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# A Plan for a Legal and Regulated UK Hemp and Cannabis Sector



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*This is not an official publication of the House of Commons or the House of Lords. It has not been approved by either House or its committees. All-Party groups are informal groups of Members of both Houses with a common interest in particular issues. The views expressed in this plan are those of the group.*

The All-Party Parliamentary Group for CBD (Cannabidiol) Products works to encourage the development of UK regulation on CBD products that reflect evidence-based policy, clear industry guidance and the most certain basis for investors and entrepreneurs to enable this industry safely to serve the public and the wider national interests. The group is co-chaired by Crispin Blunt MP and Baroness Manzoor CBE.

More details of the group can be found at [parliament.uk](https://parliament.uk)

This plan was compiled by the All-Party Parliamentary Group for CBD (Cannabidiol) Products with research assistance from the Medical Cannabis Clinicians Society (MCCS), the Cannabis Industry Council (CIC), the Cannabis Trades Association (CTA), the European Industrial Hemp Association (EIHA), the British Hemp Alliance (BHA) and the Cannabis Services Advisory Board (Jersey).

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# PLAN FOR SUCCESS

## A Plan for a Legal & Regulated Hemp and Cannabis Sector

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**Crispin Blunt MP  
(Co-chair)**



**Baroness Manzoor CBE  
(Co-chair)**

The potential benefits of a thriving hemp and cannabis industry to the UK – its jobs market, economy, and meeting of 'Net Zero' climate obligations – are made out in this APPG paper, prepared with huge and commendable efforts by the Secretariat, drawing on an immense consultation with the industry through the Secretariat Advisory Board.

All the Parliamentarians associated with the APPG urge Her Majesty's Government and the key responsible Ministers and their advisors to read, understand, and as appropriate act on the plan and data presented here.

### The Opportunity

The potential benefits are startling: an estimated extra 594,000+ jobs, £5.5b in annual tax revenue,<sup>1</sup> and environmental and agricultural benefits that will go a long way to helping us meet our carbon neutrality commitments by 2050. This analysis lays out a framework for the adoption of a process and timetable; with recommendations, actions, responsibilities, and timelines necessary for Government and parliament to deliver a new legal economic sector that will greatly benefit the UK. It is of immense potential benefit to the UK, but not yet understood by key decision makers and administrators.

This analysis presents how effective collaboration between government, parliament, and industry, around hemp and cannabis, can generate inward investment, support for farmers and entrepreneurs, rigorous trading standards, balance of consumer choice and protection, and expert service for patients. It highlights amendments needed to key regulations from Novel Foods to Proceeds of Crime.

The mature market of Colorado, USA, is used as the base case study to enable a look into the future of what a country aspiring to world class regulation and global bio-science leadership requires. It illustrates the issues around securing the major economic prize that may flow from legalisation in the future, but highlights the issues that must be addressed by any future government and parliament.

The opportunities include the effective destruction of the illicit market, successfully protecting children by reducing child cannabis use, reducing psychosis (via the introduction of low-dose safe products) and

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<sup>1</sup> These figures are based on an extrapolation using Colorado's numbers as well as additional considerations laid out in the APPG Plan Model.

crime. From prescription medicines and on-shelf wellness products, to high-protein cattle feed, carbon credits, and all the many and varied uses and benefits of hemp and cannabis, the road map to achieve these opportunities is laid out in this plan.

At a time when the Office for Budget Responsibility tells us we need 1.5 per cent of GDP additional fiscal tightening at the beginning of each decade over the next 50 years<sup>2</sup> (£37b a year in today's terms) in order to plug the UK's public debt, amongst the above public good is the financial incentive to build a properly regulated sector that can become one of a few lucrative worldwide hubs.

## Background

The APPG, co-chaired by Baroness Manzoor CBE and Crispin Blunt MP, commissioned this comprehensive analysis to identify the challenges to secure the UK's appropriate participation in the world's fast-growing hemp and cannabis industry. Using data based on extrapolation from Colorado, the most mature of the 37 US States to have legalised cannabis in some form or another to date, it illustrates the scale of opportunity for the UK that the industry has the potential to bring.

Included is a framework for the adoption of a process and timetable. Further detailed work will necessarily be part of the immediate next steps. So far, the UK industry has been markedly ineffective in communicating coherent useable recommendations and, despite the best efforts of most involved, it has been frequently side-tracked by sub-sector priorities at the price of the wider public benefits available. Changing the emphasis to what can and should be done to achieve more than half a million new jobs is essential, or those jobs will go elsewhere.

## Analysis

The UK does not have to address the issue of legalised recreational THC to establish itself as a viable commercial hub, although if and when it does the industry will need to be ready to respond along with consumer protection agencies and the rest of the regulatory and enforcement actors. Today's regulations, such as Novel Foods, should not be used to allow a few producers to lock out all newcomers at the price of not then developing a successful global industry.

As the best structural lead, Colorado provides us many lessons, not least – according to them – that they should have launched a parallel plan for actively reducing illegal usage at the same time as promoting the legal industry, not simply relying on the legal outperforming the illegal.

Industry can, already is, and needs to continue to participate in generating the viable choices, as should the respective government departments, but ultimately success relies on timely decisions from elected officials, properly and expertly advised by knowledge owned by Whitehall, as well as drawing on the industry and its investors.

The scale of what is possible is impressive. Whilst Her Majesty's Government is not yet ready to publicly present the pros and cons of a legalised adult use market, it is essential that Her Majesty's Government acquires the capacity to make this presentation in the near term. Before then, vast medical, wellness, and economic benefits are available by forward-looking regulation and energetic political and administrative leadership. Hemp and cannabis industry worldwide turnover is estimated to reach £69bn in 2026 from a pre-fully legalised level of c. £20bn today.<sup>3</sup> It is then expected to continue to grow by more than 6% annually. By comparison, whisky's worldwide turnover has levelled at £66bn. Both categories are seeing the premium segment out-performing non-premium, which also plays to the UK's strengths.<sup>4</sup>

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<sup>2</sup> Office for Budget Responsibility - Fiscal risks and sustainability – July 2022

<sup>3</sup> The Global Cannabis Report: Growth & Trends Through 2025

<sup>4</sup> Statista

Scotch whisky is more than just a convenient comparative with its 42,000 jobs and £5.5bn in annual turnover.<sup>5</sup> It also provides a template for moving fast and first into the most lucrative and least contentious premium sub-category, providing an immediate understanding of the costs and benefits, given its own historic transition from prohibition, through legalisation to premium.

For cannabis and hemp production and sales to succeed here, the UK will need to make early use of the business growth example template that whisky provides. Given the multiple jurisdictions considering full legalisation, from more mature ones such as Canada and California to newer ones like New York and Germany, the aim should be to give the UK the potential capacity to become a properly regulated worldwide hub, with all the economic and public health benefits that implies.

The successful hubs will have sorted legislation, regulation, commercialisation, and enforcement at the same time as addressing both evidentially valid and exaggerated concerns about what a successful hemp and cannabis industry actually looks like, well beyond the current smell of marijuana on the streets.

Success looks like including measured delivered benefits in soil regeneration, reduced deforestation, economic crops in the same year as a crop failure, marginal land usage, climate change resistance, more pollinators, carbon credit generation, high protein / low methane emission cattle feed, agri-tourism, fewer aching-handed gardeners, anxiety help without prescription anti-depressants, sleep without prescription sleeping pills, long term pain relief with fewer of the 212 unnecessary codeine deaths per year<sup>6</sup>, less cramp for MS sufferers, fewer epileptic fits for children and less nausea for cancer patients and even palliative care for stiffness in dogs.

Success also includes addressing so far failed issues outside the private health sector of prescription medicines, and a sensibly safe wellness business. Success will also mean we are ready to have an informed and confident debate around crime, child protection, consumer choice, jobs, and tax-based net benefits of recreational THC. There is still a clear deficit in the perceived level of reliable research to address, and the balance of those benefits along much the same lines as already established for alcohol and Scotch Whisky.

Failure would be being dragged unprepared to legalisation by Canada, Washington and Berlin, and failing to take the economic opportunities presented in an area of obvious historic UK strength.

## Conclusion

The UK's fragmented industry is making great progress, not least in maturing to support this plan, sponsored by this APPG, designed to be non-partisan, and as inclusive and transparent as possible.

This process has not been easy or perfect, but has enjoyed support from a genuinely broad range of industry participants – both UK based and worldwide. Where appropriate, these organisations and people are named, however a great many others have provided very significant input.

This plan is presented with a supporting conventional economic case, and with objectively evidence-based statements and assumptions, which identify the distinct work requirements to a level of what should be done, by whom, and when, to achieve a particular measured benefit. This plan is designed to be comprehensive and not exclude or favour some participants over others.

For example, high protein hemp-based cattle feed for lower dairy herd methane emissions will need DEFRA, industrial hemp industry representation, existing cattle feed wholesalers, carbon credit formulation sign off, and agricultural research combined with a clear instruction to be ready with a roll out plan from 2023. The financial model included in the plan provides the numbers including jobs based on clearly articulated assumptions that will of course need to be refined as part of the execution process.

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<sup>5</sup> [Scotch Whisky Association](#)

<sup>6</sup> [Office for National Statistics \(ONS\)](#)

This process will quickly involve other identified areas – for example feed merchants don't want issues over Proceeds of Crime legislation and need top-down assurance that it doesn't apply. The academics need to grow test crops under an overall permission from the Home Office, not process a series of time consuming individual annual plot exemptions – not the fault of the Home Office, they need similar assurances to the feed merchants.

## Recommendations

There is an early opportunity for the UK to establish an international lead in advance of the next US Federal election – structured correctly, led by Whitehall, and including cooperation between existing trade bodies like the CIC, EIHA (UK), CTA, ACI, industrial hemp, environmental representatives and commercial interests with the aim of measurable benefits to be achieved in 2023.

Whitehall will need Cabinet direction by early Autumn 2022 for identifying senior departmental ministers taking direct responsibility for delivery of a detailed departmental plan to create for the UK a new hemp and cannabis industry at a level which means the UK will become an international hub. Industry will in turn need to step up to provide participants and advice at the working level to enable Whitehall, and in turn Westminster, to make this a reality.

- (1) Establish the Cabinet's terms of reference for the work required to create a hemp & cannabis industry – September 2022
- (2) Name the cabinet minister responsible and departmental leads – October 2022
- (3) Select an industry point of contact group – November 2022
- (4) Scope the feasibility and methodology of establishing the UK as the world market leader in the premium hemp & cannabis industry using Scotch Whisky as the benchmark – December 2022
- (5) Name industry single point of contact sub-group participants e.g., industrial hemp from carbon credits to cattle feed e.g., novel foods 2.0 – December 2022
- (6) In all cases (4) through (6) above non-industry participants to be joined by the appropriate departments and devolved governments as appropriate – December 2022
- (7) Detailed implementation plans for the following year by sub-group – June 2023

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# Executive Summary



## 1.1 Financial summary

Sector	Department	Gross Sales (£000s)	Tax Take (£000s)	Jobs
Medicinal Cannabis	Home Office / MHRA	£3,300,590	£755,840	81,570
Cosmetics / Body Care	Office for Product Safety & Standards / Trading Standards	£23,950	£4,790	9,725
Food / Wellness	Food Standards Agency, Veterinary Medicines Directorate / Trading Standards	£1,996,580	£399,320	29,175
Agriculture	DEFRA	£1,459,940	£292,000	42,930
Industrial Manufacturing	DEFRA / BEIS	£1,608,730	£321,750	21,620
Animal Feed	DEFRA	£765,940	£153,190	9,510
Carbon Credits	DEFRA / BEIS	£1,285,340	£254,920	31,650
Adult-Use	Cabinet Office	£21,802,090	£3,308,940	368,000
<b>Total</b>		<b>£32,243,160</b>	<b>£5,490,750</b>	<b>594,180</b>

\*Expected projections as of 2027.

Topic	Application	Department	Tax Take (£000s)	Jobs
Medicinal Cannabis	Oil	MHRA	£170,660	31,370
Medicinal Cannabis	Flower	MHRA	£585,180	50,200
<b>Total</b>			<b>£755,840</b>	<b>81,570</b>

Department	Actions
<ol style="list-style-type: none"> <li>HO Drugs and Firearms Licencing Unit</li> <li>Medicines and Healthcare products Regulatory Agency</li> </ol>	<ol style="list-style-type: none"> <li>The Home Office and MHRA should work together to: <ol style="list-style-type: none"> <li>produce a simple guide to those applying for high-THC cultivation licenses.</li> <li>streamline and coordinate the application process.</li> </ol> </li> <li>make all applications transparent</li> </ol>
<ol style="list-style-type: none"> <li>Home Secretary</li> <li>Advisory Council on the Misuse of Drugs</li> </ol>	<ol style="list-style-type: none"> <li>Amend wording in paragraph 4 of <i>The Misuse of Drugs (Amendments) (cannabis and Licence Fees) (England, Wales and Scotland) Regulations 2018</i><sup>7</sup> to allow GPs and prescribing pharmacists to prescribe cannabis.</li> </ol>
<ol style="list-style-type: none"> <li>Medicines and Healthcare products Regulatory Agency</li> <li>National Institute for Health and Care Excellence</li> <li>Commission on Human Medicines</li> <li>British Pharmacopoeia</li> <li>Independent Assessor</li> </ol>	<ol style="list-style-type: none"> <li>Commission a re-assessment of NICE guidelines.</li> </ol>
<ol style="list-style-type: none"> <li>Independent Assessor</li> </ol>	<ol style="list-style-type: none"> <li>Conduct or contract for a proper and thorough health economic analysis of adding medicinal cannabis to the Drug Tariff.</li> </ol>

<sup>7</sup> [The Misuse of Drugs \(Amendments\) \(Cannabis and Licence Fees\) \(England, Wales and Scotland\) Regulations 2018](#)

Topic	Application	Department	Tax Take (£000s)	Jobs
Topicals	Creams	OPSS/TS	£2,630	5,350
Topicals	Balms	OPSS/TS	£1,200	2,430
Topicals	Lotions	OPSS/TS	£720	1,460
Topicals	Pet lotions	VMD/TS	£240	485
<b>Total</b>			<b>£4,790</b>	<b>9,725</b>

Topic	Application	Department	Tax Take (£000s)	Jobs
Ingestibles	Vapes	FDA/TS	£232,400	12,000
Ingestibles	Beverages	FDA/TS	£140,140	6,675
Ingestibles	Capsules	FDA/TS	£12,000	3,750
Ingestibles	Tinctures & Oils	FDA/TS	£9,950	3,750
Ingestibles	Gummies	FDA/TS	£4,830	3,000
<b>Total</b>			<b>£399,320</b>	<b>29,175</b>

	Department	Actions
1.	<ol style="list-style-type: none"> <li>Advisory Committee on Novel Foods and Processes</li> <li>Independent Assessor</li> </ol>	<ol style="list-style-type: none"> <li>Commission a review to provide clear definitions to differentiate between hemp food and supplements.</li> <li>Consider future reform of the NF process.</li> </ol>
2.	<ol style="list-style-type: none"> <li>Advisory Committee on the Microbiological Safety of Food</li> </ol>	<ol style="list-style-type: none"> <li>Set commercially viable THC limits in legal cannabis-based products.</li> </ol>
3.	<ol style="list-style-type: none"> <li>Advisory Committee on the Microbiological Safety of Food</li> <li>United Kingdom Accreditation Service</li> </ol>	<ol style="list-style-type: none"> <li>Introduce and enforce a harmonised standard testing protocol for all cannabis-based products.</li> </ol>
4.	<ol style="list-style-type: none"> <li>Advisory Committee on the Microbiological Safety of Food</li> <li>United Kingdom Accreditation Service</li> </ol>	<ol style="list-style-type: none"> <li>Make CoA, COO and full traceability mandatory for all foods and food supplements.</li> </ol>
5.	<ol style="list-style-type: none"> <li>Advisory Committee on Novel Foods and Processes</li> <li>Advisory Committee on the Microbiological Safety of Food</li> </ol>	<ol style="list-style-type: none"> <li>Set clear product definitions based on content and potency and associated testing and labelling guidelines.</li> <li>Set requirements to specify any synthetic ingredients on product label.</li> </ol>

Topic	Application	Department	Tax Take (£000s)	Jobs
Agriculture	Hemp flower	DEFRA	£51,650	
Agriculture	Hemp fibre	DEFRA	£31,260	32,930
Agriculture	Hemp shives	DEFRA	£48,100	
Agriculture	Hemp oil	DEFRA	£71,130	
Agriculture	Hemp protein powder	DEFRA	£34,700	10,000
Agriculture	Hemp dehulled seed	DEFRA	£55,160	
<b>Total</b>			<b>£292,000</b>	<b>42,930</b>

Topic	Application	Department	Tax Take (£000s)	Jobs
Industrial Manufacturing	Hempcrete	DEFRA / BEIS	£203,500	10,000
Industrial Manufacturing	Hemp insulation	DEFRA / BEIS	£108,850	9,430
Industrial Manufacturing	Biochar (Soil enrichment)	DEFRA / BEIS	£9,400	2,190
<b>Total</b>			<b>£321,750</b>	<b>21,620</b>

Topic	Application	Department	Tax Take (£000s)	Jobs
Animal Feed	Cattle feed	DEFRA	£48,110	
Animal Feed	Pigs feed	DEFRA	£21,550	9,510
Animal Feed	Poultry feed	DEFRA	£70,850	
Animal Feed	Other feed	DEFRA	£12,680	
<b>Total</b>			<b>£153,190</b>	<b>9,510</b>

Topic	Application	Department	Tax Take (£000s)	Jobs
Carbon Credits	CO <sub>2</sub> sequestered during cultivation	DEFRA	£250,860	22,500
Carbon Credits	CO <sub>2</sub> sequestered during construction	BEIS	£4,060	9,150

<b>Total</b>		<b>£254,920</b>	<b>31,650</b>
<b>Department</b>		<b>Actions</b>	
1.	<ol style="list-style-type: none"> <li>1. Drugs and Firearms Licencing Unit</li> <li>2. Animal &amp; Plant Health Agency</li> <li>3. Advisory Council on the Misuse of Drugs</li> </ol>	1.	Transfer hemp licencing from the Home Office to DEFRA.
2.	1. Animal & Plant Health Agency	1.	Simplify licencing process: <ol style="list-style-type: none"> <li>a) Allow farmers to apply for hemp cultivation licence year-round.</li> <li>b) Improve the user interface of the online application portal.</li> <li>c) Speed up the application process.</li> <li>d) Dispense with the requirement for DBS checks for hemp cultivation licences.</li> <li>e) Field selection should be based on agricultural and environmental considerations, not only security.</li> </ol>
3.	<ol style="list-style-type: none"> <li>1. Animal &amp; Plant Health Agency</li> <li>2. External Research Partners</li> </ol>	1.	Expand the national list of registered seed varieties to include registered EU hemp varieties and allow for registration of hemp varieties with up to 0.3% THC.
		2.	Establish partnerships with UK plant genetics research centres to develop hemp varieties suited for UK climate with accelerated approval and validation timelines.
4.	1. Animal & Plant Health Agency	1.	Amend hemp licence conditions requiring farmers to destroy hemp in field if the biomass exceeds 0.3% THC.
5.	<ol style="list-style-type: none"> <li>1. Animal &amp; Plant Health Agency</li> <li>2. Advisory Committee on the Microbiological Safety of Food</li> <li>3. Independent Assessor</li> </ol>	1.	Commission a review of suitable THC limit in products manufactured from hemp.
6.	<ol style="list-style-type: none"> <li>1. Drugs and Firearms Licencing Unit</li> <li>2. Advisory Council on the Misuse of Drugs</li> <li>3. Animal &amp; Plant Health Agency</li> </ol>	1.	Amend Home Office guidelines to remove restrictions on the use of the controlled parts of the plant under certain conditions.
		2.	Remove the licence condition requiring the flowers and leaves to be destroyed.
		3.	Define specific end uses e.g., tea/ oils etc to allow production of food products from hemp flowers, leaves & seeds.

Department		Actions
1.	1. Home Office / Home Secretary	1. Initiate consultations about amendments to POCA to enable businesses engage and invest in UK's legal medicinal cannabis market.
2.	1. Financial Conduct Authority	1. Ensure the FCA issues clear guidance to the industry on pathway to listing on the LSE.

# Background



## 2.1 Background

In 1933 the US federal government introduced the 21<sup>st</sup> Amendment to the Constitution, which overturned the failed policy of prohibition. The previous 18<sup>th</sup> Amendment failed to curb the production, sales, and consumption of alcohol, all of which led to a rise in organised crime and decline in tax collections. Consequently, whilst in the grips of the Great Depression, the federal government looked to alcohol to replenish tax revenues and provide an estimated 500,000 jobs for the US economy.<sup>8</sup>

Eighty-nine years later, the global cannabis market is in a similar position with the end of prohibition in sight and the opportunity crystal clear. Research by New Frontier Data, a leading provider of market research on the cannabis industry, estimates the total global market for cannabis was worth £337.4 billion in 2020 and expects it to grow to £403.5 billion by the end of 2025<sup>9</sup>. Legal global sales of cannabis (excluding hemp and CBD products) in 2021 accounted for £23.9 billion and are expected to grow to £41.5 billion by 2025<sup>10</sup>. Given that the legal sales represent only 7% and 10.2% of the total market in 2021 and 2025, with accelerated legalisation, the market could grow even faster.

The North American market has been at the epicentre of this wave of liberalisation and in 2021 its legal sales stood at £22.9bn, accounting for 96.8% of global sales<sup>11</sup>. This excluded the CBD market, which is estimated to be worth further £10.4bn<sup>12</sup>. The European market is poised to be the next booming legal cannabis market. It was estimated that £291.2m of product will be traded in 2021 and this is expected to grow rapidly to £1.87bn by 2025<sup>13</sup>. For comparison, the worldwide turnover of Scotch Whisky has been steady at £66bn as of 2022<sup>14</sup> (although again showing growth in the premium segment), and annually provides £5.6bn in gross value added (GVA) to the UK economy, with exports in 2021 worth £4.63bn.<sup>15</sup>

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<sup>8</sup> [Economic Effects of Prohibition Repeal, Granger, G. \(1931\)](#)

<sup>9</sup> [The Global Cannabis Report: Growth & Trends Through 2025](#)

<sup>10</sup> [The Global Cannabis Report: Growth & Trends Through 2025](#)

<sup>11</sup> [The Global Cannabis Report: Growth & Trends Through 2025](#)

<sup>12</sup> [Global Market Insights, CBD Market Size by Product](#)

<sup>13</sup> [Prohibition Partners, The European Cannabis Report: 7th Edition](#)

<sup>14</sup> [Statista](#)

<sup>15</sup> [Scotch Whisky Association](#)

3.0

# Opportunity



## 3.1 Opportunity

Over the past decade, overwhelming consumer demand has driven exponential growth in the global cannabis industry. The global market for cannabis and CBD products is on a trajectory to grow from £34.3b in 2021 to £64.4b in 2025, suggesting industry growth of 21.8% annually, with highest growth in the premium product segment.<sup>16,17</sup> Additionally the hemp market was £5.1b in 2020 and is forecast to be worth £110.2b in 2030, equating to annual growth of 36.1%.<sup>18</sup>

Consumer acceptance of cannabis and other active plant-based ingredients has accelerated in recent years and removed much of the stigma associated with psychoactive and psychedelic substances. Beyond the plant itself, the market now includes a wide variety of formulated, value-add products such as high-protein foods, wellness supplements and cosmetics. With advancing legalisation and rapidly shifting public attitudes, cannabis-based products are set to become part of the mainstream consumer offering globally.

Beyond consumer products, industrial hemp offers a plethora of economic opportunities and is likely to play a key role in tackling climate change over the coming decades. One hectare of industrial hemp can absorb 8 – 15 tons of CO<sub>2</sub><sup>19</sup> above the surface (forests typically absorb 2 – 6 tons) and the biomass can be turned into building materials, insulation, paper, textiles, and bioplastics, to name a few. Cultivation itself offers farmers a high-value crop alternative that can regenerate soil, improve yield of other crops, and provide a range of new revenue streams.

Amid rising consumer demand and economic pressures brought by the COVID-19 pandemic and other global crises, governments around the world are recognising cannabis as a significant driver of economic growth and tax revenues. In this context, the debate around full legalisation in Washington, Berlin and other world capitals has shifted from 'if' to 'how'. The UK has significant domestic capability, expertise, and consumer demand for cannabis-based products. Post-Brexit, there has never been a better time for the UK to seize the opportunities offered by the sector and establish itself at a leader in the emerging global cannabis industry.

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<sup>16</sup> [The Global Cannabis Report: Growth & Trends Through 2025](#)

<sup>17</sup> [Global Market Insights, CBD Market Size by Product](#)

<sup>18</sup> [Reportlinker - Industrial Hemp Market](#)

<sup>19</sup> [The Centre for Natural Material Innovation](#)

# Plan for the UK cannabis industry



## 4.1 Plan for the UK cannabis industry

The nascent cannabis Industry offers a once-in-a-generation opportunity for investment in new consumer and industrial products categories that will become staple goods in the years to come.

