIC). It was noted that three Epidiolex and no placebo patients achieved convulsive and total seizure freedom during the treatment period. While the poster did not discuss the impact of concomitant clobazam on efficacy, it did note that "the effect of concomitant AEDs on efficacy will be explored in future pooled analyses."

Figure 121 Efficacy Results From Epidiolex's First Phase III Trial In Dravet Syndrome



Source: GW Pharma, AES 2016

The most common adverse events were reported to be somnolence (36% in patients on Epidiolex vs. 10% in placebo patients), diarrhea (31% vs. 10%), decreased appetite (28% vs. 5%), fatigue (20% vs. 3%), pyrexia (15% vs. 9%), and vomiting (15% vs. 5%). Importantly, there was no difference in the number of patients who experienced status epilepticus between Epidiolex (n=4) and placebo (n=3). Increases in ALT or AST (>3x ULN) occurred in 12 CBD and 1 placebo patient, all of whom were on concomitant valproic acid. All elevations resolved. SAEs were seen in 10 Epidiolex patients vs. three on placebo. Eight patients on Epidiolex discontinued treatment compared with one patient on placebo, due to adverse events similar to those above, including three due to ALT/AST elevations.

Figure 122 Safety Data From Epidiolex's First Phase III Trial In Dravet Syndrome

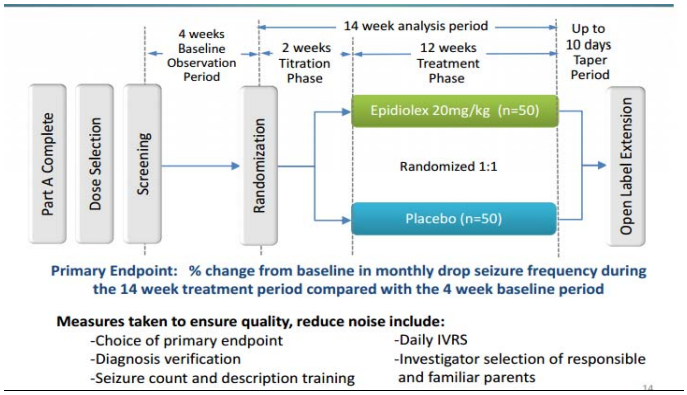
	CBD (n=61) n (%)	Placebo (n=59) n (%)
All-causality TEAEs	57 (93.4%)	44 (74.6%)
Treatment-related TEAEs	43 (70.5%)	16 (27.1%)
TEAEs leading to withdrawal	9 (14.8%)	1 (1.7%)
Serious TEAEs	10 (16.4%)	3 (5.1%)
Treatment-related serious TEAEs	5 (8.2%)	0
TEAEs reported in >10% of patients in either group by preferred term		
Somnolence	22 (36.1%)	6 (10.2%)
Diarrhea	19 (31.1%)	6 (10.2%)
Decreased appetite	17 (27.9%)	3 (5.1%)
Fatigue	12 (19.7%)	2 (3.4%)
Pyrexia	9 (14.8%)	5 (8.5%)
Vomiting	9 (14.8%)	3 (5.1%)
Lethargy	8 (13.1%)	3 (5.1%)
Upper respiratory tract infection	7 (11.5%)	5 (8.5%)
Convulsion	7 (11.5%)	3 (5.1%)

Source: Cowen and Company

In 2015, GW initiated two Phase III trials in Lennox-Gastaut Syndrome. The first trial enrolled 171 patients, and the second enrolled 225. In the first LGS study, the patients were randomized 1:1 to 20mg/kg or placebo while in the second, they were randomized 1:1:1 to 20mg/kg Epidiolex, 10mg/kg Epidiolex, or placebo. The LGS trials assessed drop seizures (atonic, tonic, and tonic-clonic seizures that involve the entire body, trunk or head that led or could have led to a fall, injury, slumping in a chair or hitting the patient's

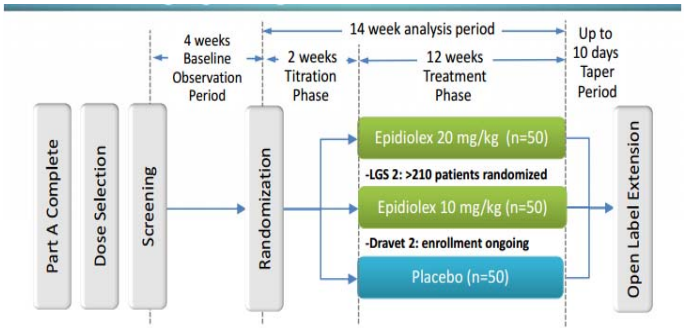
head on a surface). The primary efficacy endpoint of the trials was a comparison between Epidiolex and placebo in the percentage change in the monthly frequency of drop seizures during the 14 week treatment period (including 2 weeks of dose escalation) compared to the 4 week baseline period. Following the completion of the blinded portion of the trial, all patients were eligible to receive Epidiolex in an open label extension study.

Figure 123 1st LGS Phase 3 Trial Design



Source: GW Pharma

Figure 124 2nd LGS Phase 3 Trial Dose Ranging Design



Source: GW Pharma

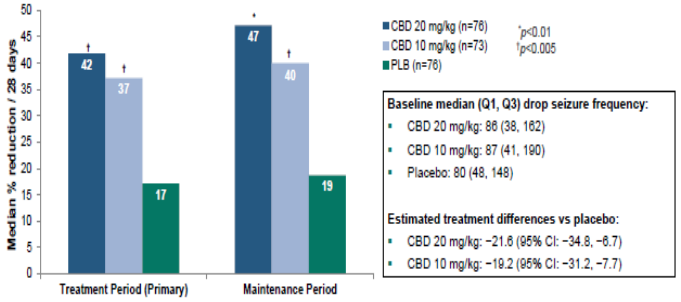
The first Phase III trial, patients were on an average of three AEDs, and had previously tried and failed an average of 6 other AEDs. Even on their baseline medications, the patients were experiencing a median baseline drop seizure frequency of 74 per month. The average age of patients in the trial was 15 years, although 34% were 18 years or older. On the primary endpoint, Epidiolex produced a median reduction in monthly drop seizures of 44% compared to a reduction of 22% in patients taking placebo (p=0.0135). Epidiolex reduced all seizures by 41% vs. a 14% reduction for placebo (p=0.0005), while the reduction in all seizures during the maintenance period was 45% for Epidiolex vs. 15% for placebo (p=0.0004). Similar to the Dravet trial, there was a clear separation between Epidiolex and placebo on percent reduction in drop seizure frequency across all magnitudes of reduction. In particular, 44% of Epidiolex patients had at least a 50% reduction in drop seizures, compared to 24% of patients taking placebo (p=0.0043). 58% of Epidiolex patients compared to 34% of placebo patients were rated as "slightly improved", "much improved" or "very much improved" on the Subject/Caregiver Global Impression of Change.

Epidiolex appeared to be well tolerated in the trial. 86% of patients on Epdiolex had an adverse event, compared to 69% of placebo patients. The most common adverse events were diarrhea (19% of patients on Epidiolex vs. 8% of placebo patients), somnolence (15% vs. 9%), pyrexia (13% vs. 8%), decreased appetite (13% vs. 2%) and vomiting (11% vs. 17%). Again, there was no difference in the number of patients who experienced status epilepticus between Epidiolex (n=1) and placebo (n=1). There was one death in the Epidiolex group from acute respiratory distress syndrome, but it was not considered treatment related. Increases in ALT or AST (>3xULN) occurred in 20 CBD and 1 placebo patient, all of whom were on concomitant valproic acid. All elevations resolved.