Notwithstanding the current operational constraints, cannabis is one of the most popular consumer products globally, with the UN drug agency and the data aggregator Statista estimating that more than 200m people consume it on a regular basis.<sup>20</sup> Some 70 countries around the world have now introduced provisions for legal access to medicinal cannabis and 10 countries<sup>21</sup> have de-criminalised or legalised adult-use entirely.<sup>22</sup> Between 2019 and 2020 alone the global cannabis market grew by 50.9%.<sup>23</sup>

Due to overwhelming consumer demand, over the past five years the UK has seen a huge increase in the number of companies manufacturing and selling cannabis-based products. However, due to regulatory uncertainty and growing pains associated with a fledgling industry, many of those businesses have encountered operational constraints and business interruptions, which in turn led to cash flow issues. Against this backdrop, the industry is now prime for a reset. With the government and industry working together, the UK has a unique opportunity to set the right foundation for a multi-faceted cannabis industry and seize one of the most promising economic opportunities of our time. There are lessons to be learned from more mature markets, such as Colorado, that could help the UK boost its economy, generate jobs and tax revenues, all while ensuring that consumers have access to safe and effective products.

This plan sets out the steps required to achieving a well-regulated, multi-faceted and competitive UK cannabis industry. If implemented, the plan could future-proof the UK farming industry, boost technological innovation and domestic manufacturing, create more than 594,000 jobs and contribute £5.5b in annual tax revenue to the UK economy.<sup>24</sup>

The plan encompasses all segments of the cannabis industry, including the production of pharmaceuticals, agricultural and industrial materials, and consumer products. It addresses the need for coordination across different government departments and highlights where regulations ought to be revised to allow for UK businesses to grow and successfully compete in international markets. Finally, it provides a commercial analysis of the monetary value of transforming the UK into a global leader in this space.

This opportunity is urgent and time limited. Countries around the world are aggressively competing to develop production excellence and become destinations for cannabis-related investment, manufacturing, professional services, and tourism. Post-Brexit, the UK has a unique opportunity to establish itself as a trusted producer of premium products and a destination of choice for international capital. The government must act fast to develop robust regulations that encourage inward investment, support farmers and entrepreneurs, protect patients and give consumers choice. In doing so, it could effectively eradicate the illicit market by making it uncompetitive, while creating a new economic sector that will pay dividends for years to come.

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<sup>20</sup> Statista: Estimated number of cannabis users worldwide from 2011 to 2019, by region

<sup>21</sup> Regulated- (Canada, United States, Uruguay, Netherlands, Guam and Northern Mariana Islands,) Decriminalised – (South Africa, Georgia, Mexico and Spain)

<sup>22</sup> The Global Cannabis Report: Growth & Trends Through 2025

<sup>23</sup> Fortune Business insights

<sup>24</sup> Internal Modelling - APPG Plan Model

# How this plan was prepared



## 5.1 How this plan was prepared

This plan was prepared by the Secretariat to the All-Party Parliamentary Group for CBD (Cannabidiol) Products, which works to encourage the development of UK regulation on CBD products that reflects evidence-based policy, clear industry guidance and the most certain basis for investors and entrepreneurs to enable this industry to safely serve the public and the wider national interests. The group is co-chaired by Crispin Blunt MP and Baroness Manzoor CBE.

The plan is the result of wide-ranging consultations with representatives of the UK and devolved governments, industry bodies and other industry stakeholders. These included:

1. Medical Cannabis Clinicians Society (MCCS)
2. Cannabis Industry Council (CIC)
3. Cannabis Trades Association (CTA)
4. European Industrial Hemp Association (EIHA)
5. British Hemp Alliance (BHA)
6. Cannabis Services Advisory Board (Jersey)

Invaluable experience and ‘lessons learned’ were also provided by the Government of Jersey, via the Cannabis Steering Committee, a cross-governmental working group dedicated to developing the domestic cannabis industry, and the US Cannabis Council (USCC), a strategic alliance that combines the collective resources of many of the largest cannabis companies, prominent advocacy organisations and hundreds of thousands of individuals to speak in one voice for ending federal prohibition in the United States.

Additionally, the plan was informed by feedback from individual industry participants who have filled out a questionnaire prepared by the Secretariat, which covered wide scope of areas that affect the industry. The Questionnaire is Include at Annex A.

The industry consultations provided a clear picture of the key areas of opportunity for a domestic cannabis industry. The UK already is a world-leading centre of cannabis research and manufacturing, and the government should preserve and enhance that reputation by developing an NHS-led programme for patients to gain access to high-quality and affordable cannabis-based medicines. With the recent surge in consumer interest in CBD, the government should ensure the availability, affordability and range of CBD products on offer, to protect consumers and eradicate the need for the illicit market.

Quite apart from the consumer aspects of cannabis, however, the largest market opportunity lies in using industrial hemp – a versatile, economic and sustainable resource with no intoxicating properties – for a wide range of agricultural, industrial and consumer applications. With clear regulations and good governance, the economic potential of the total cannabis market far exceeds the maximum extent of the medicinal and CBD markets alone.

6.0

# Industry segmentation

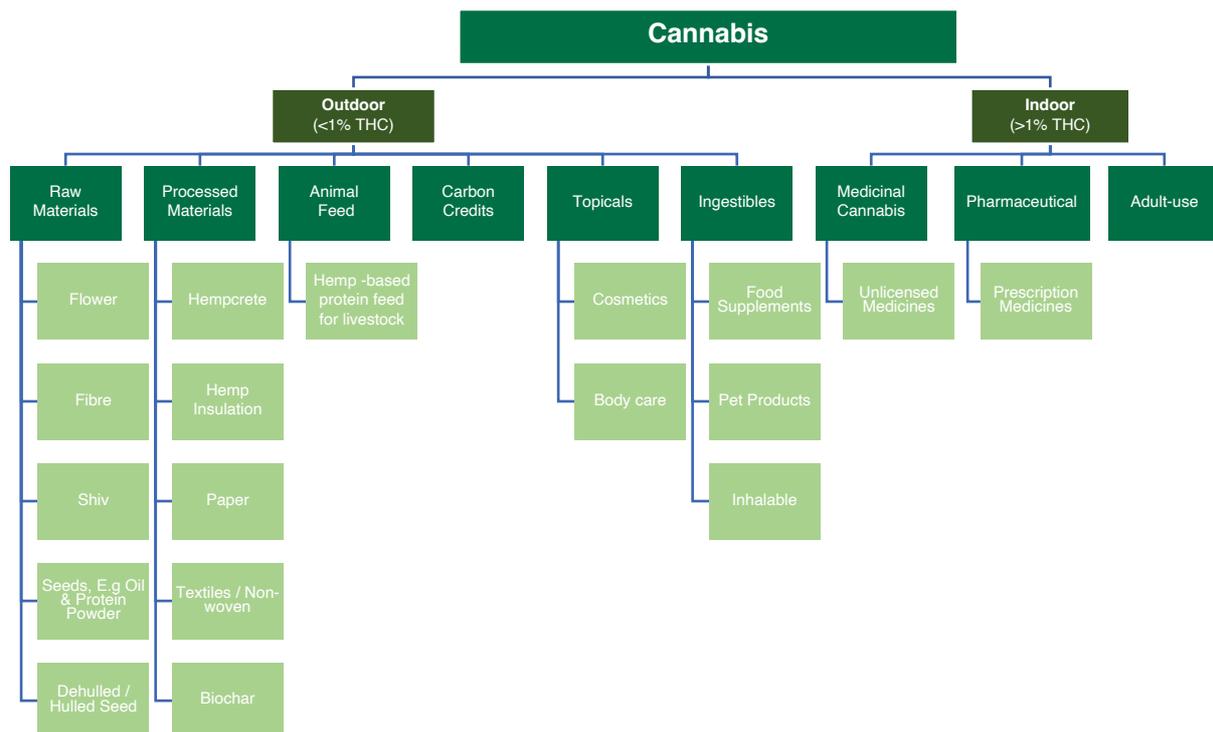


## 6.1 Industry segmentation

There is a commonly made distinction between industrial hemp and medicinal cannabis. Botanically, there is only one species of *cannabis sativa* L. However, genomic research supports the notion that over thousands of years of cultivation, cannabis farmers have selectively bred *cannabis sativa* into two distinct cultivars:<sup>25</sup>

- Low-cannabinoid, high-fibre varieties for production of fibre and seeds.
- High-cannabinoid varieties for production of medicines.

From a commercial perspective, outdoor and indoor-grown cannabis are two very distinct crops that require entirely separate approaches. The cultivation, processing, supply and marketing of both categories of products are completely divergent. Industrial hemp is farmed in open field, like any other agricultural crop, while medicinal cannabis is primarily grown in glasshouses. Farmers produce food and pharmaceutical companies produce medicines. Businesses must determine their target product and market because there is little cross-over between the processes and expertise of the two product categories.



<sup>25</sup> ScienceDaily, "How Hemp Got High: Cannabis Genome Mapped," October 24, 2011, citing van Bakel et al., "The Draft Genome and Transcriptome of *Cannabis Sativa*."

Medicinal cannabis offers the UK the opportunity to develop a domestic biopharmaceutical industry, create high-skills jobs, attract investment, and generate significant returns. Industrial hemp offers an opportunity for UK farmers to diversify their crops while bringing other benefits, such as improvement in soil health, reduce soil compaction and nutrient loss, and to engage in carbon sequestration. Both sectors require expertise, significant capital investment and a robust regulatory framework.

There is an opportunity to develop both segments in parallel, but the success of this strategy will depend on the understanding of the needs of the different sub-sectors of the cannabis industry and cooperation between the government and industry representatives.

The following sections provide an overview of the key sectors of the cannabis industry and discusses their potential contributions to the UK economy.

7.0

# Hemp



## 7.1 Hemp

Sector	Department	Gross Sales (£000s)	Tax Take (£000s)	Jobs
Agriculture	DEFRA	£1,459,940	£292,000	42,930
Industrial Manufacturing	DEFRA / BEIS	£1,608,730	£321,750	21,620
Animal Feed	DEFRA / VMD	£765,940	£153,190	9,510
Carbon Credits	DEFRA / BEIS	£1,285,340	£254,920	31,650
<b>TOTAL</b>		<b>£5,119,950</b>	<b>£1,021,860</b>	<b>105,710</b>

## 7.2 Background

Hemp is a highly versatile crop that has been cultivated around the world for centuries. Its fibres and central woody 'shiv' can be used to create products such as building materials, textiles, paper, bioplastics, car parts and livestock bedding. Hemp seeds, which are high in protein, GLAs and offer the perfect source of omega-3 fats for humans, are used to produce high-quality functional oil, protein powders with many applications in the meat-free category, and nutritious seed cake for animal feed.

*Low-THC cannabis Sativa hemp is not a new crop to England. In fact, to some extent Britain's greatness was built on the thriving hemp industry in the 15th and 16th Centuries. Hemp was so valuable during the reigns of King Henry VIII and Queen Elizabeth I that it was illegal not to grow hemp, and people even paid their taxes with it (a quarter of an acre per landowner (one root) had to be planted with hemp). Its fibres were so crucial to the British navy – providing everything from rope to sails – that it could be said hemp was a great enabler of British global exploration.*

In recent years, interest in the use of hemp-derived cannabidiol (CBD) in 'wellness' products has led to a resurgence in hemp cultivation around the world. CBD, the primary cannabinoid found in hemp, is present in concentrations ranging from 0.5% to 9.9%<sup>26</sup> in the upper third of the plant. Hemp extracts containing CBD – as well as isolated CBD – can be utilised in the production of pharmaceutical drugs, food supplements, cosmetics, and a range of pet care products, depending upon local licensing restrictions.

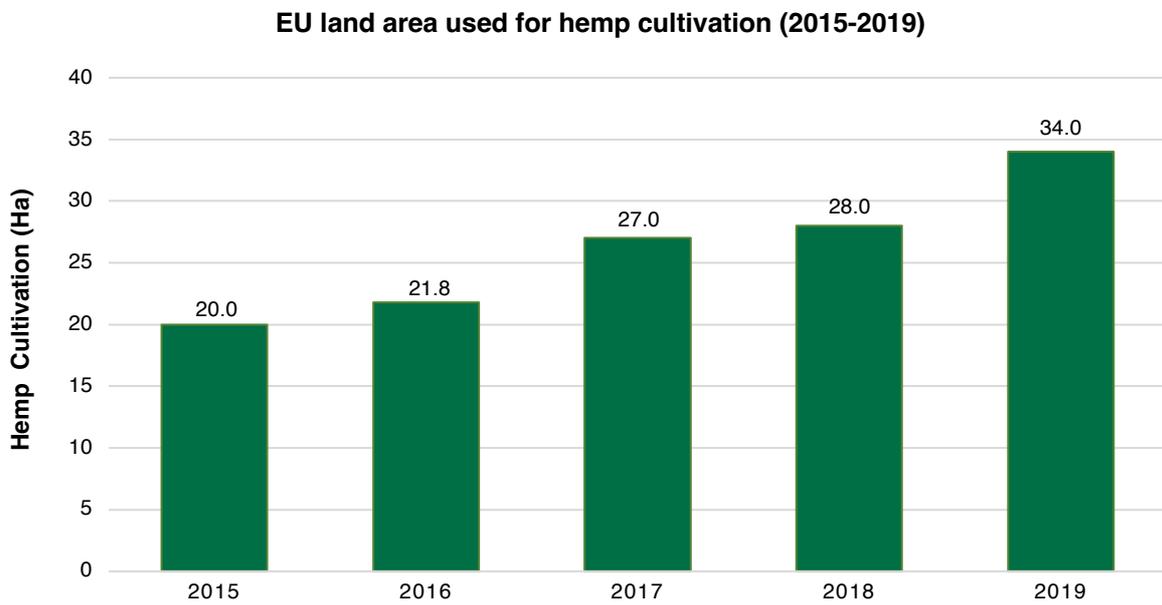
Increased need for sustainable farming and efforts to combat climate change around the world have also prompted growing numbers of farmers to add hemp to their crop rotations. Against the backdrop of global and national environmental initiatives, including the UK government's plan of achieving the 'Net Zero' target by 2050, hemp is gaining prominence as a powerful tool in tackling the adverse effects of climate change.

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<sup>26</sup> [Impact of Harvest Time and Pruning Technique on Total CBD Concentration and Yield of Medicinal Cannabis](#)

## 7.3 Analysis

The cultivation of industrial hemp for food, feed, cosmetics, fibre or carbon credits is an agricultural activity whose benefits are well-documented and there is no evidence of public harm. The US and many European countries are recognising the benefits and versatility of industrial hemp and supporting their farmers with entry into this fast-growing market.<sup>27</sup> The area dedicated to hemp cultivation in the EU has increased from 19,970 hectares in 2015 to 34,000 hectares in 2019, representing a 70.2% increase. In the same period, the production of hemp increased from 94,120 tons to 152,820 tons, a 62.4% increase. As of 2019, France was the largest European hemp producer, accounting for more than 70% of hemp production in the EU, followed by the Netherlands (10%) and Austria (4%).<sup>28</sup> Since then, other countries, notably Italy, Poland, Slovenia, Croatia and the Baltic states, have significantly increased their hemp production.



<sup>27</sup> Benzinga

<sup>28</sup> Europa

Most global hemp producers regulate the crop as an agricultural commodity, not a controlled substance, and place the industry under the regulatory remit of an agricultural department. To put the UK on a competitive footing with other hemp-producing countries, the licencing of industrial hemp cultivation should be moved to DEFRA, in line with the majority of Europe.

Country	Licensing Body
Austria	No Licence Required
Belgium	Regional Governments
Bulgaria	Ministry of Agriculture, Food and Forestry
Croatia	Registry of Industrial Hemp Growers (Ministry of Agriculture)
Cyprus	Department of Agriculture
Czech Republic	No Licence Required
Denmark	Agency for Agriculture
Estonia	Chamber of Agriculture and Commerce
France	National Agency for the Safety of Medicines and Health Products (ANSM)
Germany	Federal Ministry of Food and Agriculture (BMEL)
Greece	The Department of Rural Development and Control (TAAE)
Ireland	Agriculture and Food Development Authority (TEAGASC)
Italy	Ministry of Agricultural, Food, Forestry and Tourism Policies (MIPAAFT)
Lithuania	Ministry of Agriculture
The Netherlands	Ministry of Agriculture, Nature and Food Quality
Poland	National Agricultural Support Centre (KOWR)
Portugal	Ministry of Agriculture
Romania	County Directorate for Agriculture
Slovakia	Ministry of Health
Slovenia	Ministry of Agriculture, Forestry and Food
Spain	No Licence Required
Sweden	Board of Agriculture
<b>UK</b>	<b>Home Office - Drugs and Firearms Licensing</b>

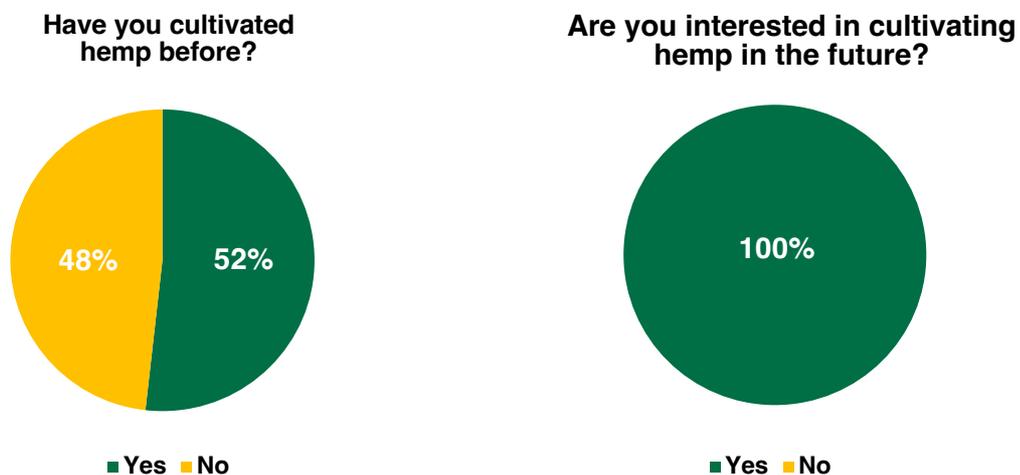
Although the UK has a history of hemp farming, little hemp farming has taken place in recent decades and the country now lags far behind its European counterparts. At present, only about 20 farmers in the UK grow hemp on a total of 800 hectares.<sup>29</sup> This is largely the result of onerous regulations. In the UK, cultivating industrial hemp constitutes a “special purpose” under the Misuse of Drugs Act 1971 (MDA), meaning it is permitted once a licence is obtained. As such, hemp farmers must meet onerous requirements associated with the licencing of controlled substances:

<sup>29</sup> Source: CIC

- **Complicated process.** Secure a renewable three-year Home Office licence, which is constantly changing and according to farmers is complicated to fill out.
- **Licence timeframe.** The licence is often awarded when it is too late for farmers to grow.
- **DBS check.** This licence requires every farmer to provide an enhanced Disclosure and Barring Service (DBS) check for every employee.
- **Flower prohibition.** The flower and leaf are prohibited to be used for processing.

These restrictions provide regulatory uncertainty and add cost, as a result disincentivising farmers from engaging in the activity.

However, there is significant interest among farmers in reviving the sector. In 2021 the Cannabis Industry Council (CIC) conducted a survey of UK farmers to establish interest in hemp cultivation. Of those who responded, the overwhelming majority expressed a desire to add hemp to their crop rotation.



Source: Cannabis Industry Council, 2021 – Great British Hemp Farming Survey (56 responses)

While the UK is currently out of step with the global hemp industry, minor legislative amendments making it easier for farmers to grow and sell hemp would boost economic output and have a lasting positive impact on the rural economy. An analysis of current market trends and farmer interest indicates that, with improved hemp licencing, by 2027 more than 220,000 hectares of hemp would be added to UK cultivation. Using current market prices per kg of hemp biomass, a conservative estimate would see the biomass generating £1.5b in additional income for farmers in the UK.<sup>30</sup>

Aside from the purely commercial benefits, hemp cultivation has the potential to improve crop resilience and yields, regenerate soil and unlock new revenue streams through the production of processed materials, animal feed and carbon credits.

<sup>30</sup> Internal Modelling - APPG Plan Model

### 7.3.1. Low-cost, high-value crop alternative

Factors such as price pressures, negative effects of high-intensity farming and increasing frequency of extreme weather events are forcing farmers to look for new ways to achieve desired economic outputs from their land. UK farmers need a greater range of spring break crops, as many current alternatives have become unprofitable or have succumbed to crop infestation. Due to its relatively late planting date and an annual crop cycle, hemp integrates well into existing annual crop rotations and could be a good second option for farmers if severe weather caused the loss of winter crops or early spring crops. Preliminary results from a trial at Rodale Institute (US) suggest that the presence of hemp as a summer crop and its earlier harvest date suppressed weeds season-long and provided a wider window for establishing the winter crop.

*A study assessing 23 crops along 26 biodiversity parameters, identified hemp as superior to most major crops in terms of limiting damage to biodiversity. On the contrary, as it is grown with little or no synthetic phytosanitary products, hemp can help enhance biodiversity in rural areas. The flowering cycle usually occurs between July and September, coinciding with a lack of pollen production from other farm crops. Being a wind pollinated, dioecious and staminate plant, cannabis produces large amounts of pollen, a vital nutritional source for bees during periods of floral scarcity. A study on the bee population in hemp fields identified 23 different genera in northern Colorado (US) plantations, with a majority of *Apis mellifera* at 38%, followed by *Melissodes bimaculata* at 25% and *Peponapis pruinosa* at 16%.<sup>31</sup>*

Additionally, hemp does not succumb to the many common consequences of current narrow cropping choices – including herbicide resistant black grass, brome grass or ryegrass – and therefore can be grown successfully without the use insecticides, herbicides or fungicides. According to an internal survey conducted by the EIHA, already 50% of EIHA members use natural fertilisers like manure or slurry and many indicate that hemp is an ideal crop for organic agriculture and cultivation near surface water.

Being a fast-growing crop and having a high leaf turnover rate, hemp will, if grown in ideal conditions, fully cover the ground three weeks post-germination. The dense leaves rapidly form a natural soil cover material that reduces water loss and soil erosion. In addition, fallen leaves provide vital nutrition for the soil. If intended for fibre, hemp stalks are an important nutritive organic matter for the soil during retting. Because of its height and shading capacity, hemp efficiently eliminates weeds leaving the soil in optimal condition.

When used in crop rotation, hemp helps to break the cycle of pests and diseases affecting other crops. Currently, it is common for farmers to follow the same narrow diversity rotation of two years of wheat (or other cereal) followed by rape. If hemp was to be introduced, it would naturally eradicate the flea beetle population, one of the major crop pests in the UK.

Research also indicates that adding hemp to crop rotations improves the yields of subsequent crops. Recent trials in the UK have provided evidence that winter wheat, planted after hemp, increased in yield by 15-20%.<sup>32</sup> High hemp planting densities also reportedly suppress weed growth and seed return to the soil, reducing herbicide requirements for subsequent crops.<sup>33</sup>

<sup>31</sup> [Bee diversity and abundance on flowers of industrial Hemp, O'Brien, C.; Arathi, H.S.](#)

<sup>32</sup> [British Hemp Alliance](#)

<sup>33</sup> [Effect of industrial Hemp \(\*Cannabis sativa\* L\) planting density on weed suppression, crop growth, physiological responses, and fibre yield in the subtropics](#)

## 7.3.2 Soil regeneration

Hemp is an excellent organic tool for tackling soil pollution and compaction issues stemming from intensive farming and poor land management practices.

According to estimates by the World Wide Fund for Nature (WWF), the land in England and Wales is being destroyed 10 times faster than it is being created<sup>34</sup> and there is unprecedented demand for sustainable and scalable farming techniques. Without a shift in the application of fertilisers, pesticides and monoculture crop growth, degradation will continue at an alarming rate. The Nature Friendly Farming Network (NFFN), a UK-based farming community initiative, estimates that without any let up in the rate of soil erosion, the UK's topsoil could become fully depleted within the next 60 years.<sup>35</sup>

Hemp can be used in soil remediation because it has the ability to absorb pollutants and heavy metals such as lead, nickel or cadmium. The large-scale cultivation of industrial hemp has been well documented in areas like Puglia in Italy and Chernobyl in Ukraine, where it has been used to decontaminate some of Europe's most polluted soils. Because of the bioaccumulation in the aerial part of the plant, it is important to identify the right applications for such biomass.

Hemp can also help farmers with soil compaction issues. The plant has long tap roots that can penetrate up to 3.5 meters deep into the soil, and a strong network of fibrous roots that break up the compacted soil, stimulate worm movement, and stave off erosion. Additionally, hemp's dense leaves become a natural soil cover, reducing water loss and staving off soil erosion.

Hemp must be recognised for its net carbon positive impact, as it also provides renewable, biodegradable, low impact materials for thousands of different uses, and is a feasible solution to petrochemical products. The environmental benefits derived from hemp cultivation fulfil the objectives of the Environmental Land Management (ELM) scheme, which is due to launch in England in 2024. By aligning government strategies with effective regulations, the UK will be able to boost the rural economy and reverse the continued degradation of UK farmlands.

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<sup>34</sup> World Wildlife Fund, Inc.

<sup>35</sup> Nature Friendly Farming Network

### 7.3.3 'Green' building materials

As discussed above, hemp cultivation offers economic and ecological benefits to farmers that are independent of the global price of hemp biomass. However, in the long term, UK's unrefined farming output will not be able to compete on price with mass-scale hemp growers such as the US and China. For that reason, a key tenet of the UK's hemp industry strategy is investment in R&D, processing infrastructure, and specialist manufacturing. Using hemp as a raw material can achieve many of the targets outlined in the UK's bioeconomy strategy, which aims to produce "smarter, cheaper materials such as bio-based plastics and composites for everyday items, as part of a more circular, low-carbon economy."<sup>24</sup>

Hemp biomass has wide application in the building materials trade, offering high performance and carbon-negative construction solutions. Hemp shivs are used to produce 'hempcrete', a hemp-lime composite walling and insulation material which, in combination with structural materials, can deliver net-zero carbon building systems that lock up more carbon than is produced during construction. Hempcrete is non-flammable, resistant to mould and bacteria, naturally regulates humidity and has an exceptional thermal and acoustic performance. Additionally, hemp fibres are an effective alternative to traditional polyurethane foams, offering far superior thermal insulation performance and therefore a reduction in the cost of heating.

The use of low-embodied-carbon, bio-based materials is a key tool for the UK to reduce buildings' carbon footprint while increasing their energy efficiency. Hemp-based construction materials have an exceptional thermal performance which reduces energy consumption while sequestering carbon. These materials include hempcrete, hemp wool and fibre-board insulation. While the production of one ton of steel emits 1.46 tons of CO<sub>2</sub> and one ton of reinforced concrete emits 198kg of CO<sub>2</sub>, one square meter of timber framed, hemp-lime wall (weighing 120kg) sequesters 35.5kg of atmospheric CO<sub>2</sub> for the lifetime of the building (without considering the energy cost for the transportation and placement of the material).<sup>36</sup>

The UK government has long been searching for sustainable alternatives to traditional building materials. As far back as 2010, a report by the Department for Business, Innovation and Skills, concluded that the UK's construction industry produced 300m tons of CO<sub>2</sub> emissions and the only way to reduce those emissions was by moving away from using traditional construction materials.<sup>37</sup> With the convergence of two government agendas, the pledge to alleviate the housing shortage and the need for energy efficient homes to meet 'Net Zero' targets, availability of domestically-produced hemp-based building materials could provide the economic stimulus for the growth of a new manufacturing sector with significant global potential.

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<sup>36</sup> Bath's Building Research Park, Dr Mike Lawrence (Director)

<sup>37</sup> The Department for Business, Innovation and Skills - Low carbon construction innovation & growth team: final report

As of 2019, the UK annual greenhouse gas emissions were estimated at 435.2m tons of CO<sub>2</sub><sup>38</sup>, of which, based on global trends, up to 38% of emissions could be accounted for by the construction industry.<sup>39</sup> As part of its 2050 Net Zero strategy, by 2035, the UK government intends to cut all emissions by 78% to bring the UK in line with 1990 levels.<sup>40</sup> This could be achieved in two ways:

1. **Using carbon-negative construction materials to lock-up carbon.** It takes over 34.6 tons of CO<sub>2</sub> to build an average UK house<sup>41</sup> and construction of 200,000 houses would contribute 6.9m tons of CO<sub>2</sub> annually. However, using hemp-based materials instead of mainstream construction products would mean an average sized house (1,500 ft<sup>2</sup> with 300mm thick walls) would capture 13.1 tons of CO<sub>2</sub><sup>42</sup> (allowing for transport and assembly), equating to a total potential capture of over 2.62m tons. This equates to a 138.0% reduction.
2. **Using natural insulation materials to improve thermal efficiency.** Hemp insulation has a higher 'specific heat capacity' (i.e., the amount of heat needed to raise the temperature of the material) than synthetic insulation and is therefore better at preventing overheating in the summer and retaining heat in the winter. Moreover, the manufacturing of synthetic and mineral insulation is energy intensive, emitting between 100kg and 1,000kg of CO<sub>2</sub> per cubic meter, compared to only 40kg of CO<sub>2</sub> per cubic meter of hemp.<sup>43</sup>

A UK market for hemp-based building and insulation materials represents one of the most important growth areas for the UK hemp industry. According to current forecasts, based on 220,000 hectares of cultivation, by 2027 the UK's hemp shiv market could be worth £240m, representing a value of £1,055 per hectare of revenue for farmers.<sup>44</sup> As of 2020, hemp insulation accounted for less than 0.5% of the total 3.3m tons of insulation used every year in the EU.<sup>45</sup> With the global thermal market for insulation expected to reach £31.67b by 2025,<sup>46</sup> there is significant commercial potential for UK producers to take advantage of this market opportunity.

*The examples of hemp in the UK construction industry keep multiplying and gaining in efficiency. A three-story building at Bath University was constructed using a hemp-lime envelope and was so effective that its administrators switched off all heating, cooling, and humidity control for over a year, maintaining steadier conditions than in their traditionally equipped stores, reducing emissions while saving a huge amount of energy. After more than 30 years of hempcrete construction in UK, which leads the rest of the world in this innovative construction method, thousands of newbuild hempcrete homes have been added to the housing stock. However, there is still work to do to upscale and mainstream this novel construction material which is still unfamiliar to much of the construction industry.*

With the correct infrastructure installed and the forecasted ramp up of hemp grown over the course of the next five years, the UK could produce enough shiv to support the production of over 61.1% of the current annual volume of houses being added to the national stock. Furthermore, each house built using hempcrete would sequester 13.1 tons of CO<sub>2</sub>, resulting in an additional £20.3m worth of carbon credits. The chart below illustrates the number of houses that could be built using hemp shiv compared to the forecasted housing completion numbers in the UK.

<sup>38</sup> Department for Business, Energy, & Industrial Strategy

<sup>39</sup> 2020 global status report for buildings and construction

<sup>40</sup> Department for Business, Energy, & Industrial Strategy

<sup>41</sup> Monahan, J., & Powell, J. C. (2011). An embodied carbon and energy analysis of modern methods of construction in housing: A case study using a lifecycle assessment framework. *Energy and Buildings*, 43(1), 179-188

<sup>42</sup> Internal Calculations based on 1,500 ft<sup>2</sup> house, 300mm thick walls and 307.26 kg CO<sub>2</sub> sequestered per m<sup>3</sup>

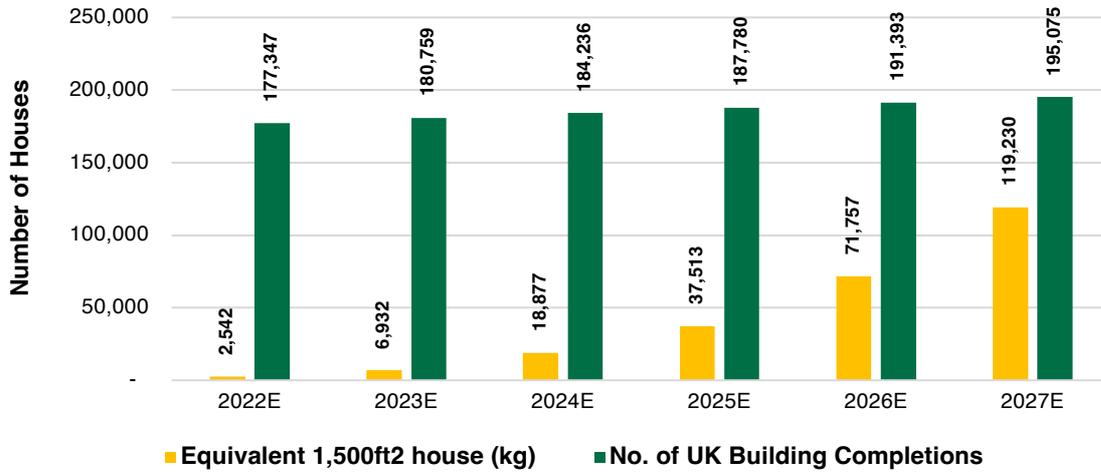
<sup>43</sup> Hemp Flax International Limited

<sup>44</sup> Internal Modelling – APPG Plan Model

<sup>45</sup> Hemp Flax International Limited

<sup>46</sup> Grand View Research, Building Thermal Insulation Market Size Worth £31.7b By 2025

**1,500 ft2 houses production using 100% of the UK shiv capacity vs current completions**



The estimates are based on the assumption that the average size of a detached house is 1,500 sq. ft. and requires 6,329kg of hemp shiv to build (equivalent of 465 x 30lbs bales).

Beyond the value of the raw materials, processing of hemp biomass and manufacturing of building materials would create high-skilled jobs in rural areas. Typically, based on current technology, hemp processing plants are capable of processing between four and 12 tons per hour. A 12-ton processing plant would provide direct employment for 54 operational staff. Based on projected demand for 16 processing facilities by 2027 and including in-direct sales and administrative staff, the sector would add 1,264 jobs to the UK economy.<sup>47</sup> With the addition to agricultural, ancillary and secondary processing jobs (estimate of 720), the employment opportunities would extend to several thousand.

<sup>47</sup> Internal Modelling – APPG Plan Model

## 7.3.4 Paper

With investment in processing capability, hemp shiv could also be used as a sustainable and cost-effective alternative to wood pulp. Paper produced from hemp is easier to manufacture because hemp shiv is a softer but more robust than wood pulp. Because hemp matures in 16 weeks, compared to 20 years for an average tree, over a 20-year period, one acre of hemp can produce as much paper as 4-10 acres of trees.

*According to research undertaken by the Massachusetts Institute of Technology (MIT), the Chinese were the first global civilisation to produce paper. Dating to 150 BC, the paper was made entirely from the pulp of hemp fibres. In subsequent centuries the material was widely adopted around the world and created significant pockets of industry. For instance, the town of Hemel Hempstead in Hertfordshire derives its name from hemp because by the 1700s it was a major hemp processing hub with four paper mills. The hemp paper industry thrived until the 19<sup>th</sup> century, when it was replaced with wood pulp, which at that time was a cheaper raw material.*

Sitka spruce, a common tree variety used in the manufacturing of paper, contains about 30% cellulose and requires bleaching with toxic chemicals before it can be manufactured into paper. By contrast, hemp contains 65-85% cellulose and requires no bleaching. Additionally, hemp can be recycled 7-8 times, compared to 3-5 times for paper made from pulp.

Hemp shiv can be used as source material for a full range of paper products, from fine stationery to cardboard boxes and moulded packaging. Hemp paper is more durable than wood paper and can be coated (using China clay) to keep opacity, whiteness, smoothness and print qualities. At present, common uses for hemp paper are:<sup>48</sup>

- **Cigarette paper.** This segment is dominated by a plethora of Chinese companies producing hemp cigarette rolling paper with a strong export market. Quintessentially Tips (UK) specialises in cigarette papers made out of hemp.
- **Artisan paper.** Hussein Papers (Rajasthan) and Eco Industries (Gujarat) produce handmade hemp paper for calligraphy, painting and craft.
- **Cardboard packaging.** Sana Packaging (Colorado), Hemp Press (Oregon) and Owyhee Produce (Oregon) are leading the hemp moulded packaging sector in the US. On the pulp-board side of the sector, Canada's Hammond Paper Group is a leader in the production of paperboard and clipboards, and Hemp Flax Group, operating in Germany, the Netherlands and Romania, manufactures a wide range of boards and paper products.

The bulk of hemp paper production is concentrated in China, with additional manufacturing hubs in Germany, the Netherlands and the UK. North American paper companies, including the multi-national operator Raw and San Diego-based Green Field Paper Company are fast establishing themselves in this sector. The market for hemp paper is expected to be worth £21.1m by 2023 and is predicted to grow at a rate of 5.3% per annum.<sup>49</sup>

<sup>48</sup> Hemfoundation.net Report (13<sup>th</sup> July 2020); Hemp Wire Article 11<sup>th</sup> October 2019 and ecofriendlypackagin.com.au.

<sup>49</sup> [Global Hemp Fiber Market Growth 2020-2025](#)

## 7.4.5 Textiles

A growing recognition of the negative environmental impact of the garments industry and the need to move away from 'fast fashion' has reignited interest in hemp as a sustainable alternative to commonly used raw materials for textile production.

Compared to cotton and other fibre crops used in the production of textiles, hemp is higher-yielding and has a lower overall ecological footprint. One acre of hemp generally produces around 1,500 pounds of fibre. This figure represents approximately three times the amount of cotton that can be grown in the same space.<sup>50</sup> Farmers can also grow hemp on the same land for several consecutive years without depleting the soil or reducing yield. Finally, hemp requires 2,721 litres of water per kg of fibre produced – less than one third of the 9,758 litres required for cotton.<sup>51</sup>

Being ten times more absorbent than cotton, hemp's hollow structure is excellent at drawing away moisture from the body during the night. It is also antibacterial and naturally hypoallergenic and resistant to mildew and bedbugs, keeping clothing and homewares such as bed sheets fresh, clean and hygienic.<sup>52</sup>

*One cotton shirt uses 2,700 litres of water throughout the growing and manufacturing process. Cotton production uses 18% of the world's pesticides and yet 400,000 tons of cheaply made, fast fashion garments are thrown into UK landfill each year. One hemp shirt consisting of 300g of dried fibre uses only 500 litres of water and needs no pesticides. It softens with every wash and its hollow fibres mean it breathes well in summer and insulates in winter.<sup>53</sup>*

Currently there is no domestic production of hemp for textiles in the UK. This is partly due to the fact that the industry is in its infancy and partly to a shortage of UK textile processing capacity, much of which has moved offshore in the previous decades. While hemp is unlikely to become a source of mass-produced garments in the UK, it is a sustainable alternative to cotton and could become a viable option for the premium segment of the 'Made in Britain' clothing industry.

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<sup>50</sup> [Hemp vs. Cotton: Is This the Future of Clothing?](#)

<sup>51</sup> [European Industrial Hemp Association](#)

<sup>52</sup> [Harrison Spinks](#)

<sup>53</sup> [Ecological Footprint and Water Analysis of Cotton, Hemp and Polyester](#)

## 7.4.6 Non-woven products

Hemp can also be used in the non-woven industry, alone or in combination with other fibres. The non-woven sector encompasses many different consumer markets, from hygiene products to medical devices (i.e., wound dressings, surgical clothing, bandages, etc.). The current need for greening of the raw materials used in the manufacturing industry makes hemp one of the best candidates for this transition. While existing machinery used to produce non-woven products can already support hemp with a few adjustments, the volumes of raw materials needed for this industry would require a significant scale up of cultivation and a coordination with the operators along the full value chain.

## 7.4.7 Composites

Hemp can be used also as reinforcement in composites. It has been particularly appreciated in the automotive industry, where it has already been used for decades to diminish weight while ensuring high resistance. A further expansion of such applications in the transportation industry would result in higher energy efficiency and a significant reduction in emissions.

## 7.4.8 Innovative uses of hemp waste

Recent technological innovations have created new commercial uses for hemp biomass leftover from traditional processing – generally referred to as ‘dust’ – which would otherwise be discarded as waste. Three product categories offer particularly attractive market potential:

- **Biochar.** Using a process called pyrolysis, hemp biomass is heated to produce a porous material that is rich in nutrients and can be added to soil to increase its biodiversity and lock-in carbon sequestered from the atmosphere. A study conducted by Cornell University found that 1.8b metric tons of carbon could be offset through the production of biochar.<sup>54</sup> According to one estimate, by 2025 the global market for biochar is expected to reach £2.68b.<sup>55</sup> Given that biochar yield equates to approximately 24.9% of input material, based on expected cultivation of 200,000 hectares of hemp by 2027, and using the conservative current market rate of £500 per ton of hemp biomass, by 2027 the UK hemp biochar market could be worth over £47m.<sup>56</sup> Based on currently-available technology, by 2027 approximately 15-20 primary processing facilities would be able to process the entire domestic production of biochar. With 10 direct and in-direct jobs required to operate a pyrolysis facility, the sector could create 210 new specialist jobs in rural areas across the UK.

Investment in pyrolysis processing technology could also generate additional revenue from energy production. Per tonne of dry hemp input material, pyrolysis produces approximately 4.55 megawatts of heat, 2.3 megawatts of cold energy and 0.4 megawatts of electricity, all of which can be sold back into the national power grid.<sup>57</sup> This technology has already been successfully deployed in Oslo, where a pyrolysis factory produces 300 tons of biochar per year, which represents the removal of approximately 700 cars from the road. The excess heat is also sold to the power grid at additional profit.<sup>58</sup> As an additional revenue stream, carbon credits generated through processing over 377,000 tons of hemp dust into biochar could amount to £10.8m in 2027.<sup>59</sup>

- **Pellets.** Hemp dust can also be processed into pellets used as fuel in CHP biomass boilers. The current UK market for hemp-based pellets is £60 per ton, compared to £80 per tonne for woodchip.<sup>60</sup> The price differential is largely due to the fact that there is minimal processing capacity currently available in the UK, with no economies of scale. However, as with biochar, there is a significant ecological incentive to invest in pellet processing infrastructure. 9.1m of the 9.4m tons of woodchip sold in the UK every year is being imported from abroad, unnecessarily incurring additional greenhouse gas emissions, including CO<sub>2</sub>.<sup>61</sup> If hemp pellets from domestically grown and processed hemp replaced 100% of the imported woodchip, based on current volumes of woodchips, the sector will add £1.3b to the UK economy.<sup>62</sup>
- **Batteries.** One of the largest potential growth areas for hemp waste is in the production of batteries. Research conducted by Dr David Mitlin at Clarkson University in New York shows that hemp-based batteries were nearly 200% more efficient and have a greater MW hour density compared to traditional lithium-ion batteries. Hemp batteries are produced by heating the hemp bast/fibre, currently treated as farming waste, at extremely high temperatures to produce graphene nanosheets, which are then used in the manufacturing of supercapacitors. Whilst the technology requires further R&D before it can be commercialised, investment in this technology could lead to an extremely lucrative future industry.

<sup>54</sup> [Nature Communications, Charcoal takes some heat off global warming](#)

<sup>55</sup> [Zion Market Research](#)

<sup>56</sup> Industry Estimations - APPG Plan Model

<sup>57</sup> Unyte Hemp Pyrolysis Trial

<sup>58</sup> [Euronews.green](#)

<sup>59</sup> Internal Modelling - APPG Plan Model

<sup>60</sup> Industry Consultations – Jamie Bartley Unyte Limited

<sup>61</sup> [Forest Research](#)

<sup>62</sup> [Forest Research](#)

Hemp offers a low-cost and low-carbon alternative to a range of raw materials currently used in industrial manufacturing. As the industry is still in its infancy, the UK has the opportunity to apply lessons learned and avoid the turbulence experienced by other markets. The US in particular offers valuable lessons about the growth of the hemp industry. The 2018 Farm Bill legalised hemp and initial interest in the crop saw the area grown under hemp exceed 240,000 hectares in 2019.<sup>63</sup> However, the US market experienced extreme turbulence, driven by a lack of an established market and producers' reliance on demand for CBD. As the market became saturated, many farmers were forced to abandon the industry.

Alongside business-friendly regulations, investment in diversifications, innovative processing and creating a domestic market will be key to the UK becoming a global leader in the manufacture of hemp-based products.

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<sup>63</sup> [Hemp Industry Daily; 2020 US Hemp Harvest Outlook](#)

## 7.4.9 Animal feed

The pressing of hemp seed for oil generates hemp seedcake as a co-product. Hemp seedcake is rich in protein and dietary fibre and used as animal feed. The addition of hemp protein to animal feed has shown a decrease in inflammatory events in cattle, improvement in milk yields, and an increase in the levels of Omega-3 fats in farmed chicken. For bovine animals, a high-protein diet has an added ecological benefit, as there is emerging evidence that it reduces flatulence in cows, in turn decreasing their methane emissions. Methane is a major contributor to climate change, estimated to be 80 times more potent than carbon dioxide.<sup>64</sup>

There are also early indications that other parts of the cannabis plant that are usually discarded as waste – including the leaves and trimmings – could improve the health of other farmed animals.

According to results of a 2015 animal study, incorporating hemp seeds and hemp seed oil to hens' diet led to eggs with increased levels of Omega-3 fatty acids in the yolks and a healthier Omega-3 to Omega-6 ratio.<sup>65</sup> Another study from 2020 calculated that the addition of as little as 157g of hemp protein per kg of animal feed to the diet of dairy cows resulted in increased milk yield.<sup>66</sup>

Early findings from a pioneering study currently being conducted by Chang Mai University in Thailand show the potential benefits of introducing cannabis into the feed of chickens.<sup>67</sup> According to researchers, there are indications that introducing some cannabinoid-rich parts of the plant into the birds' diet reduced the number of cases linked to avian bronchitis, which, in turn, could decrease the need for antibiotics in poultry farming. Secondly, the researchers found that chickens who had been fed a diet inclusive of cannabis achieved superior body mass, with increased levels of protein, fat and moisture in the meat.

Whilst more research is required to fully understand the potential benefits of hemp-rich diets on farmed animals, there are clear indications that many previously underused parts of the plant could find new commercial uses, opening potential future revenue streams for farmers. Hemp is regarded to be among the most nutritious sources of protein, but its wide adoption is currently being hampered by high cost due to low volumes of production.<sup>68</sup> With demand for alternative feed protein growing at 14% per year, market conditions are ripe for scaling up hemp production.

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<sup>64</sup> [US National Oceanic and Atmospheric Administration](#)

<sup>65</sup> [Hindawi](#)

<sup>66</sup> [Academic Journals](#)

<sup>67</sup> [Chompunut Lumsangkul, Assistant Professor Chiang Mai University](#)

<sup>68</sup> [Yahoo Finance](#)

## 7.4.10 Carbon credits

Hemp has proven to be highly effective in carbon sequestration, one of the most important human interventions in the global effort to slow down climate change. This is a double win for farmers: in addition to selling the biomass, they can also monetise hemp's negative carbon footprint via carbon credits, which can be traded in international markets.

According to the Department for Environment, Food and Rural Affairs (DEFRA), the UK farming industry emits 46.3m tons of greenhouse gas emissions on an annual basis, equating to 3.1 tons per hectare.<sup>69</sup> If the UK government is to reach its stated target of decarbonising all sectors of the UK economy and reaching 'Net Zero' by 2050, it will need to significantly diversify its current strategies. Hemp production is a high-impact, low-cost intervention that can achieve that target.

On an annual basis, hemp sequesters between 8 and 15 tons of CO<sub>2</sub> per hectare of harvested (above the ground) biomass.<sup>70</sup> By comparison, a hectare of 20-year-old woodland captures 2 to 6 tons per annum. With an average grow and harvest cycle of 120 days,<sup>71</sup> over a 20-year period hemp can capture 5 times more CO<sub>2</sub> than a forest. If manufactured into construction products or other long-lasting applications (such as panels for the automotive industry and other composites) the carbon is stored for longer periods, while a substitution effect can be accounted every time hemp is used as an alternative to extraction and synthetic materials.

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<sup>69</sup> Department for Environment Food & Rural Affairs, Agri-climate report 2021

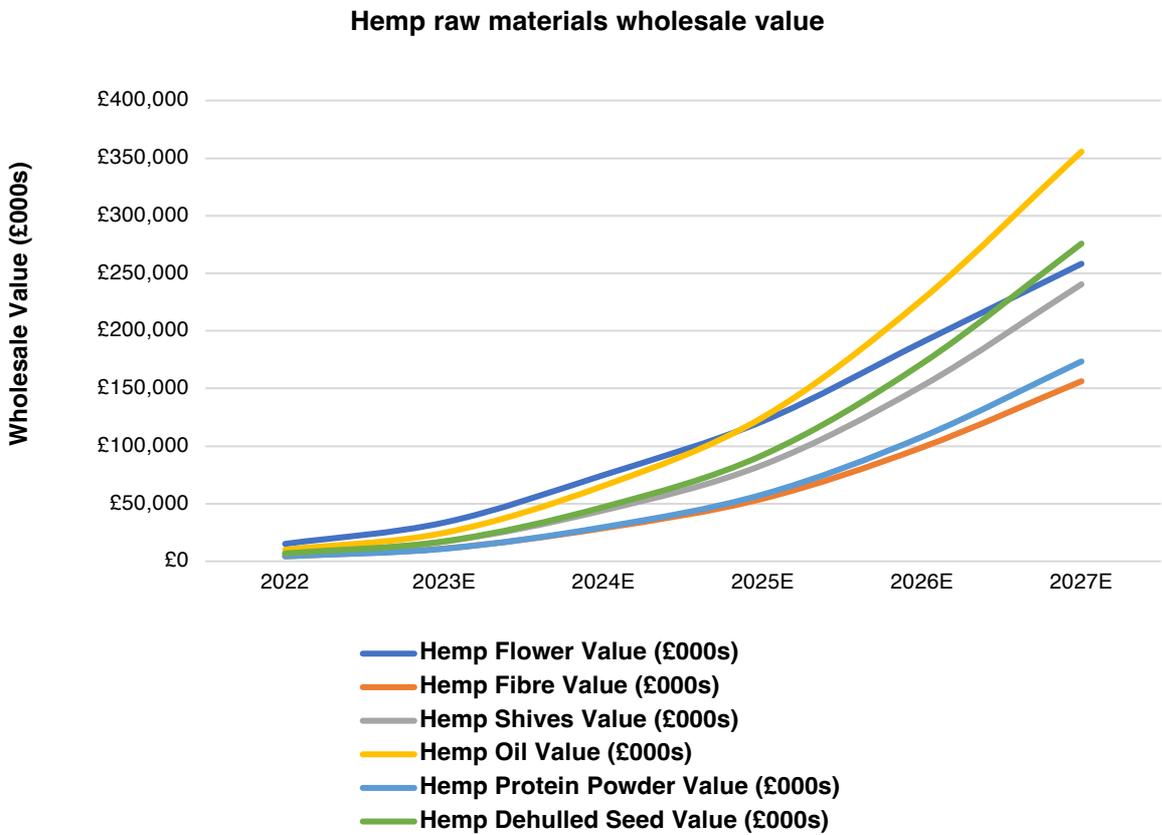
<sup>70</sup> Centre for Natural Material Innovation, Darshil Shah

<sup>71</sup> Government of Alberta – Agriculture and Forestry

# 7.5 Conclusion

Globally, the hemp market is expected to reach £5.1b in 2020 and thereafter grow at a compound growth rate of 36.1% until 2030, when the market is forecast to be worth £110.2b.<sup>72</sup> However, the true added value of industrial hemp is that the same crop can be harvested and used for a wide array of different purposes. Moreover, used in crop rotation, it has the potential to achieve positive environmental externalities.