In September 2016, GW announced that Epidiolex's second Phase III pivotal trial (GWPCARE3) in the treatment of Lennox-Gastaut syndrome was also successful. On average, patients were on 3 AEDs at baseline, having previously tried and failed a mean of 7 other AEDs (median=10). The median baseline drop seizure frequency was 85 per

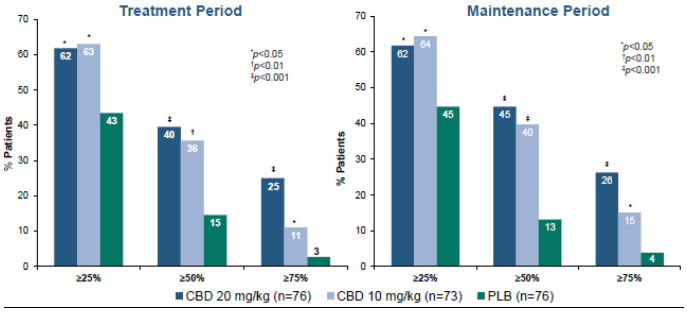
month and the average age of patients in the trial was 16 yrs, although 30% were 18 yrs or older. On the primary endpoint, 20 mg/kg Epidiolex produced a median reduction in monthly drop seizures of 42% compared to a reduction of 17% in patients taking placebo, p=0.0047. There was also a suggestion of a dose response in the data, with the lower 10 mg/kg/day dose of Epidiolex producing a median reduction in monthly drop seizures of 37%, p=0.0016. In both dose groups the difference between Epidiolex and placebo emerged during the first month of treatment and was sustained during the entire treatment period. GW disclosed that the trial's secondary endpoints, and a series of sensitivity analyses, confirmed the robustness of the results. Similar to Epidiolex's other Phase III studies, although patients on clobazam (51%) had some additional benefit, GW indicated that Epidiolex also showed efficacy in patients not on clobazam.

Figure 125 GWPCARE3: Reduction In Drop Seizures



Source: GW Pharma, AAN 2017

Figure 126 GWPCARE3: Responder Analysis



Source: GW Pharma, AAN 2017

Additional data were presented at AAN 2017. Included in this presentation were several of the trial's secondary endpoints and a series of sensitivity analyses. All of these confirmed the robustness of the results. For example, the proportion of patients with a >50% reduction in seizure frequency was 40% for 20 mg/kg Epidiolex (p<0.001), 36% for 10 mg/kg Epidiolex (p<0.01), and 15% for placebo. The proportion of patients with a >75% reduction in seizure frequency was 25% for 20 mg/kg Epidiolex (p<0.01), 11% for 10 mg/kg (p<0.05) Epidiolex, and 3% for placebo. The proportion of patients who achieved seizure freedom was 7% for 20 mg/kg Epidiolex, 4% for 10 mg/kg Epidiolex, and 1% for placebo.

Figure 127 GWPCARE3: Safety

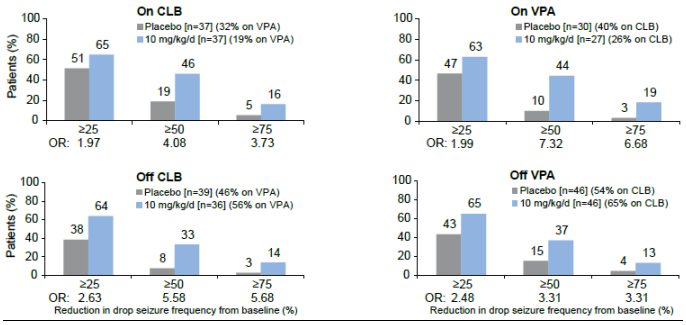
	CBD 20 mg/kg (n=82) n (%)	CBD 10 mg/kg (n=67) n (%)	Placebo (n=76) n (%)
All-causality TEAEs	77 (94)	56 (84)	55 (72)
Treatment-related TEAEs	51 (62)	20 (30)	15 (20)
TEAEs leading to withdrawal	6 (7)	1 (1.5)	1 (1)
Serious TEAEs	13 (16)	13 (19.4)	8 (11)
Treatment-related serious TEAEs	5 (6)	2 (3)	0
TEAEs reported in >10% of patients in any group by preferred term			
Somnolence	25 (31)	14 (21)	4 (5)
Decreased appetite	21 (26)	11 (16)	6 (8)
Diarrhea	12 (15)	7 (10)	6 (8)
Upper respiratory tract infection	11 (14)	11 (16)	11 (15)
Pyrexia	10 (12)	6 (9)	12 (16)
Vomiting	10 (12)	4 (6)	9 (12)
Nasopharyngitis	9 (11)	3 (5)	5 (7)
Status epilepticus	4 (5)	7 (10)	3 (4)

Source: GW Pharma, AAN 2017

Epidiolex appeared to be well tolerated in the trial. 94% of patients on 20 mg/kg Epdiolex and 84% of patients on 10 mg/kg Epidiolex had an adverse event, compared to 72% of placebo patients. 88% of 20 mg/kg patients and 89% of 10 mg/kg patients deemed their adverse events to be mild or moderate. The most common AEs on 20 mg/kg were somnolence, decreased appetite, diarrhea, upper respiratory infection, pyrexia, vomiting and nasopharyngitis. For 10mg/kg the most common AEs were somnolence, decreased appetite, upper respiratory infection, diarrhea, and status epilepticus. None of the cases of status epilepticus on 10 mg/kg were deemed treatment-related. Thirteen patients on 20 mg/kg Epidiolex had an SAE, of which five were considered treatment related; and 13 patients on 10 mg/kg Epidiolex had an SAE, of which 2 were considered treatment related, compared to 8 patients on placebo. Elevations in ALT/AST levels were observed in 11 patients in the 20mg/kg group and 2 patients in the 10mg/kg group; 10 of the 13 patients were also on valproic acid. Five Epidiolex patients withdrew due to the elevations, but none of the patients met the criteria for drug-induced liver injury. GW noted that overall 10 mg/kg seemed to be somewhat better tolerated; 6 patients on 20 mg/kg Epidiolex and 1 patient on 10 mg/kg Epidiolex discontinued treatment due to adverse events, compared with 1 patient on placebo. There were no deaths in the trial. The results of the trial were published in *NEJM* in May 2018.