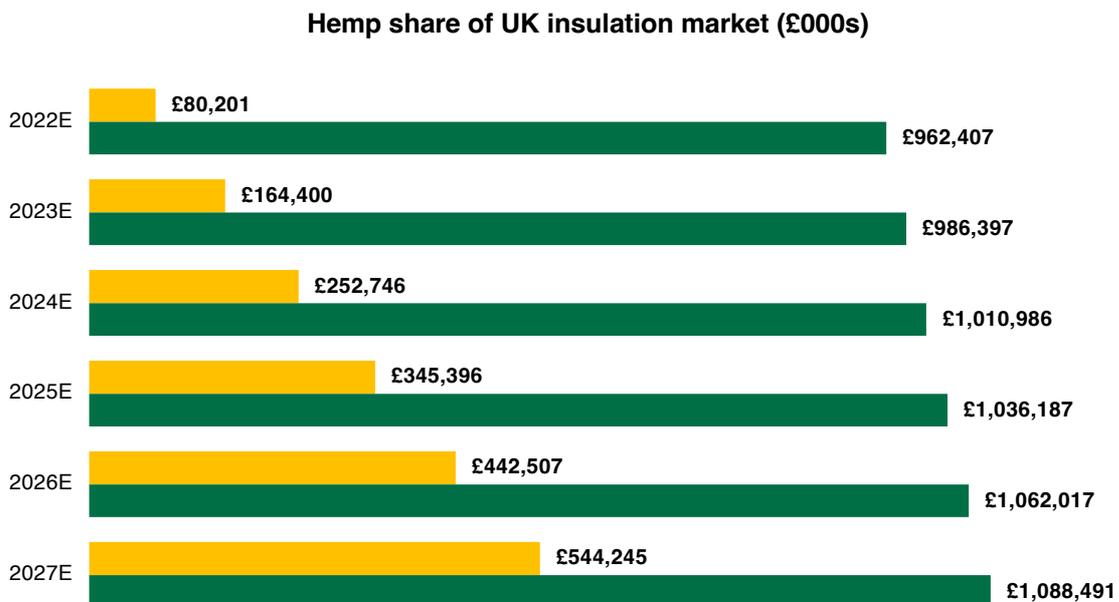
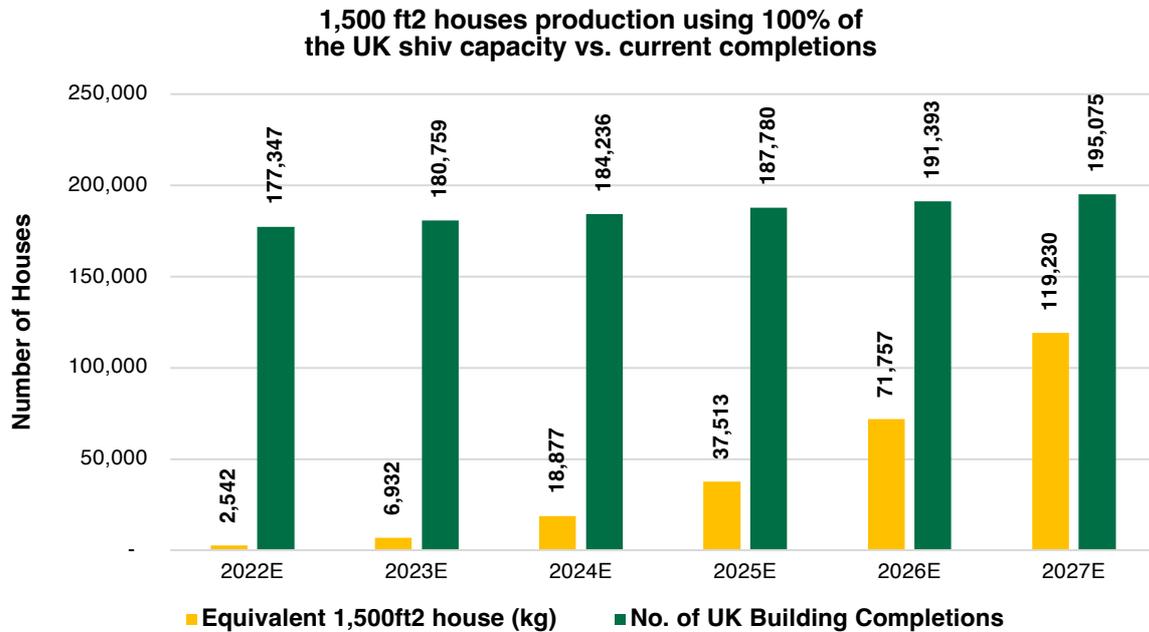
## 7.5.1 Agriculture – raw materials



<sup>72</sup> Reportlinker - Industrial Hemp Market

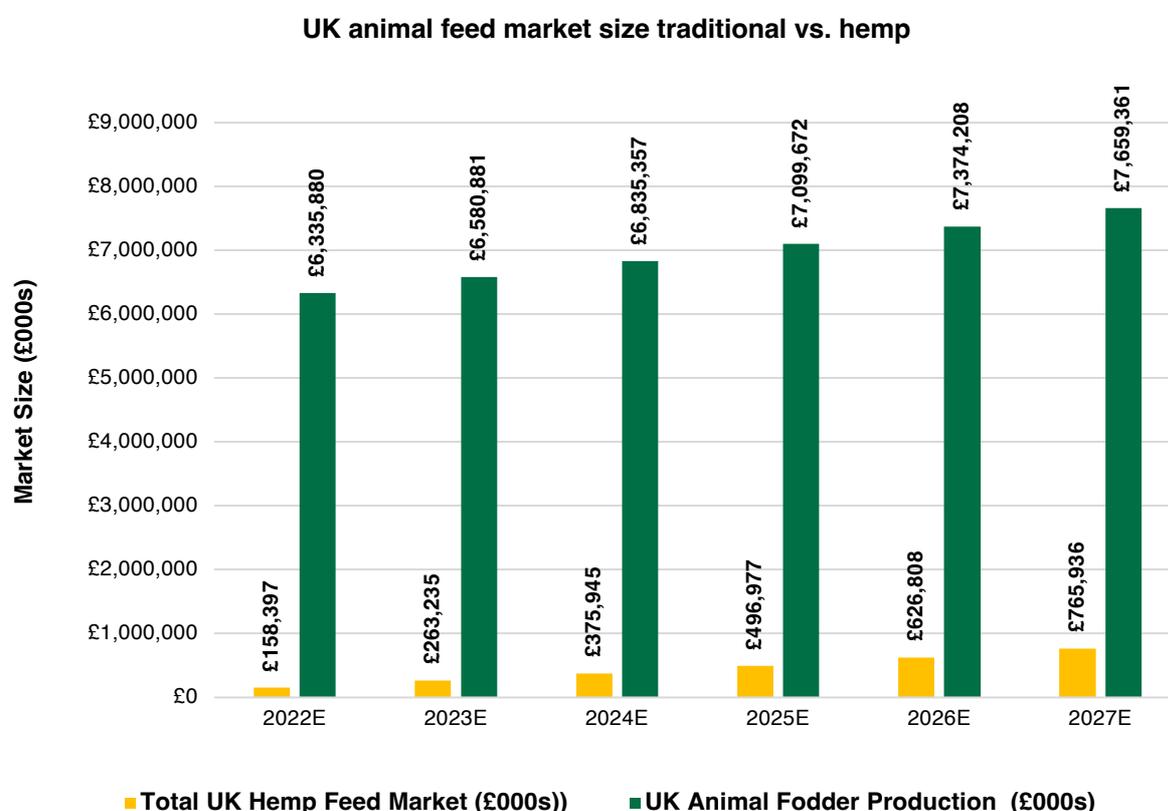
## 7.5.2 Industrial manufacturing – processed materials

The versatile nature of this plant potentially represents multi-billion-pound downstream markets, particularly in the manufacturing of reusable, recyclable and compostable biomaterials. Therefore, hemp is capable of substantially contributing to the decarbonisation of essential products for a future-proof and thriving sustainable economy.



## 7.5.3 Animal feed

The UK hemp feed industry is still nascent, with only a handful of suppliers selling small tonnages (<10 tons) per month to local livestock farmers.<sup>73</sup> These producers currently face stiff competition from suppliers of animal feed made using soy protein, which costs 25% less at £300 per tonne compared to £400 for hemp.<sup>74</sup> However, soy bean has 12.4%, while hemp seed is around 33% protein, and the protein in hemp seeds is made up of two types of proteins, edestin (60–80%) and 2S albumin, both of which are highly digestible globular and therefore offer superior nutritional value to farmers.<sup>75</sup> Additionally, when assessed against its ecological impact, domestically-supplied hemp has a vastly smaller footprint than soy protein, the majority (71%) of which is currently imported from South America.<sup>76</sup> With increased volume of hemp production and the ability to recoup some of the costs with carbon credits, there is scope for hemp becoming a highly competitive and sustainable source of animal feed. With backing from the National Farmers Union (NFU) that there is a huge potential market for protein crops, hemp is well placed as a candidate.<sup>77</sup>



<sup>73</sup> Internal Market Research/Discussions with industry experts

<sup>74</sup> Internal Market Research/Discussions with industry experts

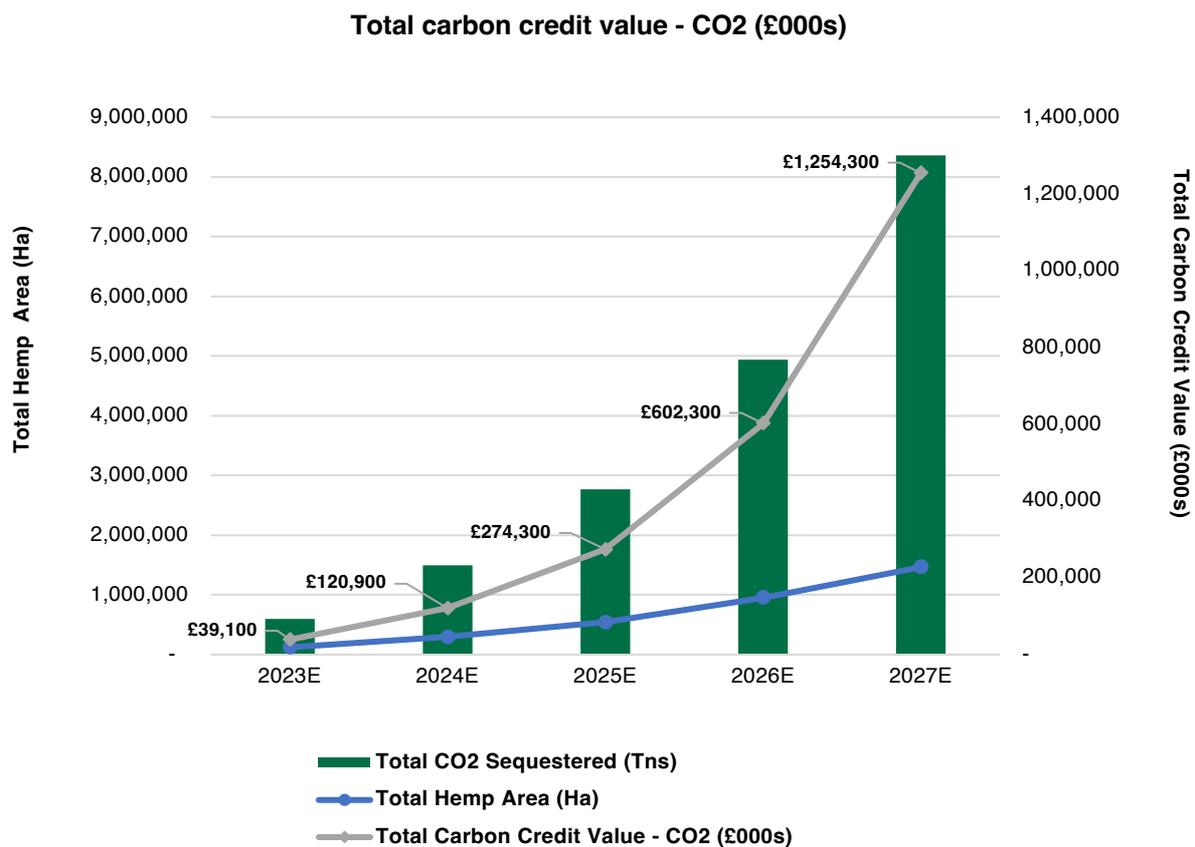
<sup>75</sup> [Hemp seed cake increases fatty acids but does not transfer cannabinoids in eggs and tissues of laying hens, Rajasekhar Kasula, Fausto Solis, Byron Shaffer, Frank Connett, Chris Barrett, Rodney Cocker and Eric Willingham](#)

<sup>76</sup> [UK Roundtable on Sustainable Soya: Annual progress report, 2019](#)

<sup>77</sup> [National Farmers Union](#)

## 7.5.4 Carbon credits

Based on an expected increase of 220,000 hectares of hemp cultivation in the UK over the next five years, UK farmers could generate in excess of £1.2b in carbon credits from cultivating hemp. This would open up a new revenue stream currently unavailable to farmers, diminishing the need for subsidies to maintain the economic viability of farming. They would also act as a direct replacement of the single farm payment that, post the UK's departure from the EU, is experiencing a tapering to £nil per acre over the next 5 years.



## 7.6 Recommendations

The following improvements in the licencing regime would enable farmers to take advantage of market opportunities in the hemp industry:

1. **Move hemp licencing from Home Office to DEFRA.** To put the UK on a competitive footing with other hemp-producing countries, the licencing of industrial hemp cultivation should be moved to DEFRA, whose staff have agricultural expertise and are better qualified than those in the Home Office to assess applications for hemp cultivation.

The licencing regime should be embedded within the UK's new Border Biosecurity Protocols, which went live on 1 July 2022, and will be extended to include other Products of Plant Origin, including hemp, in July 2023. This will add another degree of quality control at the border and will prevent rogue operators from undermining the fledgling domestic market with price dumping activities or using illegal biomass.

2. **Simplify the licencing process.** Surveys show that the licencing process is the single most important reason why farmers are reluctant to cultivate hemp. Applications must be made during a narrow window between January and April and the online application system has been widely criticised as slow and not user-friendly. Removing the time constraints and streamlining the application process will introduce efficiency and encourage more farmers to apply for licences.

Additionally, currently the Home Office has large discretionary powers to restrict the locations of where farmers can grow hemp, which is largely dictated by security considerations. With the process being administered by DEFRA, in addition to security, the suitability of specified fields should be assessed on the basis of agricultural and environmental considerations.

3. **Expand UK National List of seed varieties and streamline the registration process.** Currently, the hemp cultivation licence only allows the cultivation of hemp varieties that appear on an EU approved list and three varieties that are registered in the UK's National Lists of Varieties maintained by the Animal and Plant Health Agency (APHA), all of which have less than 0.2% THC. To gain competitive advantage over the rest of the EU, the UK should include the EU varieties in the National List, expedite the registration of new varieties, and support research in genetic improvement and agronomy to expand the list.

The registration of hemp seed varieties via APHA's Variety Tracking System (VTS) provides traceability and validation of any new varieties of seeds being added to the National List. The process should be streamlined and expedited. The National List should include hemp varieties with up to 0.3% THC, which will give UK farmers access to ca. 500 additional seed varieties beyond those currently included on the EU list.

*There are currently 81 EU certified seed varieties available for farmers to choose from, however none are ideal for the UK climate. The UK could leverage its domestic R&D capability – such as the National Plant Phenomics Centre (NPPC) at Aberystwyth University – to develop high yielding and pest-resistant genetics that are uniquely suited for the UK climate.*

To avoid the use of illegal and non-registered hemp varieties, DEFRA should conduct administrative checks on all hemp growers. Controls should be based on the verification of the official labels, proof of purchase, seed type and geospatial data to inform and generate evidence for future potential changes. Physical controls should be limited and performed randomly for audit purposes. This could be integrated into a streamlined licensing portal,

allowing farmers to upload the relevant information as evidence, at suitable times in the cultivation season.

4. **Remove requirement on farmers to destroy field hemp if it exceeds the pre-validated level of 0.3% THC.** Hot temperatures and drought conditions can naturally increase THC concentration in all hemp varieties. At present, if a hemp crop tests over the allowed legal dry-weight limit of 0.2%, then the crop has to be destroyed. In effect, farmers are penalised for natural fluctuations in the plants' chemical content which – at such trace amounts of psychoactive compounds – represent no public safety risk. By removing requirement on farmers to destroy the crop if the THC limit exceeds 0.3% (based on the limit in validated seeds), the UK will give farmers reassurance that they would not have to risk significant commercial losses due to weather events beyond their control.
5. **Commission a review to determine a suitable limit of controlled cannabinoids in field hemp.** The trend globally is to recognise the variations in the amounts of controlled cannabinoids in field hemp and to set the threshold at a more practical level. The World Health Organization (WHO) Expert Committee on Drug Dependence identified and acknowledge 1% as a safe threshold for field-grown hemp.<sup>78</sup> Several countries have already adopted this recommendation. Switzerland introduced the 1% limit as far back as 2011<sup>79</sup> and Australia followed suit in 2018.<sup>80</sup> In 2017 Italy raised the limit to 0.6%<sup>81</sup> while in January 2022 a new law came into effect in the Czech Republic, allowing 1% THC in field hemp.<sup>82</sup> In order to stay competitive, DEFRA should commission an independent review, in consultation with key industry representative bodies, to determine a suitable limit of THC in field hemp.
6. **Enable farmers to process the leaves and flowers.** The UK Hemp Licence prohibits farmers from harvesting the leaves and flowers which, although almost free from THC, must be destroyed. Aside from being wasteful, this prevents farmers from extracting CBD and using the leaves and flowers for horse bedding, bio composites, mulch or compost. Based on data from 2021, by harvesting the flowers for CBD extraction, farmers could increase their income from £6,000-9000 per hectare to £20,000.<sup>83</sup>

Currently, the Hemp Licence does not allow farmers to process the hemp on their farm, if the processing activity results in the creation of even minimal amounts of controlled drugs, unless they hold a Controlled Drugs Licence. This represents a significant loss of potential income for those farmers who are not able to invest in processing capability and the security infrastructure that is required to secure a Controlled Drugs Licence.

The requirement for a Controlled Drugs Licence to process hemp is excessive. DEFRA should engage with the industry and devise a framework which would allow farmers or third-party manufacturers to lawfully process hemp flowers and leaves to produce full-plant extracts, without needing to meet the onerous requirements of a Controlled Drugs Licence and associated pharmaceutical-level controls.

The UK Secretary of State should commission a review of the current Home Office Guidance on hemp licencing with a view to making suitable amendments to restrictions on the use of the controlled parts of the plant. The licencing regime should have conditions that are proportionate to the nature of the activity, including cultivation to processing, and the intended use of the end product.

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<sup>78</sup> [World Health Organisation Critical Review](#)

<sup>79</sup> [Hemp Today](#)

<sup>80</sup> <https://www.parliament.wa.gov.au/parliament/bills.nsf/BillProgressPopup?openForm&ParentUNID=765A8A8EEADCCBEF4825826C001824A7>

<sup>81</sup> [Parliament of Western Australia](#)

<sup>82</sup> <https://magazin-konopi.cz/piratum-se-podarilo-prosaditi-zvyseni-limitu-thc-na-1-procento/>

<sup>83</sup> [Steve Barron, Margent Farms](#)

## 7.7 Actions

No.	Department	Actions
1.	<ol style="list-style-type: none"> <li>1. Drugs and Firearms Licencing Unit</li> <li>2. Animal &amp; Plant Health Agency</li> </ol>	<ol style="list-style-type: none"> <li>2. Transfer hemp licencing from Home Office's DFLU to DEFRA.</li> </ol>
2.	<ol style="list-style-type: none"> <li>1. Animal &amp; Plant Health Agency</li> </ol>	<ol style="list-style-type: none"> <li>2. Simplify Licencing Process:               <ol style="list-style-type: none"> <li>f) Allow farmers to apply for hemp cultivation licence year-round.</li> <li>g) Improve the user interface of the online application portal.</li> <li>h) Speed up the application process.</li> <li>i) Dispense with the requirement for DBS checks for hemp cultivation licences.</li> <li>j) Field selection should be based on agricultural and environmental considerations, not only security.</li> </ol> </li> </ol>
3.	<ol style="list-style-type: none"> <li>1. Animal &amp; Plant Health Agency</li> <li>2. External Research Partners</li> </ol>	<ol style="list-style-type: none"> <li>3. Expand the national list of registered seed varieties to include registered EU hemp varieties and allow for registration of hemp varieties with up to 0.3% THC.</li> <li>4. Establish partnerships with UK plant genetics research centres to develop hemp varieties suited for UK climate with accelerated approval and validation timelines.</li> </ol>
4.	<ol style="list-style-type: none"> <li>1. Animal &amp; Plant Health Agency</li> </ol>	<ol style="list-style-type: none"> <li>2. Amend hemp licence conditions requiring farmers to destroy hemp in field if the biomass exceeds 0.3% THC.</li> </ol>
5.	<ol style="list-style-type: none"> <li>1. Animal &amp; Plant Health Agency</li> <li>2. Advisory Committee on the Microbiological Safety of Food</li> <li>3. Independent Assessor</li> </ol>	<ol style="list-style-type: none"> <li>2. Commission a review of suitable THC limit in consumer products manufactured from hemp.</li> </ol>
6.	<ol style="list-style-type: none"> <li>1. Drugs and Firearms Licencing Unit</li> <li>2. Advisory Council on the Misuse of Drugs</li> <li>3. Animal &amp; Plant Health Agency</li> </ol>	<ol style="list-style-type: none"> <li>4. Amend Home Office guidelines to remove restrictions on the use of the controlled parts of the plant under certain conditions.</li> <li>5. Remove the licence condition requiring the flowers and leaves to be destroyed.</li> <li>6. Define specific end uses e.g., tea/ oils etc to allow production of food products from hemp flowers, leaves &amp; seeds.</li> </ol>

## 7.8 Timeline

No.	Actions	Deadline
1.	1) Transfer hemp licencing from Home Office's DFLU to DEFRA.	1 November 2022
2.	1. Simplify licencing process: <ul style="list-style-type: none"> <li>a) Allow farmers to apply for hemp cultivation licence year-round.</li> <li>b) Improve the user interface of the online application portal.</li> <li>c) Speed up the application process.</li> <li>d) Dispense with the requirement for DBS checks for hemp cultivation licences.</li> <li>e) Ensure field selection is based on agricultural and environmental considerations, not only security.</li> </ul>	1 November 2022
3.	1. Expand the national list of registered seed varieties to include registered EU hemp varieties and allow for registration of hemp varieties with up to 0.3% THC. 2. Establish partnerships with UK plant genetics research centres to develop hemp varieties suited for UK climate with accelerated approval and validation timelines.	1 November 2022
4.	1. Amend Hemp Licence conditions requiring farmers to destroy hemp in field if the biomass exceeds 0.3% THC.	1 November 2022
5.	1. Commission a review of suitable THC limit in consumer products manufactured from hemp.	1 November 2022
6.	1. Amend Home Office guidelines to remove restrictions on the use of the controlled parts of the plant under certain conditions. 2. Remove the licence condition requiring the flowers and leaves to be destroyed. 3. Define specific end uses e.g., tea/ oils etc to allow production of food products from hemp flowers, leaves & seeds.	1 February 2023

# Ingestible and topical products



## 8.1 Ingestible and topical products

Sector	Department	Gross Sales (£000s)	Tax Take (£000s)	Jobs
Cosmetics / Body Care	Office for Product Safety & Standards / Trading Standards	£23,950	£4,790	
Food / Wellness	Food Standards Agency, Veterinary Medicines Directorate / Trading Standards	£1,996,580	£399,320	38,900

## 8.2 Background

Hemp is used to manufacture two types of consumer products:

- **Hemp oil and protein.** Hemp oil and hemp protein are obtained from cold pressed seeds that contain traces of cannabinoids. Hemp oil and protein generally contain trace amounts of CBD and CBDA – which have been safely consumed for generations – alongside a mix of high-quality protein, fats and other nutrients.
- **Hemp extracts.** CBD oil and other extracts are obtained from the flowers, leaves and stalks, commonly using solvent or CO<sub>2</sub> extraction methods.