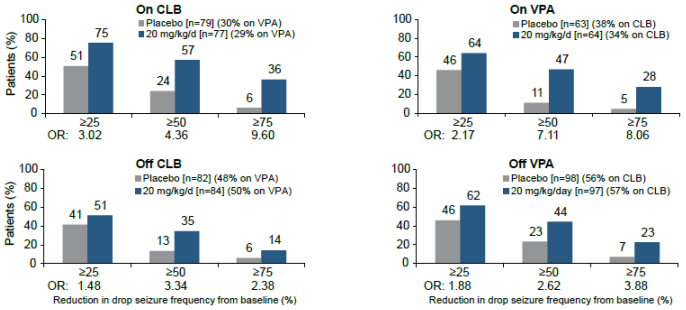
Following the release of Phase III datasets from 1 Dravet and 2 LGS trials, a key area of controversy among investors (though not physicians) had been the drug-drug interaction between Epidiolex and clobazam, and in particular whether Epidiolex was effective in patients who were not also taking clobazam. This was put to rest at AES 2017 when GW presented a pooled analysis of the two Phase III LGS trials evaluating Epidiolex's efficacy with and without concomitant clobazam. Even without clobazam, Epidiolex produced solid placebo-adjusted response rates. Response was characterized in terms of "25% responders", "50% responders", and "75% responders", meaning the proportion of patients who had a 25%, 50%, or 75% decrease in seizure frequency. For patients randomized to Epidiolex's 20mg/kg dose, the placebo-adjusted 50% response rate was 22% for patients on Epidiolex without clobazam, compared to 33% for patients on Epidiolex and clobazam. We believe that investors had been hoping for a 12-15% placebo-adjusted 50% response rate for patients on Epidiolex without clobazam in order to be satisfied that Epidiolex was active without clobazam, and therefore the results cleared this bar. For patients randomized to 10 mg/kg Epidiolex, the placebo-adjusted 50% response rate was 25% for patients on Epidiolex without clobazam, compared to 27% for patients on Epidiolex with clobazam. The results for other thresholds of seizure frequency reduction were also generally solid. For 25% responders, the placebo-adjusted response rate was 9% for patients on 20 mg/kg Epidiolex without clobazam, compared to 24% for patients on 20mg/kg Epidiolex with clobazam. At the 75% responder threshold, the placebo adjusted response rate was 8% for patients on 20mg/kg Epidiolex without clobazam, compared to 30% for patients on 20mg/kg Epidiolex with clobazam. In addition to the pooled Phase III data, there were also abstracts from the compassionate use experience of Massachusetts General Hospital and the University of Alabama Birmingham. The analyses from these two institutions also concluded that Epidiolex does not need to be combined with clobazam to be effective.

Figure 128 Pooled LGS % Seizure Reduction: 10mg/kg Epidiolex vs. Placebo



Source: GW Pharma, AES 2017

Figure 129 Pooled LGS % Seizure Reduction: 20mg/kg Epidiolex vs. Placebo



Source: GW Pharma, AES 2017

GW has also studied CBD in psychiatric indications. Results from an exploratory study of CBD (GWP42003) in schizophrenia were released in September 2015. The trial was a Phase IIa 6 week, placebo-controlled exploratory trial in 88 patients with schizophrenia refractory to first line anti-psychotic medications. To be enrolled, patients must have been treated for a minimum of four weeks on a first line anti-psychotic medication and still have a PANSS total score in excess of 60. CBD was administered as adjunct therapy on a background of antipsychotic medication. The trial did not have a primary endpoint, but rather a number of exploratory endpoints.

CBD consistently demonstrated superiority to placebo, suggesting that CBD may have substantial anti-psychotic effects. CBD produced statistically significant benefits compared to placebo on the PANSS positive sub-scale (p=0.018), the Clinical Global Impression of Severity (p=0.04) and Clinical Global Impression of Improvement (p=0.02). The proportion of responders (improvement in PANSS Total score > 20%) was higher on CBD than placebo (p=0.07), with an Odds Ratio of 2.65. Moreover, CBD trended superior to placebo (p=0.07) on sub-domains of the PANSS that were particularly relevant to cognition in people with schizophrenia. The Scale for Assessment of Negative Symptoms showed a trend in favor of CBD, and reached statistical significance in patients taking CBD together with a leading first line anti-psychotic medication. The rest of the exploratory endpoints, many of which were other scales measuring functionality and cognition in schizophrenia patients, also trended in favor of CBD.

Even in the context of schizophrenia, CBD produced a clean safety profile, with no serious adverse events and a balanced incidence of adverse events compared to placebo. The most common adverse events were diarrhea (9.3% CBD vs. 4.4% placebo), nausea (7% CBD vs. 0% placebo), headache (7% CBD vs. 8.9% placebo) and somnolence (0% CBD vs. 6.7% placebo). There were two withdrawals from the study due to treatment-related adverse events, one each for CBD and placebo.

CBD's activity in schizophrenia is supported by pre-clinical data in animal models, as well as by a recent study published in *The Journal of Clinical Investigations* (2012) which suggested CBD may be useful as either monotherapy or in combination with first line anti-psychotic agents. Nonetheless, while the p-values suggest that CBD has activity, its potency is difficult to judge without knowing the effect sizes. Therefore, additional data from this and subsequent studies will be necessary to fully understand the potential of CBD in schizophrenia. GW Pharma has indicated that it intends to pursue CBD's future development in pediatric orphan neuropsychiatric indications.

GW's platform allows it to produce chemotypes with precise concentrations of various cannabinoids, and the company is testing numerous other cannabinoids. GW's CBDV drug is in a 10 patient investigator sponsored trial in autism spectrum disorders, and a Phase II 100 patient placebo controlled trial in this indication began in December 2018. GW is also investigating CBDV for use in epilepsy, though the first clinical trial was not successful.

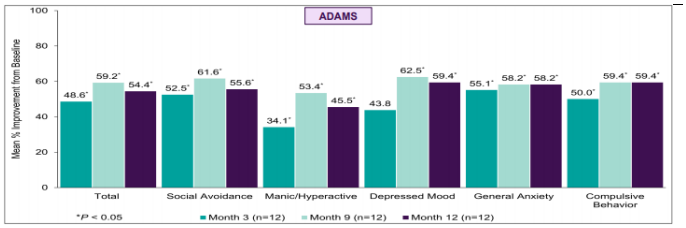
Zynerba studied its transdermal CBD gel ZYN002 in Fragile X syndrome in a 12 week Phase II open-label study in children and adolescents. In the trial, patients were initiated on a dose of 50mg daily with the option to titrate up to 250mg daily. The primary endpoint was the Anxiety, Depression, and Mood Scale (ADAMS) Total Score. Twenty patients were enrolled, 18 of whom completed the 12 week treatment. At 12 weeks, two patients were on 100mg and 16 were on 250mg. On the primary endpoint, subjects saw an average improvement of 14.1 points (or 45.8%) from baseline ($p<0.0001$) with the greatest improvements seen in social avoidance (52.9%), general anxiety (54.0%), and manic/hyperactive behavior ($p=0.0003$). Twelve patients continued in a long-term extension study out to 12 months of follow up. These patients showed statistically significant improvements in mean % change from baseline in ADAMS Total Score, as well. The extension trial also contributed to a more robust safety dataset. The most common treatment-emergent adverse events were gastroenteritis (14%) and upper respiratory tract infection (12%); no serious AEs were reported. A randomized, double-blind, placebo-controlled trial to extend these findings to a larger population is ongoing in Australia, New Zealand, and the U.S.

Figure 130 ZYN002 Produced Reductions In ADAMS At 12 Weeks...

Scale: ADAMS	Baseline (n=20)	Week 12 (n=18)	Week 12 Δ (% Improvement Group Mean)	P-value[a]
Total Score	33.4	18.1	-14.1 (45.8)	<0.0001
Social Avoidance	10.2	4.8	-5.1 (52.9)	0.0002
Manic/Hyperactive Behavior	9.4	6.1	-2.7 (35.1)	0.0003
Depressed Mood	2.8	2.0	-0.9 (28.6)	0.1417
General Anxiety	10.0	4.6	-4.8 (54.0)	<0.0001
Compulsive Behavior	2.8	1.4	-1.2 (50.0)	0.0262

Source: Zynerba

Figure 131 ...And Efficacy Persisted Out To 12 Months In An Extension Study



Source: Zynerba

Industrial Hemp And Sustainable Bioproducts (Osborne)

Figure 132 - Industrial Hemp Use Cases

Part of Plant	Fiber	Hurd	Entire Stalk	Hemp Nut	Hemp Oil	Seed Cake
Product Category	**Textiles**	**Building Materials, Industrial Products, Paper**	**Energy Products**	**Foods**	**Foods, Personal Care Products, Technical Oils**	**Pressed Products**
Common Uses	Apparel Netting Canvas	Fibre Board Mulch Printing Cardboard	Ethanol Biofuels	Bread Granola Cereal	Supplements Soap Cosmetics Solvents, lubricants, fuels	Animal Feed Proteins Flour

Source: Cowen and Company

Hemp plants have been used for industrial applications for thousands of years. Hemp stalk fiber was traditionally used as a textile for use in rope; clothing; and sails due to its tensile strength. Hemp seeds are used in foods and compressed to make oils that were used as a lighting fuel. The original diesel engine was designed to run on a variety of biodiesel fuels, including vegetable oils and seed oils, which included hempseed oil. In 1937, hemp production was banned due to its similarity to marijuana despite low THC presence, but to aid the war effort the federal government requested that farmers plant industrial hemp to make up for a shortfall in imports from the Asian Pacific. Farmers planted 36,000 acres of hemp in 1942 and set a target of 50,000 acres in order to produce the 34,000 feet of hemp that was needed in each Naval battleship and for other textile uses. The cheap availability of petroleum based synthetic products and federal regulations against hemp production caused hemp production to decline rapidly again after the war in the U.S. and throughout most of Europe. As hemp now looks to make a comeback in light of recent legislation, we see the use cases for industrial hemp to include many of the traditional textile and food uses that were previously common, in addition to the growing CBD market.

Figure 133 - Industrial Hemp Imports In 2017 ($1,000)

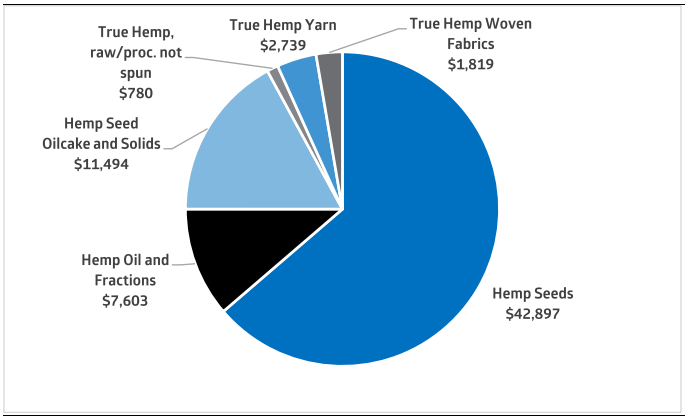
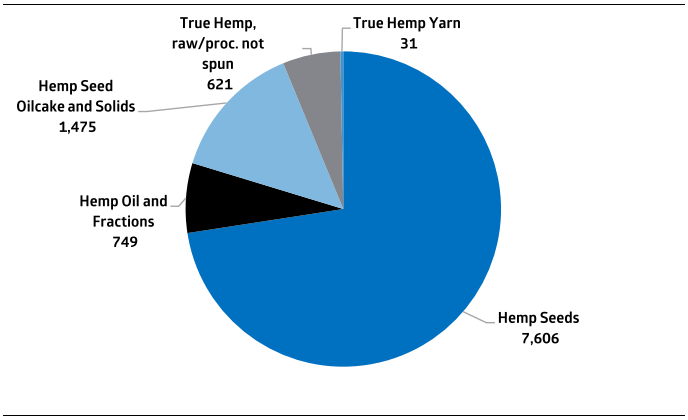


Figure 134 - Industrial Hemp Imports In 2017 (Metric Tons)



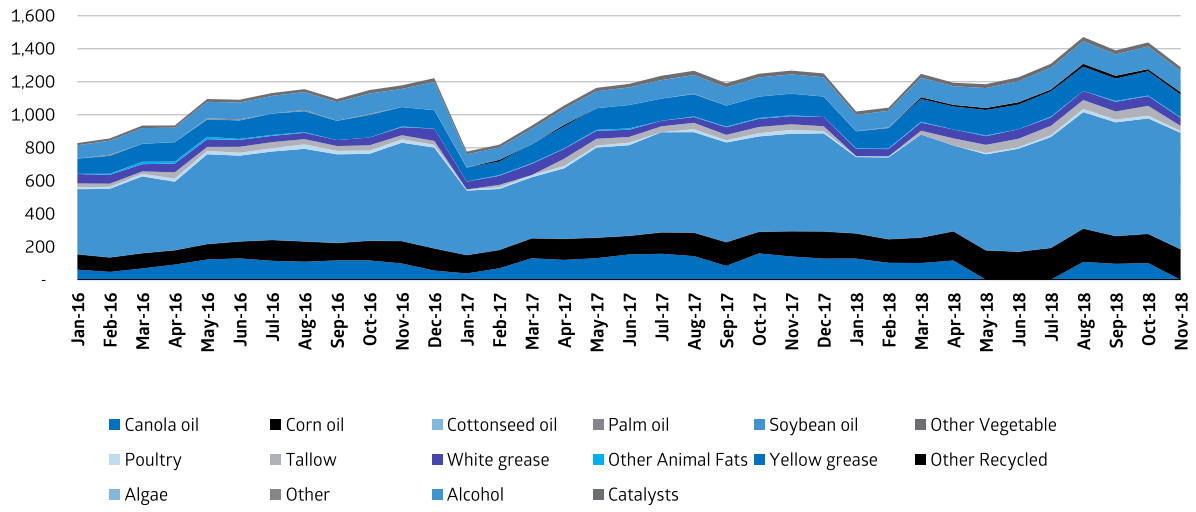
Source: Cowen and Company, Compiled by CRS using data from the U.S. ITC

Sustainability Of CBD And Hemp Production

As the CBD industry grows in size, we believe that producers will look to minimize the environmental impact of production. In addition, we could see producers try to monetize the entire waste stream of the hemp production process by converting parts of the plant that aren't used to produce CBD or other products into biomass energy. We believe the most common use cases for hemp biomass will be in the form of pelleting for

use as heating fuel, and also see potential to act as a cellulosic biofuel. The process of pelleting industrial hemp biomass would be a similar to that of pelleting wood waste, which gets converted into densified biomass products such as roundwood, pulpwood, sawmill residuals, and wood product manufacturing residues, which typically cost ~$30 per ton. Wood biomass fuel has an annual capacity of 12.6 million tons per year and produces ~675 GWh per year in energy. Access to local refineries is key to utilizing hemp biomass as a cellulosic biofuel. Through local access to refineries, the fuel can be refined while transportation costs, which can make the products uncompetitive, are minimized. Given the commoditized market for biodiesel however, where soybean oil has ~50% of the market input by weight and corn oil has ~15% of the market input by weight, we do not expect hemp to materialize as a meaningful player due to the competitive advantage of high production crops competing for low cost production.