The popularity of non-intoxicating CBD products is driving interest in cannabis and helping remove much of the stigma still attached to the plant. The UK market for CBD products, second only to the US, is the most developed in Europe and according to CBD Intel, an independent source, the UK market is £300m in 2021 and will rise to £1b in 2026, equating to a CAGR of 27.2%.<sup>84</sup> It is thought that CBD usage ranges between 8% and 11% of the adult population (19+), which would put the number of UK consumers at between 4.3 and 5.9m.

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<sup>84</sup> CBD Intel Market Size Report: The UK CBD Market

## 8.3 Analysis

### 8.3.1 Nutritious food

Hemp has been a traditional food source in Europe for thousands of years. All parts of the plant except stems have been consumed. While the flowers and leaves are rich in precious phytochemicals (cannabinoids, terpenes and polyphenols), seeds are particularly rich in high-quality proteins and have a unique essential fatty acid spectrum. Hemp seeds contain high levels of protein and considerable amounts of dietary fibre, vitamins, Omega-3 fats and minerals. De-hulled hemp seeds can be eaten raw and are used to make nutritious protein powders and functional oil for human consumption, while whole hemp seeds are used as feed for animals.

Hemp can be consumed as raw or dehulled seeds, seed flour or meal, seed oil, extracts from leaves and flowers. Hemp contains a relatively high level of cannabinoids, of these the most well-known and naturally abundant is cannabidiol or CBD, along other compounds such as terpenes, phenols, flavonoids and other cannabinoids uniquely working together to contribute to a varied diet. Fresh leaves of hemp can be eaten raw as salad, or cooked, juiced, powdered and blended into smoothies. The leaves are a rich source of fibres, polyphenols, flavonoids, nine essential amino acids (including lysine and arginine), essential oils, as well as the minerals magnesium, calcium, and phosphorous.

*Historically, hemp has been used in food preparations in much higher concentrations than today. As a matter of fact, varieties used in the past had a cannabinoid content well above the current levels. Therefore, the quantity of cannabinoids that were present in the human diet was much more significant than what is authorised nowadays. Flowers, leaves and other parts were cooked with fat, oil, water and wine, often in combinations, which are, in chemical terms, simple extraction processes similar to those of today.*

Technically a nut, hemp seed typically contains over 30% oil and about 25% protein, with considerable amounts of dietary fibre, vitamins and minerals. Hemp seed oil is over 80% in polyunsaturated fatty acids (PUFAs) and is an exceptionally rich source of the two essential fatty acids (EFAs) linoleic acid (18:2 omega-6) and alpha-linolenic acid (18:3n3 omega-3). The omega-6 to omega-3 ratio (n6/n3) in hemp seed oil is normally between 2:1 and 3:1, which is considered to be optimal for human health. In addition, the biological metabolites of the two EFAs, gamma-linolenic acid (18:3n6 omega-6; 'GLA') and stearidonic acid (18:4 omega-3; 'SDA'), are also present in hemp seed oil.

The two main proteins in hemp seed are edestin and albumin. Both of these high-quality storage proteins are easily digested and contain nutritionally significant amounts of all essential amino acids. In addition, hemp seed has exceptionally high levels of the amino acid arginine.

With the global meat substitute market valued at £4.5b in 2020 and expected to grow to £9.1b, hemp represents the perfect source of sustainable protein to be grown locally and organically.<sup>85</sup>

<sup>85</sup> UK Government, Industrial Hemp licensing: factsheet

### 8.3.2 Wellness products

Matching high consumer demand for CBD products with domestic supply, offers an unprecedented opportunity to grow a new consumer category that will become a staple in the years to come. At present, 99.9% of all CBD products purchased by UK consumers are imported from either Europe, the Americas, or China.<sup>86</sup> Due to legislative barriers, UK farmers and producers cannot currently tap into this lucrative market and UK companies can only market products manufactured abroad, capturing a very small segment of the value chain.

In January 2019 the European Food Safety Authority (EFSA) added hemp extracts and hemp-derived products containing cannabinoids including CBD to a list known as Novel Foods. However, the process of approving new products takes up to 5 years (with no guarantee of success) and no hemp CBD products can be sold during the Novel Foods process. In January 2020 the UK left the EU, giving the UK autonomy over its regulations. This presents an opportunity for the UK to streamline the process of adding new CBD products to its list of approved products.

Additionally, the UK currently only allows CBD products to be marketed if the total content of controlled cannabinoids does not exceed 1mg, or 0.0001% (combined) of Tetrahydrocannabinol (THC), Tetrahydrocannabinol Acid (THC-a), Tetrahydrocannabivarin (THC-v) and Cannabinol (CBN) combined. This effectively eliminates the possibility of marketing most whole-plant products, the category most sought-after by consumers. These regulations need reviewing if the UK is to develop a viable domestic CBD market.

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<sup>86</sup> Cambridge Network



### 8.3.3 Cosmetics and body care products

Beyond nutritional and medicinal properties, hemp extracts are also valued for their cosmetic properties. CBD reduces inflammation and CBD-enriched balms are used to treat arthritis, stiff joints and pain. CBD is also an antioxidant, and its topical use helps lessen the visible signs of ageing, irritation and inflammation.<sup>87</sup> As an on-trend ingredient, CBD is now widely available in a full range of products, including creams, lotions, balms, oils, face masks, shampoos, and even bath bombs.

Cosmetic products containing cannabis derivatives have been sold in Europe for decades. However, in recent years, these products surged in popularity. Their use has evolved into a major skin care trend with numerous products marketed as oils, balms, creams, lotions, and facial serums. The demand has been driven by recognised and validated properties related to hemp seed oil and hemp extracts. Cosmetic products containing CBD improve skin condition because of the compound's antioxidant properties and provide an excellent skin protection. Unfortunately, there is a lot of confusion over cannabis derivatives relating to their quality and permitted contents, precisely because of a lack of harmonious regulations. This situation risks discouraging many investors from further exploring hemp applications for cosmetics, resulting in lack of R&D and considerable potential missed opportunities.

In February 2021 the EU's Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs added CBD "derived from extract or tincture or resin of cannabis" as a legal cosmetic ingredient to its CosIng<sup>88</sup> guidelines. This revision to CosIng follows the landmark ruling by the Court of Justice of the European Union (the CJEU) that CBD derived from the entire hemp plant is not a narcotic under the UN Single Convention on Narcotic Drugs of 1961 and thus all parts of the plant can be processed, and its derived products should be freely traded between EU member states.

Up until this revision to the CosIng guidelines, only synthetic CBD was expressly allowed as a cosmetic ingredient in the EU's database. The new regulation allows plant-derived CBD to show its potential utility as an anti-sebum, antioxidant, skin conditioner and skin protectant. This regulatory progress paves the way for future growth and diversification in the sector.

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<sup>87</sup> **Antioxidative and Anti-Inflammatory Properties of Cannabidiol, Sinemyiz Atalay, Iwona Jarocka-Karpowicz, and Elzbieta Skrzydlewska**

<sup>88</sup> CosIng is a database of cosmetic regulations that expressly provides for authorised and unlawful ingredients and sets forth their particular purposes and functions.

### 8.3.4 Animal care products

In addition to the traditional product offering, the market for cannabinoid-based pet products offers investors significant opportunity for growth. The pet products segment is one of the fastest growing categories in the cannabis products space. Due to the increasing 'humanisation' trend, particularly visible in the US market, CBD pet products are becoming an increasingly popular option. According to the American Pet Products Association, in 2020 US pet owners spent £77.6b<sup>89</sup> on pet supplies, treatments and care. CBD pet products are already in wide use across the US and it is estimated that by 2025, CBD-based pet products will account for between 3-5% of nationwide sales.<sup>90</sup> Given the current market size and growth rates, it is estimated that in 2025 the market for CBD pet products will be worth between £97.6m and £162.6m. Currently, the most popular pet products are tinctures (69%) and powders (11)%<sup>91</sup>, representing a market for each SKU of £114.5m and £18.3m respectively. This represents a significant opportunity and upside to both manufactures and retailers who wish to penetrate this space.

Until recently the CBD animal market has suffered from a lack of scientific evidence supporting anecdotal positive indications. However, a recent study by Cornell University, in partnership with ElleVet Sciences, has found that a dose of 2 mg/kg of CBD and CBDA delivered twice daily has helped increase mobility, activity, and comfort in 80% of dogs participating in the trial.<sup>92</sup> Substantial pre-clinical work is also underway on a number of large animal species (bovine, equine, camel and porcine) at Aberystwyth University.

More research needs to be done on the toxicity of THC for canines and there are currently no CBD products authorised in the UK for veterinary use, however a veterinary surgeon may prescribe a legally obtained human CBD product under the provisions of the prescribing cascade system.<sup>93</sup> Administration of an unauthorised product containing CBD without a veterinary prescription is an offence under Regulation 8 of the Veterinary Medicines Regulations. Companies supplying CBD products for human use in line with the requirements of the Medicines and Healthcare products Regulatory Agency (MHRA) must not indicate or recommend their products for use on animals.

With more research and under close supervision of the Veterinary Medicines Directorate (VMD), the pet care products market segment has the potential to become one of the largest segments of the cannabis industry.

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<sup>89</sup> [CBD Pet products market - growth, trends, covid-19 impact, and forecasts \(2022 - 2027\)](#)

<sup>90</sup> [Nielsen IQ](#)

<sup>91</sup> [Nielsen IQ](#)

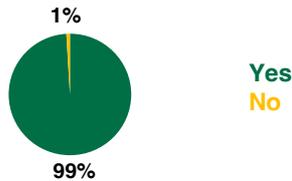
<sup>92</sup> [Pharmacokinetics, Safety, and Clinical Efficacy of Cannabidiol Treatment in Osteoarthritic Dogs](#)

<sup>93</sup> [The cascade: prescribing unauthorised medicines](#)

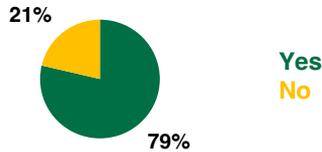
### 8.3.5 Consumer choice & protection

While more work needs to be done on educating consumers about cannabis-based products, emerging data is painting a picture about consumer preferences. A 2021 survey by the cannabis Industry Council,<sup>94</sup> which garnered 849 responses, indicates that consumers have a clear preference for natural, whole-plant products over synthetic, isolate-based products.

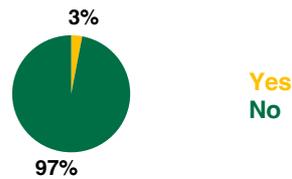
**Do you know what CBD (Cannabidiol) is?**



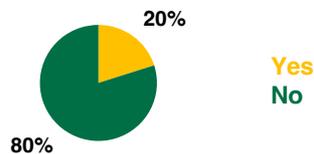
**Do you currently use CBD oil or capsules?**



**Have you ever experienced negative side effects from CBD products?**



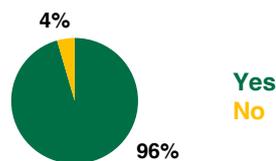
**CBD is a popular nutritional supplement made from the Hemp plant. After March 31, 2021, CBD will enter the food supply. Are you comfortable with that?**



**What type of CBD products do you prefer?**



**At the moment there is no labelling requirement in place to state if a product contains natural or synthetic CBD. We propose to the FSA and FSS that any product which contains synthetically produced cannabinoid CBD, and not plant based, should state this.**



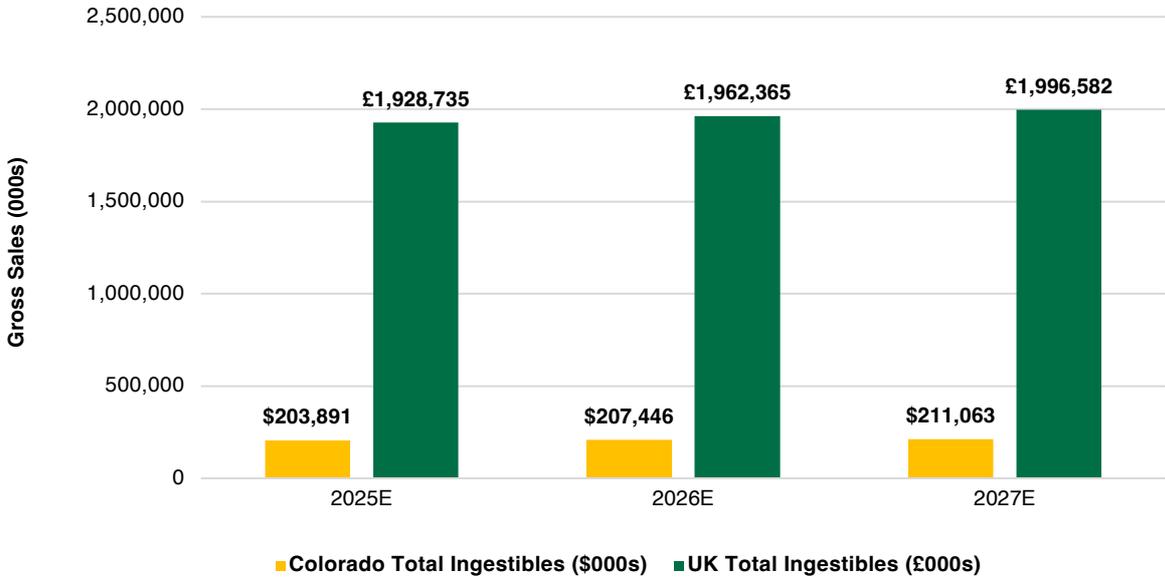
Consistency in the communication of the different types of CBD products is key to ensuring that consumers understand what they are buying, and producers are held to strict quality standards.

<sup>94</sup> Cannabis Trade Association

# 8.4 Conclusion

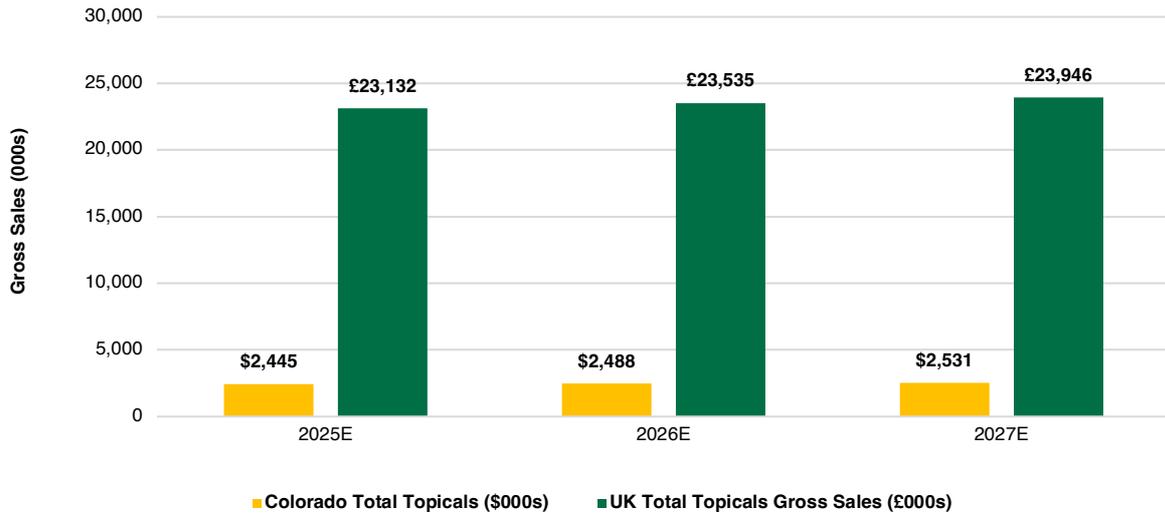
With government interventions aimed at improving regulations and enabling domestic production of CBD, the UK market in ingestible and topical CBD products could be worth £2.0b within 5 years.

**Colorado & UK Ingestibles Forecasts**



Various industry forecasts indicate that the global CBD skin and body care market will be worth more than £2.4b<sup>95</sup> by 2025.<sup>96</sup>

**Colorado & UK Topicals Forecasts**



<sup>96</sup> Technavio / Allied Market Research / Market Reports World

## 8.5 Recommendations

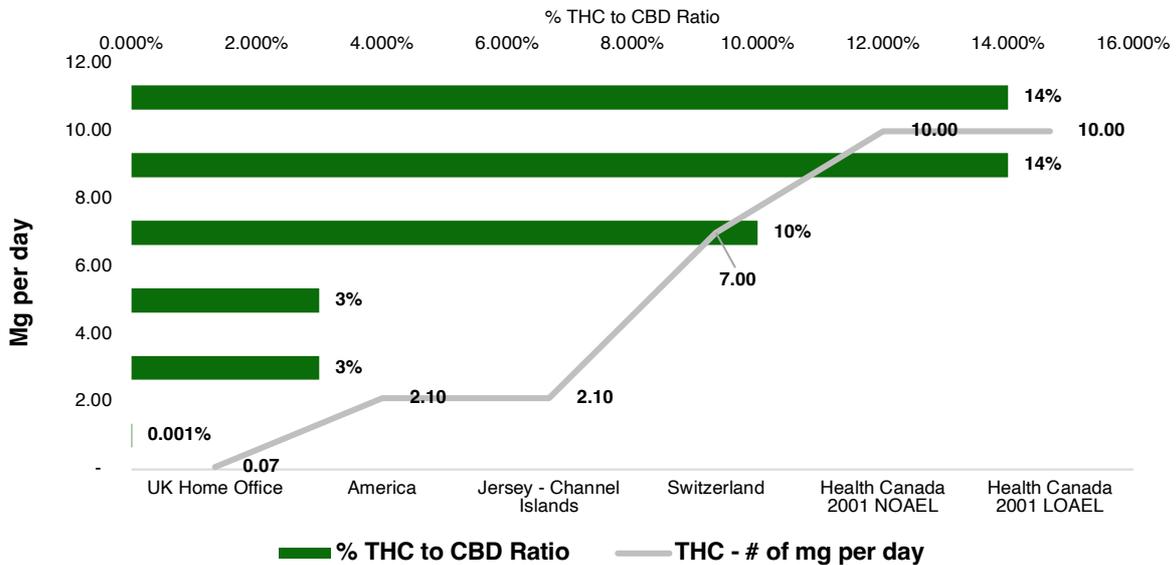
1. **Commission a review of the Novel Food Regulations and its application to hemp-based food supplements.** Today, the vast majority of CBD food supplements sold in the UK are imported. This is due to current restrictions on hemp cultivation and the onerous Novel Food (NF) process, both of which effectively preclude UK farmers from accessing this high-value-add consumer segment of the CBD sector.

The NF process is costly, onerous and lengthy, which means that the route is accessible only to large companies with sufficient scale and resources. It has proven to be a significant barrier to entry for UK companies, resulting in the UK consumer CBD market currently being dominated by foreign companies.

A review of available scientific evidence on the safety of hemp and derived foods is currently under way. Once the findings are available, the FSA should review the future application of the NF process and whether the process should relate to all products containing cannabinoids or whether any products could be made exempt from the process. The Agency should consider the history of the use of the whole cannabis plant as food in the UK and the significant consumer demand for whole-plant products. It should also review alternative regulatory approaches, such as the dose-based approach. One approach, already proposed by the EIHA, is as follows:

- a. At high doses (175 mg/d), CBD-containing products are considered medicinal products and should be regulated as medicines.
  - b. At low to medium doses, up to 70 mg/d, irrespective of delivery mechanism (capsules, tinctures, etc.), CBD for oral intake should be regarded as a food supplement. This dual approach is already applied for many products, such as valerian, essential oils, chondroitin (sulphate), Ginkgo Biloba, silymarin, some vitamins and iron products.
  - c. Low CBD concentrations should be allowed in food products insofar as the recommended daily dose that is far enough from exerting pharmaceutical effects, is not exceeded. This would require the scientific determination of the minimum dose that a physiological effect is delivered at as a 'food'.
2. **Establish commercially viable THC limit in consumer products.** The FSA should introduce commercially viable THC limits in legal cannabis-based products, as current UK regulated limits are an outlier compared to the global commercial range. The current focus on permitting only CBD isolate sales in the UK nullifies the potential economic benefits for a domestic UK industry, as isolates are an oversupplied commodity dominated by US and Chinese manufacturers. Allowing reasonable levels of THC in consumer products reflects the reality of the UK market, assuring consumer safety whilst preserving consumer choice.

### Commercial Range of % THC to CBD ratios based on THC: regulated limits, NOAEL and LOAEL evidence



A recommendation made by the Advisory Council on the Misuse of Drugs (ACMD) to adopt a 'serving-based' approach to controlled cannabinoids should be reviewed, with additional consideration being given to a daily intake orientation utilising a robust and science-supported daily dose.

Only D-9 THC should be included in the measurement of THC levels. If the acid form of THC, THCA, is also designated a 'controlled' cannabinoid as 'total THC', this could, by default, make hemp seed foods non-compliant as these naturally contain trace levels of the acid (and non-intoxicating) form of this compound which cannot be fully removed as they are an integral part of the plant.

- 3. Develop standardised testing protocols.** A lack of agreed testing protocols for cannabis-based products means that many products currently available on the market use vastly different testing methods to establish their potency and quality. The FSA needs to set clear definitions of different product types, based on the variety and potency of active substances, and ensure robust enforcement of labelling requirements. Based on the limit guidelines discussed above, the products need to contain clear information about amount of active ingredients and recommended dosing guidelines. The Ring Trial Proficiency report, undertaken by the testing company LGC and the United Kingdom Accreditation Service (UKAS), has already proposed limits and parameters and the FSA should require all CBD producers to adopt the required testing protocols in their manufacturing processes.
- 4. Ensure enforcement of CoA and COO requirements for food supplements.** The FSA should ensure that products containing non-trace amounts of cannabinoids should be sold with a Certificate of Analysis (CoA), providing information about content of active ingredients and any contaminants, and a Certificate of Origin (COO), which ensures full traceability. The CoAs should be issued by accredited laboratories using the FSA-approved testing protocols for cannabis-based products.

5. **Develop labelling guidelines.** The FSA should establish clear definitions of different product types, based on the variety and potency of active substances, and provide labelling guidelines. Strict definitions and associated testing and labelling requirements must be developed for products currently commonly referred to as follows:

Description	Details
Whole plant hemp extract	Botanical – Derived from the seed only with trace levels of controlled cannabinoids
Full spectrum	Botanical – Derived from the leaf and flower with naturally occurring levels of controlled cannabinoids
Broad spectrum	Botanical – Derived from the leaf and flower with trace levels of controlled cannabinoids
Narrow spectrum	Botanical – Derived from the leaf and flower with one or two cannabinoids
Mono spectrum / Isolate	Botanical – Derived from the leaf and flower purified single cannabinoid
Mono spectrum / Isolate	Synthetic – Single cannabinoid

Any products made using synthetic ingredients must be clearly labelled. Consideration should be made to compliance with EU and other international regulations, to not exclude UK producers from access to international markets.

## 8.6 Actions

No.	Department	Actions
1.	<ol style="list-style-type: none"> <li>1. Advisory Committee on Novel Foods and Processes</li> <li>2. Independent Assessor</li> </ol>	<ol style="list-style-type: none"> <li>1. Commission a review to provide clear definitions to differentiate between hemp food and supplements.</li> <li>2. Consider future reform of the NF process</li> </ol>
2.	<ol style="list-style-type: none"> <li>1. Advisory Committee on the Microbiological Safety of Food</li> </ol>	<ol style="list-style-type: none"> <li>1. Set commercially viable THC limits in legal cannabis-based products.</li> </ol>
3.	<ol style="list-style-type: none"> <li>1. Advisory Committee on the Microbiological Safety of Food</li> <li>2. United Kingdom Accreditation Service</li> </ol>	<ol style="list-style-type: none"> <li>1. Introduce and enforce a harmonised standard testing protocol for all cannabis-based products.</li> </ol>
4.	<ol style="list-style-type: none"> <li>1. Advisory Committee on the Microbiological Safety of Food</li> <li>2. United Kingdom Accreditation Service</li> </ol>	<ol style="list-style-type: none"> <li>1. Make CoA, COO and full traceability mandatory for all foods and food supplements.</li> </ol>
5.	<ol style="list-style-type: none"> <li>1. Advisory Committee on Novel Foods and Processes</li> <li>2. Advisory Committee on the Microbiological Safety of Food</li> </ol>	<ol style="list-style-type: none"> <li>1. Set clear product definitions based on content and potency and associated testing and labelling guidelines.</li> <li>2. Set requirements to specify any synthetic ingredients on product label.</li> </ol>

## 8.7 Timeline

No.	Actions	Deadline
1.	<ol style="list-style-type: none"><li>1. Commission a review to provide clear definitions to differentiate between hemp food and supplements.</li><li>2. Consider future reform of the NF process</li></ol>	1 November 2022
2.	<ol style="list-style-type: none"><li>1. Set commercially viable THC limits in legal cannabis-based products.</li></ol>	1 November 2022
3.	<ol style="list-style-type: none"><li>1. Introduce and enforce a harmonised standard testing protocol for all cannabis-based products.</li></ol>	1 November 2022
4.	<ol style="list-style-type: none"><li>1. Make CoA, COO and full traceability mandatory for all foods and food supplements.</li></ol>	1 November 2022
5.	<ol style="list-style-type: none"><li>1. Set clear product definitions based on content and potency and associated testing and labelling guidelines.</li><li>2. Set requirements to specify any synthetic ingredients on product label.</li></ol>	1 November 2022

9.0

# Medicinal cannabis



## 9.1 Medicinal cannabis

Sector	Department	Gross Sales (£000s)	Tax Take (£000s)	Jobs
Medicinal	Home Office / MHRA	£3,300,590	£755,840	81,570

## 9.2 Background

The previous five years have seen a wave of legalisations of medicinal cannabis sweep across the globe and the reform momentum continues, with more than 55 countries now having or considering legal access programmes. Europe is on a trajectory to becoming the largest medicinal cannabis market in the world, offering significant growth opportunities to companies capable of meeting the EU's rigorous regulatory and quality standards. The UK, already a leader in cannabis research and pharmaceutical production, is in pole position to become a European powerhouse in the production of whole-plant and extract-based medicines, subject to change in the Proceeds of Crime Act (POCA).

Beyond the economic potential of a home-grown pharmaceutical industry, medicinal cannabis could play an important role in lowering the costs of provision of public healthcare in the UK. There is emerging evidence that cannabis-based medicines can help reduce patients' dependence on opioids and benzodiazepines, as well as other prescribed medications. This is particularly relevant to the UK, which has one of the fastest growing rates of opioid use in the world, with an estimated one in four adults taking an addictive medication such as a strong opioid, zopiclone, gabapentinoid or benzodiazepine. In many cases, these medicines are being prescribed "off label", or outside of their original marketing authorisation, as patients have often exhausted first line treatments.<sup>97</sup>

In the UK, polypharmacy has become the norm rather than the exception and – aside from being associated with a wide range of negative health outcomes – is placing a huge financial burden on the NHS. By ignoring medicinal cannabis as part of a wider pharmacopeia, the UK is potentially missing an opportunity to provide patients with safer and more effective medications than some of those currently on offer, and to explore potential cost savings for our cash-strapped NHS.

*"The government needs to work urgently with the industry bodies in order to capitalise on this opportunity to create a profitable industry, create new jobs, create a significant tax income stream and most importantly give hundreds of thousands of people access to a medicine that may change their lives." Prof. Mike Barnes*

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<sup>97</sup> [Dependence and withdrawal associated with some prescribed medicines](#)

## 9.3 Analysis

Based on data from across North America, medicinal cannabis markets typically peak at 2% of the population.<sup>98</sup> Given that as of 2021 the patient population in Europe was estimated at 150,000 – representing merely 0.02% of the European population – the European market is set for exponential growth in the coming years.

Using the 2% benchmark the UK, with a population of 67m, would have at least 1.34m patients choosing cannabis as their primary medicine. However, industry polling suggests that the patient population in the UK already exceeds that number, with 1.4m patients already self-medicating with cannabis sourced from the illicit market.<sup>99</sup>

Despite medicinal cannabis being made legal in 2018, patients in the UK continue to face significant barriers to accessing their medicines. There are currently only three patients who receive cannabis free on the NHS, with the overwhelming majority obtaining their prescriptions from private clinics.

There are two key challenges that the government and cannabis industry in the UK must address:

1. **Constraints on Prescribers.** Currently in the UK only specialist doctors are allowed to initiate prescription of medicinal cannabis and only under highly restricted circumstances. Cannabis is treated as a drug of last resort, which often means that patients are required to try other medications before they are allowed to access cannabis and doctors must triage their prescribing decision with two other peers. This procedure is an administrative burden on doctors and causes delays and suffering for patients.

Patients accessing medicinal cannabis through existing private clinics are predominately being treated for conditions that would usually be taken care of by their GPs. For example, data from the first cohort of 678 patients enrolled in Drug Science's Project Twenty21 Study found that the most commonly reported primary conditions were chronic pain (55.6%) and anxiety disorders (32.0%) and patients reported high levels of multi-morbidity, including high rates of insomnia and depression.<sup>100</sup>

Global trends demonstrate that when GPs are permitted to prescribe medicinal cannabis, many subsequently take an active interest in this subject and further their learning to become active prescribers. Unsurprisingly, GPs now make up the majority of prescribers in the 55+ countries where cannabis is legal on prescription.

Australia, which shares many similarities with the UK in terms of medical training and healthcare delivery, has seen a large uptake in GP prescribing medicinal cannabis since its re-scheduling in 2018 and patient access numbers overshadow figures currently seen in the UK. As of 31 August 2021, the Australian healthcare regulator has issued 159,665 Special Access Scheme approvals for medicinal cannabis products, primarily for pain, anxiety, and sleep disorders.<sup>101</sup>

Closer to home in the Channel Islands, Jersey's laws permit all doctors, including both specialists and GPs to initiate scripts and oversee treatment for cannabis-based medicines. It is estimated that around 2% of the population of Jersey are now being prescribed medicinal cannabis – predominately by GPs. Patients in Jersey are being treated for common conditions including chronic pain, sleep issues, anxiety/mood disorders and end-of-life-care.<sup>102</sup>

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<sup>98</sup> Colorado & Oregon Department of Health

<sup>99</sup> YouGov Poll

<sup>100</sup> Developing a real-world evidence base for prescribed cannabis in the United Kingdom

<sup>101</sup> MacPhail, S. L., Bedoya-Pérez, M. A., Cohen, R., Kotsirilos, V., McGregor, I. S., & Cairns, E. A. (2022). Medicinal Cannabis Prescribing in Australia: An Analysis of Trends Over the First Five Years

<sup>102</sup> Bussiness Cann

2. **Affordability.** Aside from enabling a greater number of patients to access medicinal cannabis on the NHS, allowing all GPs to prescribe would make it accessible to patients that do not have access to private healthcare and reduce the costs of their prescriptions. According to research by the Primary Care Cannabis Network, 25-30% of GPs in the UK would be willing to prescribe cannabis if they were allowed to do so.<sup>103</sup>

A patient can spend upwards of £300 per month (excluding consultation fees) on medicinal cannabis.<sup>104</sup> Licenced medicines such as Sativex and Epidiolex, which are available on the NHS, are even more expensive. The high cost of medicinal cannabis means that some patients simply choose to go without their medications or turn to the illicit market for cannabis. By contrast, in Australia, where 250,000+ prescriptions for medicinal cannabis have been written to date, a streamlined process has led to a drop in prices for patients and better access to a wider range of medicines.

Data over the past four years shows strong patient demand for a variety of medicinal cannabis products. According to estimates by Prohibition Partners, in 2021 private prescriptions for medicinal cannabis in the UK reached 23,446, an increase of 425% from 4,469 in 2020.<sup>105</sup> According to one industry expert, despite patients having to bear the cost of their cannabis prescriptions, the patient population continues to grow at a rate of 1,000-1,500 new patients per month.<sup>106</sup> Considering such significant demand despite significant constraints, with improved access and affordability, the industry has the potential to grow exponentially.

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<sup>103</sup> LVL Health

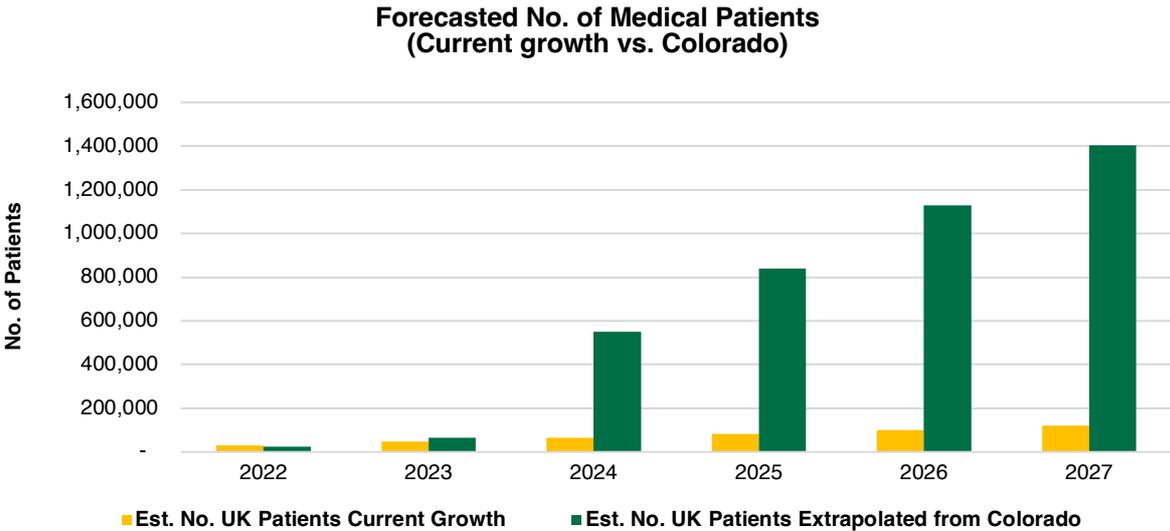
<sup>104</sup> Based on 1g/day at £5/gram of dried flower

<sup>105</sup> Prohibition Partners, **The European Cannabis Report: 7th Edition**

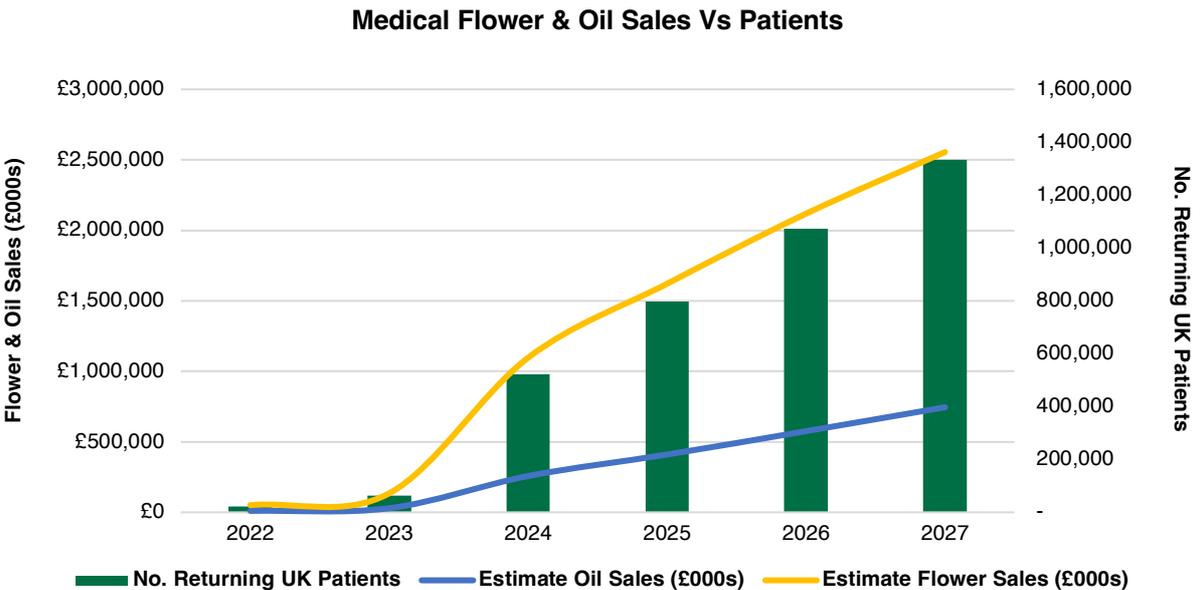
<sup>106</sup> Interview with Prof. Mike Barnes, 13 June 2022

# 9.4 Conclusion

The experience of mature jurisdictions such as Colorado show that improved access, affordability and range of medicinal cannabis product not only stimulates the industry but also protects the patients, as they turn away from the illicit market. With UK adopting the same approach of easy access with strong regulatory oversight, by 2030 the UK population of medicinal cannabis patients accessing cannabis through legal channels is projected to reach 1.4m.



During the same timeframe, the UK medicinal cannabis market is projected to grow in value to more than £3.3b. This figure is conservatively based on the sales of flowers and oils alone, with the actual figure likely to be much higher with the inclusion of ancillary products such as vapouriser devices.



The UK is an unchallenged leader in the pharmaceutical sub-set of the cannabis industry. The pioneering work of GW Pharmaceuticals (now Jazz Pharmaceuticals) has contributed vast amounts to advancing our knowledge of cannabis, bringing to market two licenced medicines, and demonstrating the power of cannabis in managing some of the most intractable diseases. At the same time, there is demonstrable demand for whole-plant products and growing body of evidence that they work better for some patients than isolate-based products. By supporting domestic legislation that champions the production of a wide range of cannabis-based products, the UK government would deliver more therapeutic options for patients and solidify its reputation as a premier producer of medicinal cannabis. If the UK government fails to own this space, other countries will seize this opportunity instead.

## 9.5 Recommendations

In order to produce high-THC medicinal products, the following licences and certificates are required:

1. Home Office Controlled Drug Licence
2. MHRA Manufacturer's Specials Licence
3. EU GMP Certificate

This licencing regime is a time-consuming and confusing process. Whilst applying for a Home Office licence to possess, supply and / or produce controlled drugs is rightly a strict and regulated process, the bureaucratic barriers and confusing process are only likely to lead to smaller market participants deciding to not enter the space. This will have ramifications for competition, investment and patient access to high-THC products.

It is well documented that industries dominated by a single company are unlikely to have competitive pricing structures. As such, at the present time with just one company producing licensed products, medicinal cannabis is unlikely to be seen as commercially/financially viable by the NHS. It is therefore imperative that the Home Office makes the application process simpler, and it must also allow for smaller market participants by making the licensing process clearer.

Recommendations for the UK government:

1. Reform the high-THC cultivation / controlled drugs license system for medicinal cannabis to make the process simpler and more efficient.
2. Allow GPs to prescribe cannabis and remove the requirement for doctors to triage their prescription with 2 other peers, as the procedure is slowing down the process.
3. Re-visit NICE Guidelines in order to assess cannabis as a botanical product and not a pharmaceutical product.
4. Make cannabis more readily available and paid for by the NHS.

## 9.6 Actions

No.	Department	Actions
1.	<ol style="list-style-type: none"> <li>1. HO Drugs and Firearms Licencing Unit</li> <li>2. Medicines and Healthcare products Regulatory Agency</li> </ol>	<ol style="list-style-type: none"> <li>3. The Home Office and MHRA should work together to:               <ol style="list-style-type: none"> <li>a. produce a simple guide to those applying for high-THC cultivation licenses.</li> <li>b. streamline and coordinate the application process.</li> <li>c. make all applications transparent</li> </ol> </li> </ol>
2.	<ol style="list-style-type: none"> <li>1. Home Secretary</li> <li>2. Advisory Council on the Misuse of Drugs</li> </ol>	<ol style="list-style-type: none"> <li>1. Amend wording in paragraph 4 of <i>The Misuse of Drugs (Amendments) (cannabis and Licence Fees) (England, Wales and Scotland) Regulations 2018</i><sup>107</sup> to allow GPs and prescribing pharmacists to prescribe cannabis.</li> </ol>
3.	<ol style="list-style-type: none"> <li>1. Medicines and Healthcare products Regulatory Agency</li> <li>2. National Institute for Health and Care Excellence</li> <li>3. Commission on Human Medicines</li> <li>4. British Pharmacopoeia</li> <li>5. Independent Assessor</li> </ol>	<ol style="list-style-type: none"> <li>1. Commission a re-assessment of NICE guidelines.</li> </ol>
4.	<ol style="list-style-type: none"> <li>1. Medicines and Healthcare products Regulatory Agency</li> <li>2. Independent Assessor</li> </ol>	<ol style="list-style-type: none"> <li>1. Conduct or contract for a proper and thorough health economic analysis of adding medicinal cannabis to the Drug Tariff.</li> </ol>

<sup>107</sup> [The Misuse of Drugs \(Amendments\) \(Cannabis and Licence Fees\) \(England, Wales and Scotland\) Regulations 2018](#)

## 9.7 Timeline

No.	Actions	Deadline
1.	1. The Home Office and MHRA should work together to: <ol style="list-style-type: none"> <li>produce a simple guide to those applying for high-THC cultivation licenses.</li> <li>streamline and coordinate the application process.</li> <li>make all applications transparent</li> </ol>	1 November 2022
2.	1. Amend wording in paragraph 4 of <i>The Misuse of Drugs (Amendments) (cannabis and Licence Fees) (England, Wales and Scotland) Regulations 2018</i> <sup>108</sup> to allow GPs and prescribing pharmacists to prescribe cannabis.	1 February 2023
3.	1. Commission a re-assessment of NICE guidelines.	1 November 2022
4.	1. Conduct or contract for a proper and thorough health economic analysis of adding medicinal cannabis to the Drug Tariff.	1 November 2022

<sup>108</sup> [The Misuse of Drugs \(Amendments\) \(Cannabis and Licence Fees\) \(England, Wales and Scotland\) Regulations 2018](#)

10.0

# Legal adult-use market



## 10.1 Background

The final segment of a fully-fledged cannabis industry is a regulated adult-use market. This plan uses Colorado as an illustration of the economic value and social benefits of a well-regulated and efficient state-regulated adult-use program. It discusses lessons learned from Colorado and other US states to show how effective regulatory models have stimulated economic growth, generated tax revenues and made positive social impact. Above all, it shows that competitive legal markets have the potential to extinguish the illicit market.

## 10.2 Analysis

In 2012 Colorado was the first US state to legalise and establish a regulated cannabis market for adults 21yrs and older. It is a prime example of a mature, well-regulated jurisdiction that has successfully harnessed the growth of the cannabis industry to stimulate its economy, generate significant tax revenues, and put the state on the global map as one of the premier destinations for cannabis tourism.

## 10.3 Tax revenue

Colorado was one of the early proponents of cannabis reform in the US and as a result has achieved a steady growth in revenue from cannabis tax collections. Since the start of state-licensed adult-use retail sales of cannabis in February 2014, Colorado has collected nearly £1.8b in taxes.<sup>109</sup> As of March 2022 Colorado's tax take accounted for 20% of the total £8.9b collected by all US states with legal adult-use markets.<sup>110</sup> Considering Colorado's population of 5.8m, accounting for roughly 6% of the 100m people living in 11 US states that operated legal adult-use markets in 2021, the outsized proportion of Colorado's tax revenues is a testament to the effectiveness of its regulatory model.<sup>111</sup>

*In 2021, the 11 states that allowed legal sales within their borders raised nearly £2.4b in cannabis excise tax revenue, an increase of 33% compared to 2020. In 2021, most of the states that allowed cannabis sales raise 20% more revenue from cannabis excise taxes than from alcohol excise taxes.<sup>112</sup>*

US states generally impose significant retail and excise taxes on cannabis, coupled with standard state sales taxes, local taxes, and licensing fees. Colorado has a 15% excise tax on wholesale cannabis and a 15% retail tax on sales, a portion of which is shared back with local governments, who can adopt their own taxes. Over the past decade, tax revenue from legal cannabis sales funded improvements to the state's public school system, including the construction of new schools, early literacy programmes, prevention of drop out and bullying and provision of mental health services.<sup>113</sup>

A significant achievement of the Colorado regulatory model was the fact that it was able to strike a balance between tax collection and creating an attractive business environment. An important lesson

<sup>109</sup> Colorado Department of Revenue

<sup>110</sup> Mpp.org – Cannabis Tax Revenue in States that Regulate Cannabis for Adult Use

<sup>111</sup> Population source: US Census Bureau. The states are Alaska, Arizona, California, Colorado, Illinois, Maine, Massachusetts, Michigan, Nevada, Oregon, Washington

<sup>112</sup> TEP – Institute on taxation and Economic Policy

<sup>113</sup> Colorado Department of Revenue Taxation Division, *Marijuana Tax Reports*

to be learned from the Colorado model is that in order to succeed in the long term, licenced operators must be able to outcompete the illicit market.

Colorado state regulators understood that while the legal industry was in its infancy, licenced businesses faced strong competition from the illicit market which, unburdened by tax and already operating at scale, was able to offer consumers highly competitive prices. Accordingly, the state introduced a progressive tax rate and a regulatory regime that proved easy for start-up businesses to navigate. Having nurtured a competitive home-grown industry, Colorado gradually increased taxes, with tax revenues between 2015 and 2020 growing at a CAGR of 21.8%.<sup>114</sup>

A comparative analysis illustrates an equivalent tax revenue for the UK market. In 2021 Colorado's revenue from cannabis taxes and fees amounted to £344.7m.<sup>115</sup> Given that the UK population is 11.6 times that of Colorado, a fully regulated and mature cannabis market in the UK with the same levies as Colorado could generate annual revenues of £4.11b, equating to 0.42% of all UK receipts forecast for 2022-23.<sup>116</sup>

The UK is facing unprecedented pressures to identify new sources of tax revenue to replenish state coffers devastated by the impact of COVID-19. Additionally, the country is striving towards ambitious goals of achieving the targets of its Net Zero Strategy by 2050. With electric cars being the central plank of the Net Zero Strategy, the UK treasury needs alternative sources of income to replace the £26.2bb<sup>117</sup> currently collected through the annual Fuel Duty. A mature and regulated consumer cannabis market contributing £5.4b annually would equate to over a fifth of that.

## 10.4 Job creation

As of January 2022, the US cannabis industry employed 428,059 full time workers, representing an annual growth rate of 28.4% over the previous 5 years.<sup>118</sup> This means there are more people employed in-directly and directly by cannabis businesses than there are firefighters, insurance agents and bank tellers. Thanks to its attractive regulatory regime, Colorado was able to attract investment, become a cannabis production hub and a vibrant consumer market, in the process creating 38,337 jobs.<sup>119</sup> In addition to direct cultivation, manufacturing, and retail jobs, the industry creates a wide array of high-skilled ancillary jobs, including engineering, equipment manufacturing, consulting, accounting, media, technology, legal, tourism and hospitality.

By cannabis employment figures, Colorado is second only to California, a state with a population 6 times its size. Using the experience of Colorado as a benchmark, at maturity, a fully legalised cannabis industry could provide 543,000 jobs. This represents approximately 43% of currently UK unemployed adults (16+).<sup>120</sup>

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<sup>114</sup> Colorado Department of Revenue Taxation Division, *Marijuana Tax Reports*

<sup>115</sup> While this analysis uses a simple comparative projection based on population, it is important to note differences in underlying adult cannabis use rates between the United Kingdom and Colorado. These differences in reported cannabis use may influence market size, and as such tax revenue generation, in ways that cannot be fully captured by a population comparison. The United Kingdom drug situation 2019: Focal Point annual report (updated 31 March 2021) provides past year statistics for adult cannabis consumption – [Link](#). In England and Wales, 7.6% of adults surveyed said that they had used cannabis in the last year. In Scotland 8.4% of adults said they used cannabis in the past year. For Colorado, similar adult cannabis use statistics can be drawn from the 2019-2020 National Survey on Drug Use and Health – [Link](#). In this report, 27.72% of adults 18 and older in Colorado report using cannabis at least once in the last year. While these reported use rates differ significantly, it is also important to note that differences in self-reported drug use may be attributed in part to differences in survey honesty based on legality of adult cannabis use between jurisdictions.

<sup>116</sup> Office for Budget Responsibility

<sup>117</sup> Office for Budget Responsibility

<sup>118</sup> Leafly Report

<sup>119</sup> Leafly Report

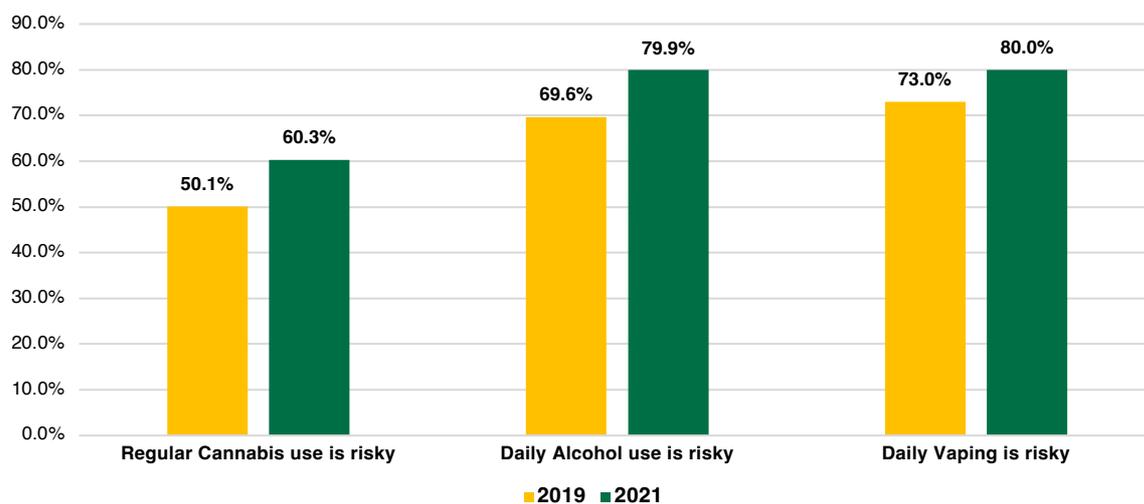
<sup>120</sup> Office for National Statistics

## 10.5 Consumer protection

Contrary to popular apprehensions about increased criminality and under-age cannabis use, the experience of legalisation in Colorado shows improvement in consumer safety and social justice outcomes. In the years since the legalisation of cannabis, Healthy Kids Colorado Survey (HKCS), the state's most comprehensive survey on the health and well-being of young people, has shown no increase in the use of cannabis among children and adolescents. On the contrary, data from the most recent survey conducted in 2021 showed a decrease in the use of cannabis among youth from 20.6% in 2019 to 13.3% in 2021.<sup>121</sup> Additionally, the survey showed that in 2021 only 40.3% of youth felt it would be easy to obtain cannabis, a 14.6% drop since 2013,<sup>122</sup> indicating an increase in the effectiveness of regulatory measures to protect young adults from accessing cannabis illegally. Other government surveys similarly demonstrate that adolescent cannabis use has not increased and, in some surveys, has declined. The Colorado dataset from the federal National Survey on Drug Use and Health reported past-month cannabis consumption for adolescents aged 12-17 declined from 12.56% in 2013-2014, the first year of regulated sales, to 8.45% in 2019-2020.<sup>123</sup> The National Institute on Drug Abuse funded 2020 Monitoring the Future survey of 8th (13-14 year old), 10th (15-16 year old), and 12th (17-18 year old) grade students similarly showed that nationally the use of marijuana "did not significantly change in any of the three grades for lifetime use, past 12-month use, past 30-day use, and daily use from 2019-2020."<sup>124</sup> Finally, data from the Colorado Division of Criminal Justice indicates that the state has seen a market reduction in arrests for drug-related crimes across all racial groups.<sup>125</sup>

Eight years on from legalisation of adult-use cannabis market, Colorado has experienced a decline in the ease of access and use of cannabis among youth under 18. Additionally, Colorado high school students, when asked about perceived risk of cannabis, alcohol and tobacco, believe that each is riskier in 2021 than it was in 2019, but that cannabis was the least risky of the three product categories. This mature and informed approach to cannabis among the young is a testament to the effectiveness of Colorado's regulatory model.