Figure 135 - Biodiesel Production By Input (Millions Of Pounds)



Source: Cowen and Company, EIA

Biochemical CBD Production Methods

CBD is most commonly produced by either CO2 or ethanol extraction from hemp plants. In CO2 extraction, plants are filtered through a series of chambers with temperature and pressures applied to the plants that isolate the cannabinoids. The C02 method is able to isolate CBD at a 90% efficiency and is typically used when producing small quantities. Ethanol extraction introduces the hemp plant to solvent ethanol and enables higher volumes production. In addition to hemp-based production of CBD, we believe the opportunity exists for players within the biochemical space to produce CBD by utilizing a fermentation approach from other feedstocks. Amyris recently announced a $255 million cannabinoid development, licensing and commercialization agreement. Amyris plans to utilize the C5 molecule found in sugarcane in a fermentation process to produce CBD. The company believes that the fermentation process ensures a level of purity that is not possible through traditional plant-based production, where CBD levels can vary from plant to plant. In order to build out the industrial scale necessary for mass food market, CBD products will need to be produced at standardized levels. Given Amyris plans to produce CBD at its Brotas plant in Brazil, which is fueled by biomass co-product of the nearby sugarcane fields, we believe this will be an attractive option for companies looking to integrate CBD into their products sustainably assuming the company is able to produce cost competitively with hemp plants.

Appendix

Figure 136 Cannabis Comp Table

Company Name - Non-Coverage	Ticker	Local Curr	Price 2/22/2019	52 Week Low	52 Week High	Market Value	Enterprise Value	Enterprise Value / LTM Rev	Enterprise Value / FY1 Rev	Enterprise Value / FY2 Rev	Enterprise Value / FY3 Rev	Enterprise Value / FY1 EBITDA	Enterprise Value / FY2 EBITDA	Enterprise Value / FY3 EBITDA
1933 Industries Inc	TGIF.CD	CAD	0.56	0.30	0.80	133	131	8.8	4.3	3.1	NA	31.2	11.8	NA
Aphria Inc	APHA.N	USD	10.18	3.75	13.45	2,535	3,219	56.2	NA	NA	NA	NA	NA	NA
Aurora Cannabis Inc	ACB	USD	6.96	3.90	12.53	6,948	9,318	78.2	NA	NA	NA	NA	NA	NA
Charlotte's Web Holdings Inc	CWEB.CD	CAD	18.15	9.05	22.75	1,678	1,199	NA	17.1	7.6	4.4	51.1	21.5	12.0
Cronos Group Inc	CRON.O	USD	21.92	5.12	25.10	3,892	5,113	NM	NM	37.7	29.2	NM	122.0	96.1
Curaleaf Holdings Inc	CURA.CD	CAD	10.25	1.43	26.01	3,412	3,412	NA	38.3	9.3	4.7	NM	27.8	12.9
CV Sciences Inc	CVSI.PK	USD	4.90	0.37	9.20	463	453	11.0	NA	NA	NA	NA	NA	NA
Elixinol Global Ltd	EXL.AX	AUD	3.47	1.34	3.69	161	148	NA	1.4	1.2	1.0	14.6	7.6	6.3
Emblem Corp	EMC.V	CAD	1.78	0.83	2.12	234	202	35.4	24.4	2.7	1.4	NM	18.2	5.6
Emerald Health Therapeutics Inc	EMH.V	CAD	3.89	2.04	6.35	554	504	NM	NA	NA	NA	NA	NA	NA
Green Organic Dutchman Holdings Ltd	TGOD.TO	CAD	3.69	2.06	9.64	989	789	NA	53.6	4.0	1.4	NM	NM	6.3
Green Thumb Industries Inc	GTII.CD	CAD	19.69	8.21	32.50	1,257	859	NA	13.0	4.0	1.9	NM	19.2	5.6
Khiron Life Sciences Corp	KHRN.V	CAD	4.05	0.87	4.35	308	294	NA	NM	24.6	3.9	NM	NM	15.3
Level Brands Inc	LEVB.N	USD	5.05	2.60	8.41	51	43	4.7	NA	NA	NA	NA	NA	NA
Neptune Wellness Solutions Inc	NEPT.O	USD	3.67	2.27	5.14	295	374	14.5	14.1	6.1	2.7	84.2	30.6	11.1
OrganiGram Holdings Inc	OGI.V	CAD	7.74	3.26	8.55	1,013	1,016	NA	8.2	4.3	3.2	19.5	11.6	8.8
Company Name - Coverage														
Canopy Growth Corp	WEED.TO	CAD	58.51	23.88	76.68	20,071	16,142	NA	NM	74.2	34.9	NM	NM	105.0
KushCo Holdings Inc	KSHB.PK	CAD	6.38	3.76	7.20	560	16,142	NA	NM	NM	NM	NM	NM	NM
Tilray Inc	TLRY.OQ	USD	79.07	20.10	300.00	7,367	16,142	NM	NA	NA	NA	NA	NA	NA
Turning Point Brands Inc	TPB	USD	41.00	19.11	47.00	802	16,142	NM	NM	NM	NM	NM	NM	NM
				Overall Min		50.6	42.6	4.7	1.4	1.2	1.0	14.6	7.6	5.6
				Overall Mean		2636.1	4582.0	29.8	19.4	14.9	8.0	40.1	30.0	25.9
				Overall Median		895	937	14.5	14.1	5.2	3.2	31.2	19.2	11.1
				Overall Max		20,071	16,142	78.2	53.6	74.2	34.9	84.2	122.0	105.0

Source: Thomson Reuters and Cowen and Company

This page left blank intentionally.

This page left blank intentionally.

This page left blank intentionally.

VALUATION METHODOLOGY AND RISKS

Valuation Methodology

Cannabis: Our valuation methodology is primarily based on Relative EV-to-Sales (EV-to-Sales divided by Sales-Growth), followed by EV-to-Sales.

Investment Risks

Cannabis: Cannabis is an emerging industry and is subject to regulatory headwinds. While over 50% of the population is in favor of legalization, only a few states have thus far legalized cannabis for recreational use and the product remains illegal at the federal level. Looking forward, much work and change still needs to occur in order for this industry to realize its full potential.

Risks Pertaining to U.S. Cannabis-Related Companies: If you are considering investing in a U.S. company that is connected to the cannabis industry, be aware that cannabis-related companies may be at risk of federal and/or state criminal prosecution. The Department of Treasury has issued guidance that The Controlled Substances Act ("CSA") makes it illegal under U.S. federal law to manufacture, distribute, or dispense cannabis and cannabis-related products. Many states impose and enforce similar prohibitions. Notwithstanding the federal ban, however, many U.S. states and the District of Columbia have legalized certain cannabis-related activities.

Risks Pertaining to Canadian Cannabis-Related Companies: In Canada, cannabis is an emerging industry and is subject to regulatory headwinds. While medical cannabis is legal in Canada, legislation has also been introduced to legalize adult-use sales on October 17, 2018. An initial regulatory framework has been laid out for the adult-use market, looking ahead, the category will be subject a number of potential headwinds, including taxes and restrictions on from factors and packaging.