Colorado students' perception of risk



<sup>121</sup> Healthy Kids Colorado Survey

<sup>122</sup> Healthy Kids Colorado Survey Dashboard

<sup>123</sup> National Survey on Drug Use and Health

<sup>124</sup> Monitoring the Future (MTF) survey

<sup>125</sup> Colorado Division of Criminal Justice

## 10.6 Cannabis tourism

Cannabis tourism is now a major industry in jurisdictions where it has been fully legalised. In the US alone, the cannabis tourism industry is now estimated to be worth £13.8b.<sup>126</sup> In 2021 the US legal cannabis market was estimated to be approximately £20.3b, with £3.7b<sup>127</sup>, equating to 18%, being driven by tourists visiting states with legal access. Perhaps more importantly, tourists contributed additional £10.2b in revenue by visiting restaurants, hotels, attractions, and other retail outlets. In Colorado this is more pronounced and represents a multiplier effect of an additional £2.80 for every £1 injected into local economies and ultimately that filters through to local and tax coffers.

Cannabis tourism is an emerging industry, but one that over the coming decades will undoubtedly command a higher proportion of the current £975b gross value that tourism adds to the US economy every year. The US cannabis tourism market has developed rapidly and half of millennials now state that access to regulated cannabis market is important in their choice of travel destination. Furthermore, 43% millennials go as far as saying they have specifically chosen a destination based on whether it offered legal access to cannabis. Coupled with the fact that by 2025 50% of the travellers will be millennials, this highlights the clear opportunity that this market presents.<sup>128</sup>

Colorado is a good case study for the in-direct effects of cannabis legalisation. In 2014, immediately following the launch of legal retail sales of cannabis, hotel bookings in Denver grew by 3.5%, which in turn led to a 3.8% increase in room rates.<sup>129</sup> This change alone contributed £105.7m in additional hotel revenue to the city of Denver.<sup>130</sup>

Cannabis tourism is a relatively new concept but already lifestyle brands are increasingly entering the market to cater for enthusiastic travellers who are driving the market into a wellness and consumer friendly territory. Additionally, in places like California there are already tourist attractions such as Sonoma Hills, where tourists can visit craft cultivators, learn about the integration of the cannabis plant with traditional farming, how it can be incorporated into a farm-to-table lifestyle while supporting the natural ecosystems.<sup>131</sup> Farms in the Sonoma Valley have benefited from cannabis legislation in the same way that the wine did in the neighbouring Napa Valley benefitted from wine.

Appellations of origin, in the same way as found with Champagne, whisky or cheese, are on the rise in the cannabis industry. Cultivators are increasingly vying to promote individual strains from specific regions<sup>132</sup> and tourists treat their visits to cultivation sites as they would a visit to a vineyard in the South of France or a distillery in the Scottish Highlands. North America does not have a monopoly of cannabis tourism and its effect can be found in other countries like Thailand, which until recently had a zero-tolerance stance on the use of cannabis. In the next three years the Thai cannabis market is projected to generate £8.1b in sales, with an even larger multiplier effect driven by tourism.<sup>133</sup>

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<sup>126</sup> [Forbes](#)

<sup>127</sup> [Forbes](#)

<sup>128</sup> [Cannabis Travel Association International – Brian Applegarth](#)

<sup>129</sup> [Travelpulse](#)

<sup>130</sup> [John O'Neill, professor of hospitality management at Penn State University](#)

<sup>131</sup> [Sonoma Hills](#)

<sup>132</sup> [What do we know about opportunities and challenges for localities from Cannabis legalization?](#)

<sup>133</sup> [BBC Article](#)

Among the greatest benefits of tourism is its potential to develop and revitalise local economies, in turn improving the quality of life of local residents. In the UK, the Scotch Whisky industry has achieved exactly that. In 2019 the Scotch Whisky distilleries, 139 in total, were the third most popular tourist attraction – after the National Museum of Scotland and Edinburgh Castle – with over 2.2m visitors.<sup>134</sup> Two in every three visitors to distilleries were international tourists.<sup>135</sup> In 2019 visitor centres employed over 1,200 people, accounting for 10% of Scotland’s tourism sector, and tourists contributed nearly £85m (2018: £68m) to the local economy.<sup>136</sup> Average discretionary spend by each visitor was calculated to be approximately £39 per visit (2018: £34). Based on the fact that 10% of the Scotch Whisky industry’s jobs are directly attributable to tourism, the tourism element of a fully regulated cannabis market could create around 54,354 additional jobs in the UK.

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<sup>134</sup> Scotch Whisky Association

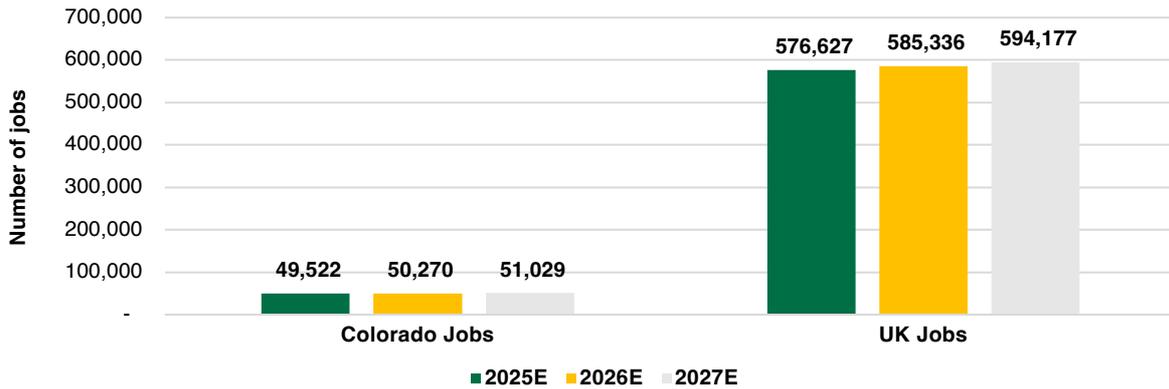
<sup>135</sup> Scotch Whisky Association

<sup>136</sup> Scotch Whisky Association

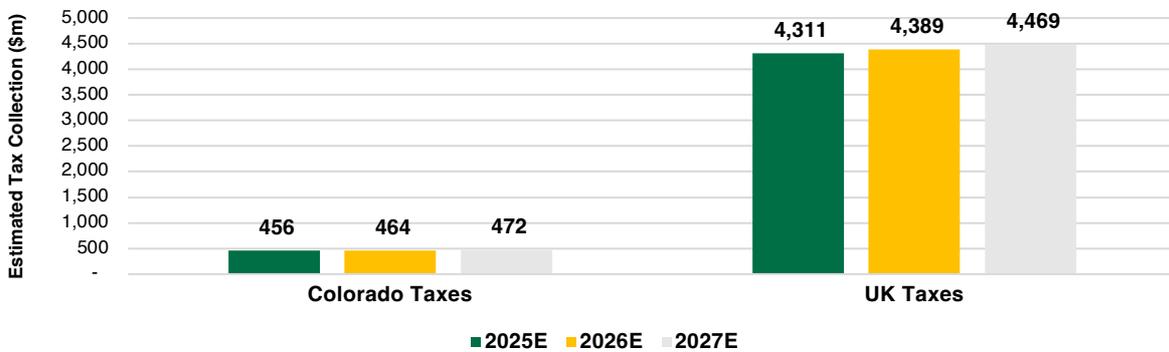
# 10.7 Conclusion

The experience of Colorado, and high-quality data available on the market, enables an analysis of the potential tax revenues and jobs that the new sector could create if the UK implemented clear guidelines and a robust regulatory framework. The analysis below is based on value add of medicinal and consumer products alone.

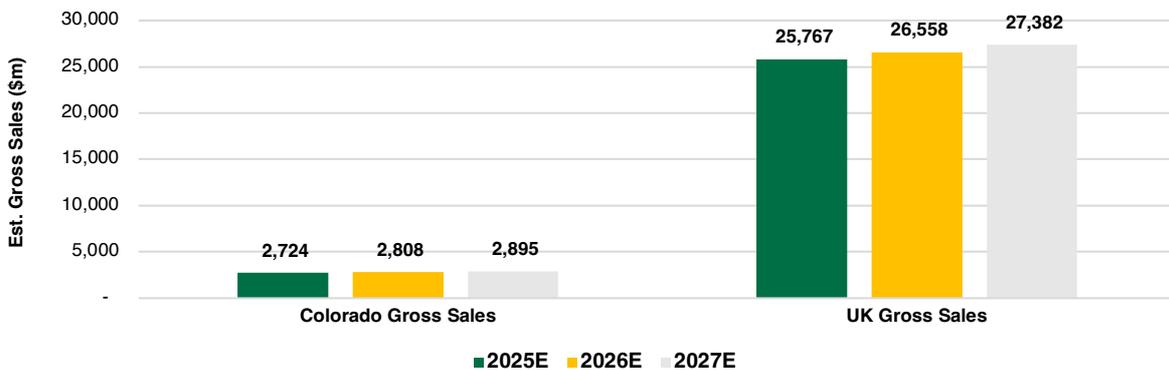
**Colorado and UK employment extrapolation**



**Colorado and UK taxes extrapolation**



**Colorado and UK gross sales extrapolation**



11.0

# Lessons learned



## 11.1 United States

With the benefit of nearly a decade of experience across the US with the implementation of different legislative models, the UK can learn valuable lessons about the effectiveness of different cannabis policies. Based on an analysis of successes and failures of different policies across various US states, it is evident that there are three essential ingredients required for successful markets:

1. **Availability.** For a market to be attractive to investors and generate sizable tax revenues, consumers need to be able to easily access the market and obtain the products they demand. This means physical availability in the form of plentiful storefronts and delivery. States with very limited licenses, delays in implementation, or widespread local restrictions, fail to reach the number of necessary access points and see the continuation of illicit enterprises. Five years after California voters legalised adult-use cannabis, only 32% of the state's local jurisdictions allow sales – propping up the illicit market and leading to an oversupply of growers. In New York, only 40 medical dispensaries have been licenced to serve 20m New Yorkers, making the state one of America's most ineffective medical markets, driving patients to the illicit market.<sup>137</sup> Analysis of available market data shows that constricting supply or retail availability does not improve the business environment or protect consumers. Instead, it drives consumers underground, where taxes are not collected, customers are not asked for ID, and consumers are exposed to dangerous products, legal risk, and even physical danger.
2. **Affordability.** Affordability comes with geographic competition, licensing, and a diverse and robust supply chain. A strong market requires sufficient cultivation and product manufacturing to enable competition and reduce prices. Otherwise, base prices are too high to allow cannabis to be effectively taxed while remaining competitive with the illicit market. If regulations are unclear or confusing, constantly changing, or overly burdensome, legal and operational costs increase. Products that are legal and compliant one month may be prohibited or require expensive new packaging the next month. California, for example, has complicated local and state regimes, difficult bureaucracies, and high taxes that stifled industry growth.
3. **Assortment.** As with any other consumer products industries, customers demand choice. Consumers have specific preferences regarding strains, potency levels and modes of ingestion. US cannabis states that banned the sale of flowers did not perform well because 40-60% of consumers still demand whole flowers.<sup>138</sup> If consumers cannot get the products they desire from a legal store, they will turn to the illicit market or travel out of state. The recent crash of the US CBD market offers a cautionary tale. Delays in US FDA regulations prevented big-box retailers from carrying popular product types like CBD gummies and vape pens. The only products widely available at major retailers were topicals and tinctures – which are less than 5% of the adult-use market – resulting in underwhelming sales. Projected market sales never occurred at the pace expected, and the market crashed when there was far too much CBD supply for underperforming demand.

By introducing regulations that ensure availability, affordability, and assortment – and strictly enforcing those regulations while maintaining barriers to entry by non-compliant operators, states such as Colorado have been able to capitalise on the economic potential of the cannabis market.

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<sup>137</sup> Leafly Report

<sup>138</sup> CPS Daily News

### 11.1.1 Eradicating the illicit market

In cannabis as in any other industry, there is likely always to be an illicit market. It is estimated that 12% of global sales of tobacco, a long-established and highly regulated industry, take place in the illicit market.<sup>139</sup> However, there is clear evidence that with the creation of well-regulated markets that deliver product that meet customers' price and quality expectations, the attractiveness of the illicit market diminishes considerably.

To the extent illicit activity occurs in a state like Colorado, the overwhelming majority is driven by prohibition in other states where consumers do not have access to a variety of legal products. However, notwithstanding illicit demand from its neighbouring prohibition states, Colorado's legal market has shown rapid growth by outcompeting illicit suppliers and directing existing consumers toward legal businesses. A study in Colorado as early as 2017 – 3 years after the start of legal sales – found that the state's pre-existing illicit market had been fully absorbed into the regulated market.<sup>140</sup>

Since licensed adult-use cannabis businesses opened their doors to consumers in January 2014, Colorado cannabis licensees have sold £10.4b worth of legal products.<sup>141</sup> From 2015 to 2020, the total market size averaged 22.2% in year-over-year sales growth. This represents billions of dollars of consumer demand that goes to licensed businesses rather than the illicit market.

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<sup>139</sup> KPMG – Illicit cigarette consumption in the EU, UK, Norway and Switzerland

<sup>140</sup> Market Size and Demand for Marijuana in Colorado 2017 Market Update

<sup>141</sup> Colorado Department of Revenue Taxation Division, *Marijuana Sales Reports*

## 11.1.2 Key takeaways

A successful cannabis regulatory framework is grounded in it having the core elements of an attractive investor environment, reasonable barriers to entry, and enforcement of responsible regulation designed for consumer safety. The experience of Colorado shows that a cannabis market will operate effectively when it is well-regulated, products are available and affordable, and consumer safety and choice are at the forefront of the market. Regulations must be clear, stable and easy to follow, while taxes must be reasonable. Enough businesses must be licensed to ensure sufficient supply and product creation and enable the type of robust competition that brings down prices and increases innovation. Otherwise, legalisation will only serve to reduce criminal penalties and consumers will continue to patronise unregulated illicit providers.

For investors, the markets with the fastest return on investment and highest asset valuations are usually limited licence markets where large companies can expand without restrictions, but competition is curtailed. However, these are not always (and typically not) the best markets for consumers or governments seeking to maximise tax revenue. An effective regulatory environment must not severely limit licences to the extent that it impedes competitive innovation, but rather has sufficient regulation and high-quality standards to keep out unsafe products and disreputable producers. Reasonable product regulations (like cGMP) ensure market participants are legitimate and responsible operators, while allowing for innovation and entrepreneurship. Striking this balance can ensure availability and access while ensuring the market is attractive for business investors, consumers, and governments.

State legalisation in the US, and especially well-regulated markets like Colorado, has resulted in broad, generally positive impacts on US public health and economy. It has also demonstrated that legalisation is more effective than prohibition in safeguarding public safety. In Colorado, monitoring of youth use since the legalisation of medicinal cannabis 20 years ago shows that legalisation has not meaningfully changed consumption patterns among youth. What is more, thanks to the new tax revenues, the state was able to fund important public health programmes. With effective regulation, tens of billions of dollars of cannabis demand can be redirected from the illegal market to one that is taxed and regulated, job-creating, and subject to robust manufacturing, testing, safety, and marketing regulation.

*“Despite limited access to financial services and an effective tax rate of 70%, the regulated cannabis industry in the US has proven to be an economic engine. The positive impacts of cannabis legalisation are evident across the economy, including substantial job creation, billions in new tax revenues and government savings from reduced incarceration. We fully expect this trend to accelerate as more states legalise and regulate cannabis”*

*Jessica Billingsley, Chair, US Cannabis council (USCC)*

Closer to home, Jersey has successfully applied its agility and reputation as a business-friendly jurisdiction, to attract investors and operators to its burgeoning cannabis industry. In June 2021 Jersey passed an amendment to its Proceeds of Crime (Jersey) Law, a progressive piece of legislation that makes two unprecedented allowances for cannabis businesses:

1. It allows Jersey-based businesses to transact with jurisdictions that have legalised adult-use cannabis, even though the activity is still illegal in Jersey.
2. It includes the US on its list of ‘Approved’ jurisdictions, thereby allowing Jersey companies to own and transact with companies in US states that have legalised adult-use cannabis, despite the fact that under US federal law, cannabis remains illegal.

Alongside Jersey's other advantages – stable government, robust regulations, mature professional services industry and proximity to the UK – a Jersey HQ offers cannabis companies an excellent base to develop their international operations, making Jersey a destination of choice for international capital. The island is already well ahead of the UK in servicing its patient population and there are already several licenced producers set to supply medicinal and consumer products to Jersey and export to international markets.

*Over the past several years the Jersey Government has been able to demonstrate its agility in innovation to maximise opportunities for start-up cannabis businesses to set up on the island and to establish Jersey as a 'centre of excellence' on the world stage. Jersey is continuing to work on developing a seed bank, intellectual property, educational partners and further opportunities for developing a skilled workforce. Alignment has been key to the government's effectiveness. From the outset, the government set up a cross-departmental steering committee dedicated to the sector, which quickly identified the key areas that required reform and the key advantages that would attract businesses to set up on the island. Setting up the CSAB as a conduit between industry and government has also helped the government move at the pace of the wider, commercial world. There is a continued need to update the existing legislative framework, but there is a significant competitive advantage that can be gained by doing this thoroughly from the beginning."*

*Daniel Houseago, Group Director, Economy, Department for the Economy*

Finally, while looking for a framework for the burgeoning cannabis industry, legislators need to look no further than the immensely successful Scotch Whisky industry. The iconic perception of Scotch Whisky has translated into vast economic benefits, making it one of the pillars of the Scottish economy:

- In 2021 the Scotch Whisky industry had global turnover of £66b and annually provides £5.6b in gross value added (GVA) to the UK economy, with exports in 2021 worth £4.6b.<sup>142</sup>
- It directly employs 11,000 people in Scotland, 7,000 of these in deprived rural areas, and supports 42,000 permanent high-value jobs across the UK.
- In 2019 alone, there were 2.2m visits to Scotch Whisky distilleries and their visitor centres, making the industry the third most popular tourist attraction in Scotland.<sup>143</sup>

Post-Brexit, the UK has the autonomy to decide and implement its own regulations across all sectors of the cannabis industry. With the benefit of lessons learned from other jurisdictions, the UK is in an excellent position to develop robust regulations and a supporting business environment that will allow UK companies to seize the opportunity offered by the growing global cannabis market.

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<sup>142</sup> Statista

<sup>143</sup> Scotch Whisky Association

### 11.1.3 Recommendations

Key to an effective regulatory model will be assigning regulatory oversight to government departments with the most direct expertise of the different market segments for different cannabis-derived products. Additionally, the government needs to address two key regulatory hurdles that hold the UK back from being a destination of choice for cannabis investment capital:

1. **Reform the Proceeds of Crime Act 2002.** At present, investors remain cautious about investing in the cannabis sector, owing to the risks associated with the Proceeds of Crime Act 2002 (POCA). As a consequence of POCA, proceeds from medicinal cannabis business in states such as Colorado may constitute “criminal property” even if fully legal and authorised in the foreign state. It is essential that the government conducts an urgent review of the Proceeds of Crime Act 2002 and introduces legislative changes that would give investors legal clarity and confidence about investing in this space.
2. **Ensure Financial Conduct Authority (FCA) issues clear guidelines on listing.** In September 2020 the UK’s Financial Conduct Authority (FCA) published guidance relating to the listing of cannabis related business on London’s primary markets, the Official List. The FCA stated that its approach to the listing of the securities of cannabis related business is as follows:
  - **Adult-use:** Any companies who undertake, or who derive a benefit, profits, from adult-use cannabis operations (regardless of whether these are fully regulated and licenced in overseas jurisdictions) remain unable to have their securities admitted to the Official List.
  - **UK Medical:** UK-based medicinal cannabis companies, operating in accordance with applicable law and regulation in the UK, can have their securities admitted to the Official List.
  - **Overseas Medical:** Medicinal cannabis companies who have operations outside the UK may have their securities admitted to the Official List, provided they can satisfy the FCA that their activities would not be a breach of POCA, that their activities would be legal if carried out in the UK and if they can explain to the FCA the nature of local licensing regime.

While the FCA guidance is helpful, there is still regulatory ambiguity around whole-plant product, which effectively means that companies engaging in the production of whole plant products are barred from listing on the main market of the London Stock Exchange. In recognition of the enduring consumer interest in products containing full-plant extracts, the government should create the appropriate regulatory framework to support, not hinder, this new industry.

## 11.1.4 Actions

No.	Department	Actions
1.	Home Secretary	1. Initiate consultations about amendments to POCA to enable businesses engage and invest in UK's legal medicinal cannabis market.
2.	Financial Conduct Authority	2. Ensure the FCA issues clear guidance to the industry on pathway to listing on the LSE.

## 11.1.5 Timeline

No.	Actions	Deadline
1.	1. Initiate consultations about amendments to POCA to enable businesses engage and invest in UK's legal medicinal cannabis market.	1 October 2022
2.	1. Ensure the FCA issues clear guidance to the industry on pathway to listing on the LSE.	1 March 2023

# Cannabis industry review questionnaire



## 1. What challenges are you currently facing in your business?

(grade from 1 to 4, with 1 being 'of no concern' and 4 being 'of maximum concern').

- a. Restrictions throughout supply chain both in and outside the British Isles (grade 1-4 & why?)
- b. UK Legislation on controlled drugs (score 1-4 & why?)
- c. UK Legislation on growing and hemp growers licences (score 1-4 & why?)
- d. UK Legislation on production and manufacture in the UK (score 1-4 & why?)
- e. UK FSA Novel Foods process (score 1-4 & why?)
- f. Enforcement by UK Trading Standards (score 1-4 & why?)
- g. UK Legislation on Veterinary products (score 1-4 & why?)
- h. UK Legislation on Cosmetics and body care products (score 1-4 & why?)
- i. Consumer fear of fake or illegal products (score 1-4 & why?)
- j. Consumer fear of mislabelling and misrepresentation (score 1-4 & why?)
- k. Consumer confusion with products and usage (score 1-4 & why?)
- l. Uneven application of restrictions on advertising/label claims (score 1-4 & why?)
- m. Lack of harmonised laboratory testing standard (score 1-4 & why?)
- n. Ability to open bank accounts (score 1-4 & why?)
- o. Ability to use online e-commerce tools such as Shopify (score 1-4 & why?)
- p. Access to professional products and services, such as accounting and insurance (score 1-4 & why?)

## 2. What regulations or recent recommendations would you change and why?

(If you don't have a comment, please leave blank)

- a. [Misuse of Drugs Act 1971](#) →
- b. [Misuse of Drugs Regulations 2001](#) → [updated in 2016]
- c. [NICE Guidelines on cannabis, CBD etc](#) →
- d. [Hemp Growing Licensing](#) →
- e. [Novel Foods Process](#) →
- f. [ACMD Report](#) → [Advice on consumer cannabidiol (CBD) products December 2021]
- g. [Veterinary Medicines Directive on Cannabidiol](#) →

## 3. Are there any challenges we have omitted, and what would you like done about them?

## 4. We'd like to know a little about you

Are you:

- a. A cannabis business (hemp grower, manufacturer, seller/stockist)
- b. A cannabis-oriented organisation (trade association, supplier to, consultancy)
- c. Other

# Glossary



## All-Party Parliamentary Groups (APPGs)

APPGs are informal cross-party groups that have no official status within Parliament. They are run by and for Members of the Commons and Lords, though many choose to involve individuals and organisations from outside Parliament in their administration and activities.

## Aggregation Strategy

'Buy and Build' involves purchasing a target company with the view to making subsequent 'add-on' acquisitions in the same sector, harnessing the concept that the whole is greater than the sum of its parts. This 'platform' company is often an established business with proven management, systems and back-office functions allowing the PE house to use the infrastructure of this platform as a base to grow and realise synergistic benefits.

## Cannabidiol (CBD)

Major cannabinoid extracted from cannabis sativa (mostly low-THC hemp). Claimed to provide wide-ranging properties useful for health and wellness including anti-anxiety, anti-inflammatory, anti-pain, anti-arthritis, and neuroprotective effects.