ADDENDUM

Stocks Mentioned In Important Disclosures

Ticker	Company Name
WEED	Canopy Growth Corporation
GWPH	GW Pharmaceuticals Plc
TLRY	Tilray
TPB	Turning Point Brands

Important Disclosures and Information Relating to Cowen Washington Research Group

Cowen Washington Research Group produces commentaries on political, economic or market conditions. Commentaries produced by Cowen Washington Research Group are not intended as research reports as defined in FINRA Rule 2241 Research Analysts and Research Reports or FINRA Rule 2242 Debt Research Analysts and Debt Research Reports. Sections of this report noted as authored by Cowen Washington Research Group have not been prepared, are not intended, and should not be interpreted as a research report or investment recommendation regarding securities of any company. Investors should not consider purchasing or selling securities based upon any information contained in sections of the report denoted as authored by Cowen Washington Research Group.

Cowen Research Analyst Certification

Each author of this research report hereby certifies that (i) the views expressed in the research report accurately reflect his or her personal views about any and all of the subject securities or issuers, and (ii) no part of his or her compensation was, is, or will be related, directly or indirectly, to the specific recommendations or views expressed in this report.

Important Disclosures Relating to Cowen Research

Cowen and Company, LLC and or its affiliates make a market in the stock of GW Pharmaceuticals Plc, Tilray, Turning Point Brands and Canopy Growth Corporation securities.

Cowen and Company, LLC served as the placement agent in connection with Tilray's Series A preferred stock financing in February and March 2018.

Cowen and Company, LLC managed or co-managed a public offering of GW Pharmaceuticals Plc, Tilray, Turning Point Brands and Canopy Growth Corporation in the past 12 months.

Cowen and Company, LLC received compensation for investment banking services from GW Pharmaceuticals Plc, Tilray, Turning Point Brands and Canopy Growth Corporation in the past 12 months.

GW Pharmaceuticals Plc, Tilray, Turning Point Brands and Canopy Growth Corporation is or has been in the past 12 months a client of Cowen and Company, LLC; Cowen and Company, LLC has provided or is providing investment banking services during the past 12 months.

Cowen and Company, LLC and/or its affiliates expect to receive, or intend to seek, compensation for investment banking services in the next 3 months from Tilray and Turning Point Brands.

Cowen and Company, LLC compensates research analysts for activities and services intended to benefit the firm's investor clients. Individual compensation determinations for research analysts, including the author(s) of this report, are based on a variety of factors, including the overall profitability of the firm and the total revenue derived from all sources, including revenues from investment banking, sales and trading or principal trading revenues. Cowen and Company, LLC does not compensate research analysts based on specific investment banking transactions or specific sales and trading or principal trading revenues.

The Nielsen material contained in this report represent Nielsen's estimates and do not represents facts. Nielsen has neither reviewed nor approved this report and/or any of the statements made herein.

Information contained in this report from The NPD Group, Inc. and its affiliates is the proprietary and confidential property of NPD and was made available for publication herein by way of limited license from NPD. Such NPD data may not be re-published in any manner, in whole or in part, without the express written consent of NPD.

Disclaimer

Our research reports and commentaries are simultaneously available to all clients are on our client website. Research reports and commentaries are for our clients only. Not all research reports and commentaries are disseminated, e-mailed or made available to third-party aggregators. Cowen and Company, LLC is not responsible for the redistribution of research or commentaries by third party aggregators. Selected research reports and commentaries are available in printed form in addition to an electronic form. All published research reports and commentaries can be obtained on the firm's client website, https://cowenlibrary.bluematrix.com/client/library.jsp.

The information, opinions, estimates and forecasts are as of the date of this report and subject to change without prior notification. We seek to update our research and commentaries as appropriate, but various regulations may prevent us from doing so. Research reports and commentaries are published at irregular intervals as appropriate in the analyst's judgement.

Further information on subject securities may be obtained from our offices. This research report is published solely for information purposes, and is not to be construed as an offer to sell or the solicitation of an offer to buy any security in any state where such an offer or solicitation would be illegal. Other than disclosures relating to Cowen and Company, LLC, the information herein is based on sources we believe to be reliable but is not guaranteed by us and does not purport to be a complete statement or summary of the available data. Any opinions expressed herein are statements of our judgment on this date and are subject to change without notice. The opinions and recommendations herein do not take into account individual client circumstances, objectives or needs and are not intended as recommendations of investment strategy. The recipients of this report must make their own independent decisions regarding any securities subject to this research report. In some cases, securities and other financial instruments may be difficult to value or sell and reliable information about the value or risks related to the security or financial instrument may be difficult to obtain. To the extent that this report discusses any legal proceedings or issues, it has not been prepared to express or intended to express any legal conclusion, opinion or advice. Our salespeople, traders and other professionals may provide oral or written market commentary or trading strategies to our clients that reflect opinions that are contrary to the opinions expressed in our research. Our principal trading area and investing businesses may make investment decisions that are inconsistent with recommendations or views expressed in our research. Cowen and Company, LLC maintains physical, electronic and procedural information barriers to address the flow of information between and among departments within Cowen and Company, LLC in order to prevent and avoid conflicts of interest with respect to analyst recommendations.

For important disclosures regarding the companies that are the subject of this research report, please contact Compliance Department, Cowen and Company, LLC, 599 Lexington Avenue, 20th Floor, New York, NY 10022. In addition, the same important disclosures, with the exception of the valuation methods and risks, are available on the Firm's disclosure website at https://cowen.bluematrix.com/sellside/Disclosures.action.

Equity Research Price Targets: Cowen and Company, LLC assigns price targets on all companies covered in equity research unless noted otherwise. The equity research price target for an issuer's stock represents the value that the analyst reasonably expects the stock to reach over a performance period of twelve months. Any price targets in equity securities in this report should be considered in the context of all prior published Cowen and Company, LLC equity research reports (including the disclosures in any such equity report or on the Firm's disclosure website), which may or may not include equity research price targets, as well as developments relating to the issuer, its industry and the financial markets. For equity research price target valuation methodology and risks associated with the achievement of any given equity research price target, please see the analyst's equity research report publishing such targets.

Cowen Cross-Asset Research: Due to the nature of the fixed income market, the issuers or debt securities of the issuers discussed in "Cowen Cross-Asset Research" reports do not assign ratings and price targets and may not be continuously followed. Accordingly, investors must regard such branded reports as providing stand-alone analysis and reflecting the analyst's opinion as of the date of the report and should not expect continuing analysis or additional reports relating to such issuers or debt securities of the issuers.

From time to time "Cowen Cross-Asset Research" analysts provide investment recommendations on securities that are the subject of this report. These recommendations are intended only as of the time and date of publication and only within the parameters specified in each individual report. "Cowen Cross-Asset Research" investment recommendations are made strictly on a case-by-case basis, and no recommendation is provided as part of an overarching rating system or other set of consistently applied benchmarks. The views expressed in "Cross-Asset Research" report may differ from the views offered in the firm's equity research reports prepared for our clients.

Notice to UK Investors: This publication is produced by Cowen and Company, LLC which is regulated in the United States by FINRA. It is to be communicated only to persons of a kind described in Articles 19 and 49 of the Financial Services and Markets Act 2000 (Financial Promotion) Order 2005. It must not be further transmitted to any other person without our consent.

Notice to European Union Investors: Individuals producing recommendations are required to obtain certain licenses by the Financial Regulatory Authority (FINRA). You can review the author's current licensing status and history, employment history and, if any, reported regulatory, customer dispute, criminal and other matters via "Brokercheck by FINRA" at http://brokercheck.finra.org/. An individual's licensing status with FINRA should not be construed as an endorsement by FINRA. General biographical information is also available for each Research Analyst at www.cowen.com.

Additionally, the complete preceding 12-month recommendations history related to recommendation in this research report is available at https://cowen.bluematrix.com/sellside/Disclosures.action

The recommendation contained in this report was produced at February 25, 2019, 22:19 ET. and disseminated at February 25, 2019, 22:19 ET.

Cowen and Company, LLC. New York 646 562 1010 **Boston** 617 946 3700 **San Francisco** 415 646 7200 **Chicago** 312 577 2240 **Cleveland** 440 331 3531 **Atlanta** 866 544 7009 **Stamford** 646 616 3000 **Washington, D.C.** 202 868 5300 **London** (affiliate) 44 207 071 7500

COWEN AND COMPANY EQUITY RESEARCH RATING DEFINITIONS

Outperform (1): The stock is expected to achieve a total positive return of at least 15% over the next 12 months

Market Perform (2): The stock is expected to have a total return that falls between the parameters of an Outperform and Underperform over the next 12 months

Underperform (3): Stock is expected to achieve a total negative return of at least 10% over the next 12 months

Assumption: The expected total return calculation includes anticipated dividend yield

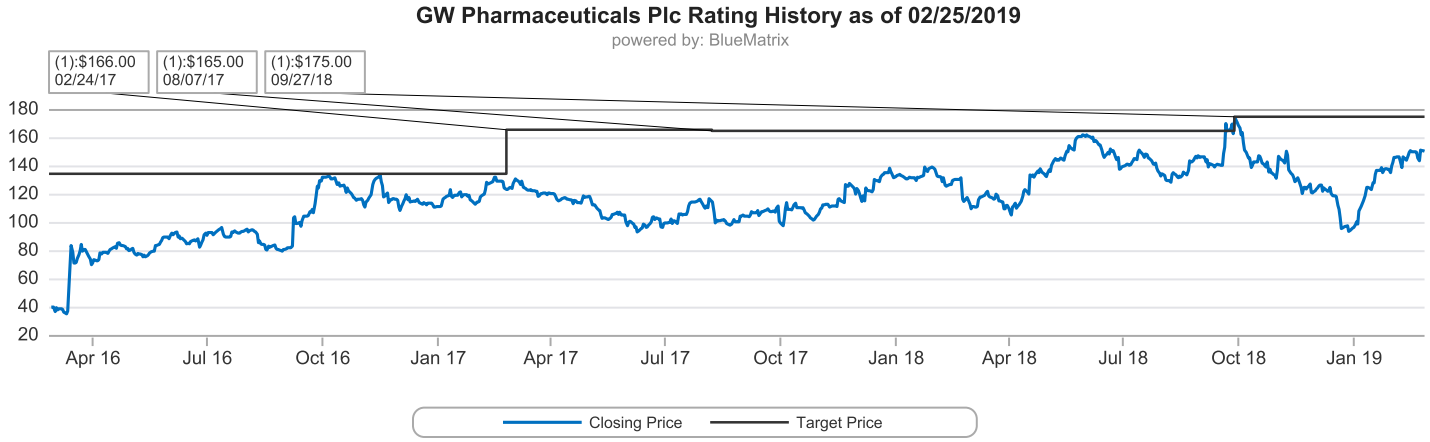
Cowen and Company Equity Research Rating Distribution

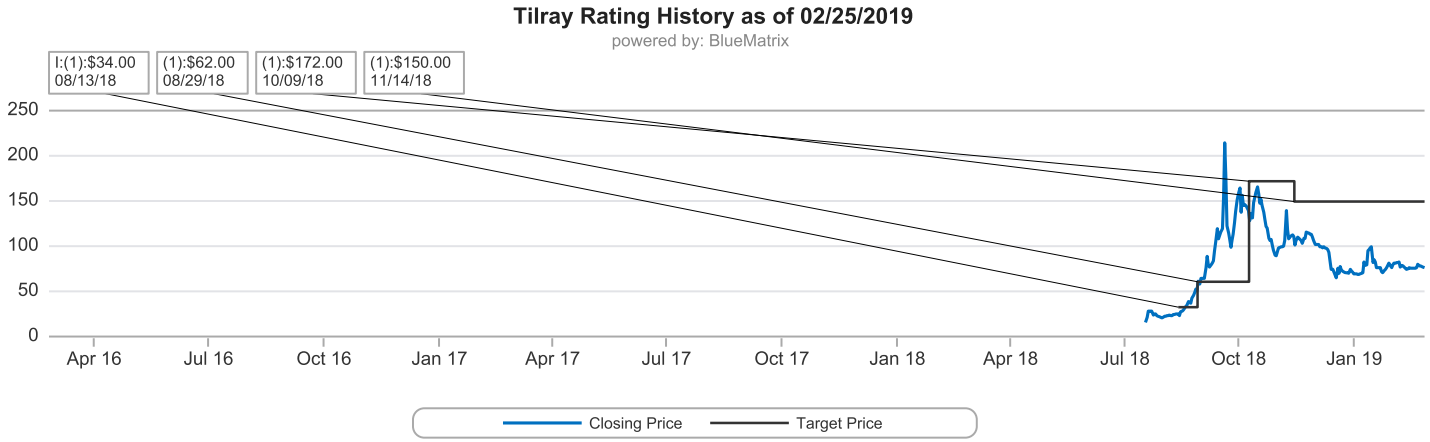
Distribution of Ratings/Investment Banking Services (IB) as of 12/31/18

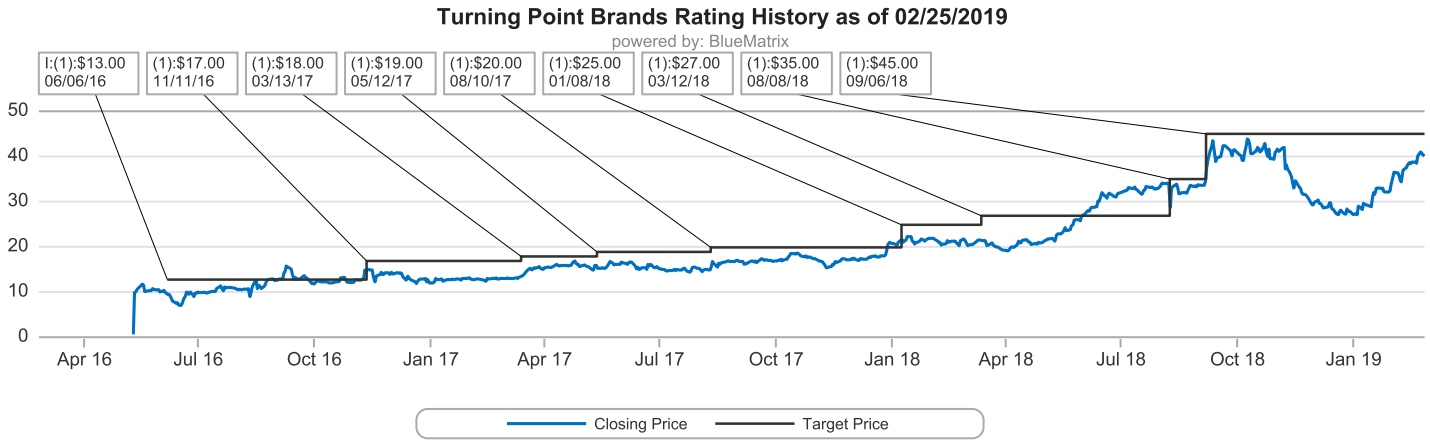
Rating	Count	Ratings Distribution	Count	IB Services/Past 12 Months
Buy (a)	473	64.01%	116	24.52%
Hold (b)	259	35.05%	20	7.72%
Sell (c)	7	0.95%	0	0.00%

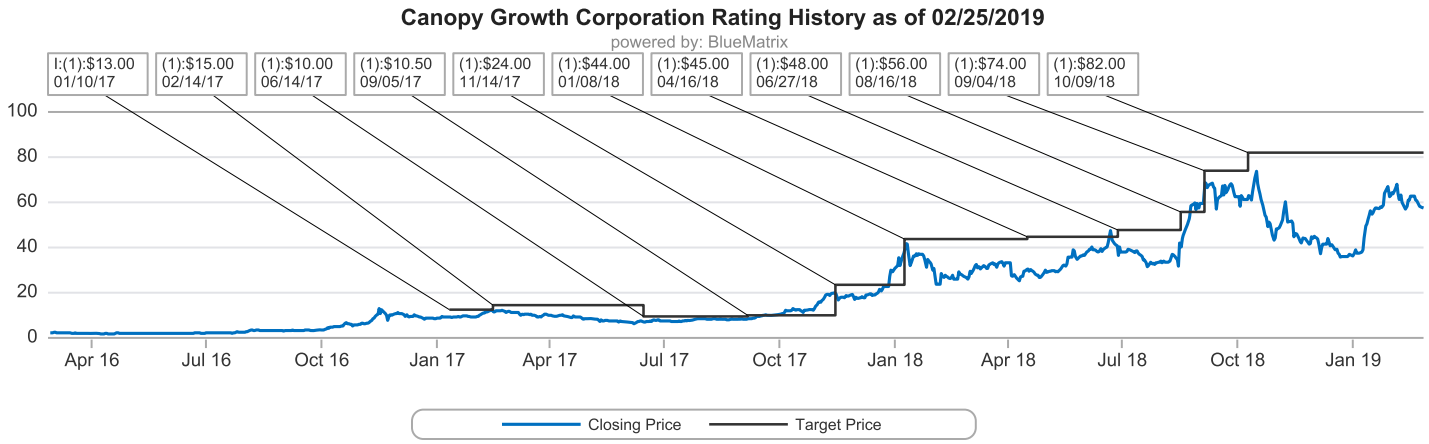
(a) Corresponds to "Outperform" rated stocks as defined in Cowen and Company, LLC's equity research rating definitions. (b) Corresponds to "Market Perform" as defined in Cowen and Company, LLC's equity research ratings definitions. (c) Corresponds to "Underperform" as defined in Cowen and Company, LLC's equity research ratings definitions. Cowen and Company Equity Research Rating Distribution Table does not include any company for which the equity research rating is currently suspended or any debt security followed by Cowen Credit Research and Trading.

Note: "Buy", "Hold" and "Sell" are not terms that Cowen and Company, LLC uses in its ratings system and should not be construed as investment options. Rather, these ratings terms are used illustratively to comply with FINRA regulation.









Legend for Price Chart:

I = Initiation | 1 = Outperform | 2 = Market Perform | 3 = Underperform | UR = Price Target Under Review | T = Terminated Coverage | $xx = Price Target | NA = Not Available | S=Suspended

POINTS OF CONTACT

Author Profiles

Cowen Research
New York
646 562 1330
cowen.research@cowen.com

Vivien Azer
New York
646 562 1351
vivien.azer@cowen.com

Vivien Azer is a senior analyst covering beverages, tobacco and cannabis. She joined Cowen in 2014.

John Blackledge
New York
646 562 1359
john.blackledge@cowen.com

John Blackledge is a senior analyst covering the Internet sector. He joined Cowen in 2012 as the head of Internet research.

Andrew M. Charles, CFA
New York
646 562 1332
andrew.charles@cowen.com

Andrew Charles is an analyst focused on restaurants. He has spent over seven years on the sell side covering the sector.

Oliver Chen, CFA
New York
646 562 1424
oliver.chen@cowen.com

Oliver Chen is an *II*-ranked analyst covering retailing/specialty, broadlines, department stores, & luxury goods. He has an MBA from Wharton.

John Kernan, CFA
New York
646 562 1324
john.kernan@cowen.com

John Kernan is a research analyst focused on apparel, footwear and textiles. He has spent seven years on the sell side covering the sector.

Phil Nadeau, Ph.D.
New York
646 562 1336
phil.nadeau@cowen.com

Phil Nadeau is a senior analyst covering biotech. He joined Cowen in 2000 and holds an SB/M.Eng from MIT, and a Ph.D. from Harvard.

Charles Neivert
New York
646 562 1370
charles.neivert@cowen.com

Charlie Neivert is a senior research analyst covering agricultural & commodity chemicals. He has a BA from University of Pennsylvania.

Jeffrey Osborne
Stamford
646 562 1391
jeffrey.osborne@cowen.com

Jeff Osborne is an analyst covering sustainable energy tech. He has a BS from Trinity University and an MBA from Wayne State University.

Charles Rhyee
New York
646 562 1376
charles.rhyee@cowen.com

Charles Rhyee is a senior analyst covering health care IT and distribution, which he has followed since 1999. He joined Cowen in 2011.

Eric Assaraf
Washington, DC
202 868 5304
eric.assaraf@cowen.com

Eric Assaraf is with Cowen Washington Research Group covering health care. He received degrees from the University of Maryland.

Doug Schenkel
Boston
617 946 3918
doug.schenkel@cowen.com

Doug Schenkel is a senior analyst covering tools and diagnostics. He joined Cowen in 2005 and holds an M.B.A. from the UCLA Anderson School.

Reaching Cowen

Main U.S. Locations

New York
599 Lexington Avenue
New York, NY 10022
646 562 1010
800 221 5616

Boston
Two International Place
Boston, MA 02110
617 946 3700
800 343 7068

Cleveland
20006 Detroit Road
Suite 100
Rocky River, OH 44116
440 331 3531

San Francisco
One Maritime Plaza, 9th Floor
San Francisco, CA 94111
415 646 7200
800 858 9316

Atlanta
3399 Peachtree Road NE
Suite 417
Atlanta, GA 30326
866 544 7009

Chicago
181 West Madison Street
Suite 3135
Chicago, IL 60602
312 577 2240

Stamford
262 Harbor Drive
Stamford, CT 06902
646 616 3000

Washington, D.C.
2900 K Street, NW
Suite 520
Washington, DC 20007
202 868 5300

International Location

Cowen International Limited

London
1 Snowden Street - 11th Floor
London EC2A 2DQ
United Kingdom
44 20 7071 7500