## Cannabinoids

Cannabinoids are the chemical compounds unique to cannabis that act upon the human body's cannabinoid receptors, producing various effects including pain relief and other medically beneficial uses. Marijuana's most well-known cannabinoid is tetrahydrocannabinol (THC) since it is the most abundant, and because it produces the psychoactive effects (or the "high") that drives the plant's adult-use. However, there are over 66 plus known variants of cannabinoids all with differing effects, so THC isn't the only one.

A partial list includes but is not limited to:

- CBC (Cannabichromene)
- CBCa (Cannabichromene carboxylic acid)
- CBD (Cannabidiol)
- CBDa (Cannabidiolic Acid)
- CBG (Cannabigerol)
- CBGa (Cannabigerolic Acid)
- CBGV (Cannabigerovarin)
- CBGVa (Cannabigerovarinic Acid)
- CBE (Cannabielsoin)
- CBL (Cannabicyclol)
- CBN (Cannabinol (Illegal in the UK))
- CBND (Cannabinidiol)
- CBT (Cannabitriol)
- THC or  $\Delta$ 9THC (Delta9-Tetrahydrocannabinol (Illegal in the UK))
- $\Delta$ 9THCa (Delta9-Tetrahydrocannabinolic acid (Illegal in the UK))
- Delta8 (Tetrahydrocannabinol (Illegal in the UK))
- THCV (Tetrahydrocannabivarin)
- THCVa (Tetrahydrocannabivarinic acid)

## **Cannabis Services Advisory Board (CSAB)**

A new cannabis trade organisation for the Island of Jersey. It brings together businesses, legislators, and other stakeholders in monthly meetings to act as an official conduit between the industry and the Government. It provides input to the Government on commercial industry development issues with a view to further regulation within the British Isles.

## **Edibles**

Edibles are medicated edible goods that have been infused with cannabis extracts. They are commonly baked goods such as cookies and brownies, but options as varied as flavoured coffee drinks, breads, and candies exist as well. Dispensaries also often sell marijuana-infused butters or oils for patients or consumers to make their own edibles. Consuming edibles means the active components from the extracts require longer to take effect as they need to be absorbed through the digestive system.

## **Industrial hemp**

Industrial hemp refers to cannabis plants cultivated for high yields of materials like seeds, fibre, and oil, with low concentrations of psychoactive compounds. The common limit for Tetrahydrocannabinol (THC) content in hemp materials in Europe is 0.2% w/w but this varies and can be as high as 0.6% and 1% in Italy and Switzerland respectively.

## **Marijuana**

Marijuana is the general term for female cannabis plants or their dried flowers. Females are distinct from male plants in that they are the ones that produce flowers which contain the high percentage of cannabinoids that hold both their medicinal and psychoactive properties.

## **Medicinal cannabis**

Cannabinoid-based medicine not holding marketing authorisation and therefore sold as an unlicensed medicine that is supplied through health systems and prescribed by a doctor; or Active Pharmaceutical Ingredient (API) to be manipulated and/or compounded by a magistral pharmacy to prepare a cannabinoid-based medicine without marketing authorisation (unlicensed).

## **Minor Cannabinoids**

Cannabinoids found in low concentrations in the cannabis plant such as Cannabigerol (CBG) and Cannabinol (CBN). Many have been shown to be bio-active though evidence for their therapeutic benefits is yet lacking. Many researchers hope these will provide a host of new ways of modulating the endocannabinoid system.

## **Novel Foods**

Novel Food is defined as food that had not been consumed to a significant degree by humans in the EU before 15 May 1997, when the first Regulation on novel food came into force 'Novel Food' can be newly developed, innovative food, food produced using new technologies and production processes, as well as food which is or has been traditionally eaten outside of the EU. The underlying principles underpinning Novel Food in the European Union are that

Novel Foods must be:

- Safe for consumers
- Properly labelled, so as not to mislead consumers
- If novel food is intended to replace another food, it must not differ in a

way that the consumption of the Novel Food would be nutritionally disadvantageous for the consumer□

Pre-market authorisation of Novel Foods on the basis of an evaluation in line with the above principles is necessary.

## **Pharmaceutical cannabis**

Formulated, processed or synthetic cannabis sold as a finished product, which has undergone full medical trials, and holds (in one or more geographical areas) a medical marketing authorisation e.g., Cesamet®, Marinol®, Syndros®, Sativex®, Epidiolex® and any derived generic medicines (such as dronabinol).

## **The Proceeds of Crime Act (POCA)**

The Proceeds of Crime Act 2002 is an Act of the Parliament of the United Kingdom which provides for the confiscation or civil recovery of the proceeds from crime and contains the principal money laundering legislation in the UK.

## **Terpenes**

Are a large and diverse class of organic compounds, produced by a variety of plants. They often have a strong odour and may protect the plants that produce them by deterring herbivores and by attracting predators and parasites of herbivores. Terpenes and terpenoids are the primary constituents of the essential oils of many types of plants and flowers. Synthetic variations and derivatives of natural terpenes and terpenoids also greatly expand the variety of aromas used in perfumery and flavours used in food additives.

## **Tetrahydrocannabinol (THC)**

The other primary cannabinoid, and the main psychoactive cannabinoid of cannabis. THC is considered the primary source of the 'high' produced by ingesting cannabis. Evidence suggests that THC exhibits medicinal properties that are useful in treating chemotherapy-related nausea, pain, and spasticity. THC can also be synthesised and, in general, is more widely controlled than CBD.

## **Tincture**

A tincture is a liquid cannabis extract usually made with alcohol or glycerol that is often dosed with a dropper. Tinctures can be flavoured and are usually placed under the tongue, where they are absorbed quickly. Effects can be felt within minutes. Tinctures can also be mixed into a drink, but in these cases, effects will take longer because the tinctures will be absorbed by the digestive system.

# Abbreviations



Abbreviation	Description
ACMD	Advisory Council on the Misuse of Drugs
ASA	Advertising Standards Agency
BHA	British Hemp Association
CIC	Cannabis Industry Council
CND	Commission On Narcotic Drugs
COA	Certificate of Analysis (Lab Report)
CosIng	Cosmetic ingredient database
CPD	Cannabis Products Directive
CTPA	Cosmetic, Toiletry and Perfume Association
DBS	Disclosure & Barring Service
DEFRA	Department for Environment, Food & Rural Affairs
DFLU	Drugs & Firearms Licensing Unit
EFSA	European Food Safety Agency
EIHA	European Industrial hemp Association
FDA	Federal Drugs Agency (USA only)
FSA	Food Standards Agency
GDP	Good Distribution Practice
GMC	General Medical Council
GMP	Good Manufacturing Practice
HFMA	Health foods Manufacturers Association
HO	Home Office
IHMB	Industrial hemp Marketing Board
INCI	International Nomenclature Cosmetic Ingredients
MA	Marketing Authorisation (formerly known as a Medicine's License)
MoDA	Misuse of Drugs Act 1971
MDR	Misuse of Drugs Regulations 2001
NFR	Novel Foods Regulations
NFWG	Novel Foods Working Group
NIH	Northern Ireland Hemp
NICE	National Institute for Health and Care Excellence
SAB	Secretariat Advisory Board
SANTE	Administrators of the Novel Foods Register Europe
SCCS	Scientific Committee on Cosmetic Safety
SHA	Scottish Hemp Association
TPD	Tobacco Products Directive
TS	Trading Standards
UN61	United Nations Treaty on Narcotics 1961
VMD	Veterinary Medicines Directorate

# Appendix



## APPG - Business Plan Model

Jurisdiction	Sector	Market	Department	Gross Sales (\$000s)	Tax Take (\$000s)	Jobs	Support Schedule
Colorado	Recreational	Adult-use	Colorado Government	\$2,304,750		31,600	A1
Colorado	Medical	Medical	Colorado Government	\$376,300	\$472,420	7,010	A1
Colorado	CBD	CBD & Hemp	Colorado Government	\$213,590		11,520	A1
<b>Colorado Total</b>				<b>\$2,894,640</b>	<b>\$472,420</b>	<b>50,130</b>	
Jurisdiction	Sector	Market	Department	Gross Sales (\$000s)	Tax Take (\$000s)	Jobs*	Support Schedule
USA	Recreational	Adult-use	US Federal Government	\$132,324,160		1,814,540	A1
USA	Medical	Medical	US Federal Government	\$21,604,930	\$27,123,210	402,180	A1
USA	CBD	CBD & Hemp	US Federal Government	\$12,263,250		713,050	A1
<b>USA Total</b>				<b>\$166,192,340</b>	<b>\$27,123,210</b>	<b>2,929,770</b>	
Jurisdiction	Sector	Market	Department	Gross Sales (£000s)	Tax Take (£000s)	Jobs*	Support Schedule
UK	Recreational	Adult-use	Cabinet	£21,802,090	£3,308,950	368,000	A1
UK	Medical	Medical	Home Office / MHRA	£3,300,590	£755,840	81,570	A2
UK	CBD	Topicals	Trading Standards	£23,950	£4,790	38,900	A3
UK	CBD	Ingestibles	Trading and Veterinary Standards / FSA	£1,996,580	£399,310		A4
<b>UK Subtotal (i)</b>				<b>£27,123,210</b>	<b>£4,468,890</b>	<b>488,470</b>	
UK	Hemp	Agricultural	DEFRA	£1,459,940	£292,000	42,930	A5
UK	Hemp	Industrial Manufacturing	DEFRA / BEIS / Trade Dept.	£1,608,730	£321,750	21,620	A6
UK	Hemp	Animal Feed	DEFRA	£765,940	£153,190	9,510	A7
UK	Hemp	Carbon Credits	DEFRA / BEIS	£1,285,340	£254,920	31,650	A8
<b>UK Subtotal (ii)</b>				<b>£5,119,950</b>	<b>£1,021,860</b>	<b>105,710</b>	
<b>UK Total</b>				<b>£32,243,160</b>	<b>£5,490,750</b>	<b>594,180</b>	

Information procured from secondary and primary data to establish baselines for forecasting has been analysed as follows:

- 1 Identifying variables and establishing market impact
- 2 Establishing market trends
- 3 Analysing future opportunities and market penetration rates by understanding product commercialisation, regional expansion etc.
- 4 Analysing changes in the industry dynamics to establish future growth
- 5 Analysing historical market trends and super-imposing them on the current and future variables to determine year-on-year trend
- 6 Derivation of market estimates via analysing other geographical markets

Financial modelling approach:

- 1 Bottom-up approach for estimating and forecasting demand size and opportunity - Schedules A2, A5, A6 & A7
- 2 Top-down approach for new product forecasting and penetration - Schedules A3, A4 & A8
- 3 Combined approach of both Bottom-up and Top-down for full coverage analysis

<b>A1 - Tax, Jobs and Gross Sales (000s)</b>	<b>2022E</b>	<b>2023E</b>	<b>2024E</b>	<b>2025E</b>	<b>2026E</b>	<b>2027E</b>
<b>Colorado (\$000)</b>						
Colorado Sales Tax	\$297,452	\$302,851	\$308,347	\$313,943	\$319,641	\$325,443
Colorado Excise Tax	\$121,304	\$123,506	\$125,747	\$128,029	\$130,353	\$132,719
Colorado License Fees	\$13,030	\$13,266	\$13,507	\$13,752	\$14,002	\$14,256
<b>Colorado Total Tax (\$000)</b>	<b>\$431,786</b>	<b>\$439,623</b>	<b>\$447,602</b>	<b>\$455,725</b>	<b>\$463,996</b>	<b>\$472,417</b>
Colorado Population ('000s)	5,773,000	5,773,000	5,773,000	5,773,000	5,773,000	5,773,000
UK Population ('000s)	67,220,000	67,220,000	67,220,000	67,220,000	67,220,000	67,220,000
<b>UK Total Tax Take (£000)</b>	<b>£4,084,537</b>	<b>£4,158,668</b>	<b>£4,234,145</b>	<b>£4,310,992</b>	<b>£4,389,233</b>	<b>£4,468,894</b>
US Population ('000s)	331,449,000	331,449,000	331,449,000	331,449,000	331,449,000	331,449,000
<b>US Total Tax Take (\$000)</b>	<b>\$24,790,417</b>	<b>\$25,240,344</b>	<b>\$25,698,437</b>	<b>\$26,164,845</b>	<b>\$26,639,717</b>	<b>\$27,123,208</b>
<b>Employment (000s)</b>						
Period	<b>Dec-22</b>	<b>Dec-23</b>	<b>Dec-24</b>	<b>Dec-25</b>	<b>Dec-26</b>	<b>Dec-27</b>
<b>Colorado</b>						
Total Cannabis Jobs (Excl. Hemp)	38,916	39,504	40,100	40,706	41,321	41,945
Recreational Jobs	29,322	29,765	30,215	30,671	31,134	31,605
Medical Jobs	6,499	6,597	6,697	6,798	6,901	7,005
CBD Jobs	3,094	3,141	3,189	3,237	3,286	3,335
Hemp	8,428	8,556	8,685	8,816	8,949	9,084
<b>Total jobs in Colorado</b>	<b>47,344</b>	<b>48,059</b>	<b>48,785</b>	<b>49,522</b>	<b>50,270</b>	<b>51,029</b>
Colorado Population	5,773,000	5,773,000	5,773,000	5,773,000	5,773,000	5,773,000
<b>UK</b>						
UK Population	67,220,000	67,220,000	67,220,000	67,220,000	67,220,000	67,220,000
Recreational Jobs	341,426	346,583	351,817	357,131	362,525	368,000
Medical Jobs	75,675	76,818	77,979	79,156	80,352	81,566
CBD Jobs	36,031	36,575	37,128	37,689	38,258	38,836
Hemp Jobs	98,137	99,619	101,124	102,651	104,201	105,775
<b>Total Jobs</b>	<b>551,270</b>	<b>559,596</b>	<b>568,048</b>	<b>576,627</b>	<b>585,336</b>	<b>594,177</b>
<b>US</b>						
US Population	331,449,000	331,449,000	331,449,000	331,449,000	331,449,000	331,449,000
Recreational Jobs	1,683,506	1,708,933	1,734,744	1,760,945	1,787,542	1,814,540
Medical Jobs	373,141	378,777	384,498	390,305	396,200	402,184
CBD Jobs	177,663	180,347	183,071	185,836	188,642	191,491
Hemp Jobs	483,895	491,203	498,622	506,153	513,798	521,558
<b>Total Jobs</b>	<b>2,718,206</b>	<b>2,759,260</b>	<b>2,800,935</b>	<b>2,843,239</b>	<b>2,886,182</b>	<b>2,929,773</b>
<b>Gross Sales (000s)</b>						
Period	<b>Dec-22</b>	<b>Dec-23</b>	<b>Dec-24</b>	<b>Dec-25</b>	<b>Dec-26</b>	<b>Dec-27</b>
<b>Colorado</b>						
Recreational Gross Sales	\$1,897,029	\$1,972,350	\$2,050,661	\$2,132,082	\$2,216,736	\$2,304,751
Medical Gross Sales	\$399,584	\$394,815	\$390,104	\$385,448	\$380,848	\$376,303
CBD Gross Sales	\$195,909	\$199,325	\$202,800	\$206,336	\$209,934	\$213,595
<b>Total Gross Sales (\$000s)</b>	<b>\$2,492,522</b>	<b>\$2,566,490</b>	<b>\$2,643,565</b>	<b>\$2,723,867</b>	<b>\$2,807,518</b>	<b>\$2,894,649</b>
Colorado Population	5,773,000	5,773,000	5,773,000	5,773,000	5,773,000	5,773,000
<b>UK</b>						
UK Population	67,220,000	67,220,000	67,220,000	67,220,000	67,220,000	67,220,000
Recreational Gross Sales	£17,945,190	£18,657,699	£19,398,498	£20,168,710	£20,969,504	£21,802,092
Medical Gross Sales	£3,779,919	£3,734,809	£3,690,237	£3,646,197	£3,602,682	£3,559,687
CBD Gross Sales	£1,853,226	£1,885,539	£1,918,416	£1,951,867	£1,985,900	£2,020,527
<b>Total Gross Sales (£000s)</b>	<b>£23,578,335</b>	<b>£24,278,047</b>	<b>£25,007,151</b>	<b>£25,766,774</b>	<b>£26,558,086</b>	<b>£27,382,306</b>
<b>US</b>						
US Population	331,449,000	331,449,000	331,449,000	331,449,000	331,449,000	331,449,000
Recreational Gross Sales	\$108,915,338	\$113,239,792	\$117,735,948	\$122,410,622	\$127,270,904	\$132,324,161
Medical Gross Sales	\$22,941,588	\$22,667,798	\$22,397,275	\$22,129,981	\$21,865,877	\$21,604,925
CBD Gross Sales	\$11,247,844	\$11,443,967	\$11,643,509	\$11,846,530	\$12,053,091	\$12,263,254
<b>Total Gross Sales (\$000s)</b>	<b>\$143,104,770</b>	<b>\$147,351,557</b>	<b>\$151,776,732</b>	<b>\$156,387,134</b>	<b>\$161,189,872</b>	<b>\$166,192,340</b>
<b>Assumptions</b>						
	<b>No. / Pct.</b>	<b>Link</b>	<b>Source</b>			
USA Population ('000s)	331,449,000	<a href="#">Link</a>	United States Census Bureau			
UK Population ('000s)	67,220,000	<a href="#">Link</a>	The World Bank			
Colorado Population ('000s)	5,773,000	<a href="#">Link</a>	United States Census Bureau			

Colorado Sales Tax CAGR (%)	1.8%	<a href="#">Link</a>	Colorado Legislative Council Staff March 2022   Page 35
Colorado Excise Tax CAGR (%)	1.8%	<a href="#">Link</a>	Colorado Legislative Council Staff March 2022   Page 35
Colorado License Fees CAGR (%)	1.8%	<a href="#">Link</a>	Colorado Legislative Council Staff March 2022   Page 35
Recreational Jobs	28,886		Pro-rata based on Colorado Gross Sales \$
Medical Jobs	6,402		Pro-rata based on Colorado Gross Sales \$
CBD Jobs	3,048		Pro-rata based on Colorado Gross Sales \$
Total Cannabis Jobs (Excl. Hemp)	38,337	<a href="#">Link</a>	Leafly Jobs Report 2022 Page 5
Hemp Jobs	8,303	<a href="#">Link</a>	Colorado Business Outlook 2020 Page 39
Colorado Jobs CAGR (%)	1.5%	<a href="#">Link</a>	Leafly Jobs Report 2022 Page 10
Recreational Gross Sales (\$)	\$1,824,584	<a href="#">Link</a>	Colorado Department of Revenue - Marijuana State Sales Report
Medical Gross Sales (\$)	\$404,411	<a href="#">Link</a>	Colorado Department of Revenue - Marijuana State Sales Report
CBD Gross Sales (\$)	\$192,551	<a href="#">Link</a>	Statista 2019
Recreational Sales Growth %	3.9%	<a href="#">Link</a>	Colorado Legislative Council Staff March 2022   Page 27
Medical Sales Growth %	-1.2%	<a href="#">Link</a>	Colorado Legislative Council Staff March 2022   Page 29
CBD Sales Growth %	1.7%	<a href="#">Link</a>	Internal extrapolation
July Monthly Exchange Rates - GBP:USD	1.2309	<a href="#">Link</a>	HMRC

**Notes**

Colorado is one of the longest standing regulated Cannabis market globally and serves as a strong baseline for an extrapolation of taxes, jobs and gross sales to size the US and UK markets.

A2 – Medicinal Cannabis	2022E	2023E	2024E	2025E	2026E	2027E
<i>UK Population</i>	67,220,000	67,220,000	67,220,000	67,220,000	67,220,000	67,220,000
Est. No. Medical Patients Increase	1,500	1,500	1,500	1,500	1,500	1,500
Est. No. UK Patients Current Growth	29,500	47,500	65,500	83,500	101,500	119,500
<i>Medical Patients % of Population</i>	0.044%	0.071%	0.097%	0.124%	0.151%	0.178%
<i>COL Population</i>	5,773,000	5,773,000	5,773,000	5,773,000	5,773,000	5,773,000
Act. No. Medical Patients	2,073	5,645	47,298	72,023	96,987	120,631
<i>Medical Patients % of Population</i>	0.0359%	0.0978%	0.8193%	1.2476%	1.6800%	2.0896%
Est. No. UK Patients Extrapolated from Colorado	24,138	65,724	550,726	838,624	1,129,306	1,404,609
No. Returning UK Patients	22,931	62,438	523,190	796,693	1,072,841	1,334,379
<i>Oil Market Share %</i>	26.8%	28.3%	29.8%	31.3%	32.8%	34.3%
Number of Patients (Oil)	6,136	17,643	155,686	249,023	351,432	457,120
Ave. Oil prescriptions per Patient (Per Annum)	12	12	12	12	12	12
Est. Total Prescriptions	73,629	211,717	1,868,237	2,988,281	4,217,183	5,485,440
Ave. Mg per Prescriptions (mg)	1,000	1,000	1,000	1,000	1,000	1,000
<i>% Price Compression</i>	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ave £ per Mg	£0.14	£0.14	£0.14	£0.14	£0.14	£0.14
<b>Estimate Oil Sales (£000s)</b>	<b>£10,257</b>	<b>£29,345</b>	<b>£257,658</b>	<b>£410,074</b>	<b>£575,826</b>	<b>£745,260</b>
<i>Flower Market Share %</i>	73.2%	71.7%	70.2%	68.7%	67.2%	65.7%
Number of Patients (Flower)	16,796	44,795	367,504	547,669	721,409	877,259
Ave. Flower prescriptions per Patient (Per Annum)	12	12	12	12	12	12
Est. Total Prescriptions	201,546	537,535	4,410,043	6,572,033	8,656,905	10,527,103
Ave. Grams per Prescriptions (g)	30	30	30	30	30	30
<i>% Price Compression</i>	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Ave £ per Gram	£8.43	£8.36	£8.29	£8.23	£8.16	£8.09
<b>Estimate Flower Sales (£000s)</b>	<b>£50,974</b>	<b>£134,838</b>	<b>£1,097,191</b>	<b>£1,621,706</b>	<b>£2,118,694</b>	<b>£2,555,333</b>
Estimate Oil Sales (£000s)	£10,257	£29,345	£257,658	£410,074	£575,826	£745,260
Estimate Flower Sales (£000s)	£50,974	£134,838	£1,097,191	£1,621,706	£2,118,694	£2,555,333
<b>Total Medical Sales (£000s)</b>	<b>£61,231</b>	<b>£164,184</b>	<b>£1,354,849</b>	<b>£2,031,780</b>	<b>£2,694,519</b>	<b>£3,300,593</b>
Oil Tax	£2,350	£6,720	£59,000	£93,910	£131,860	£170,660
Flower Tax	£11,670	£30,880	£251,260	£371,370	£485,180	£585,170
Excise Tax	£1,776	£4,761	£39,291	£58,922	£78,141	£95,717
Sales Tax	£12,246	£32,837	£270,970	£406,356	£538,904	£660,119
<b>Total Tax</b>	<b>£14,022</b>	<b>£37,598</b>	<b>£310,260</b>	<b>£465,278</b>	<b>£617,045</b>	<b>£755,836</b>
<b>Assumptions</b>	<b>No. / Pct.</b>	<b>Link</b>	<b>Source</b>			
<i>UK Population ('000s)</i>	67,220,000	<a href="#">Link</a>	The World Bank			
<i>COL Population ('000s)</i>	5,773,000	<a href="#">Link</a>	United States Census Bureau			
Est. No. Medical Patients Increase	1,500		As per Mike Barnes interview 13/06/22			
Est. No. UK Patients Current Growth	11,500		As per Mike Barnes interview 10/12/21			
No. Returning UK Patients	95.0%		Internal estimation			
<i>Oil Market Share % Increase</i>	1.5%		Internal estimations based on industry experience			
<i>Oil Market Share % 2021</i>	25.3%	<a href="#">Link</a>	Project T21 Drug Science			
Ave. Oil prescriptions per Patient (Per Annum)	12		Internal estimations based on industry experience			
Ave. Mg per Prescriptions (mg)	1,000		Internal estimations based on industry experience			
<i>% Price Compression</i>	0.5%		Internal estimations based on industry experience			
Ave £ per Mg	0.14	<a href="#">Link</a>	MedBud - Navigating Medical Cannabis			
<i>Flower Market Share % Decrease</i>	-1.5%		Inverse of Cell C49 (Flower cedes market share to Oil)			
<i>Flower Market Share % 2021</i>	74.7%	<a href="#">Link</a>	Project T21 Drug Science			
Ave. Flower prescriptions per Patient (Per Annum)	12		Internal estimations based on industry experience			
Ave. Grams per Prescriptions (g)	30		Internal estimations based on industry experience			
<i>% Price Compression</i>	0.8%		Internal estimations based on industry experience			
Ave £ per Gram	8.50	<a href="#">Link</a>	MedBud - Navigating Medical Cannabis			
Excise Tax (%)	2.9%	<a href="#">Link</a>	Colorado Department of Revenue			
Sales Tax (%)	20.0%	<a href="#">Link</a>	Based on UK VAT Rate			

Research & Development	5,000	Internal estimations based on industry experience
Cultivation	10,000	
Processing & Manufacturing	17,850	
Laboratories / Quality Analysis	7,020	
Distribution / Logistics	10,000	
Retail & Pharmacy	15,000	
In-Direct Roles	<u>16,700</u>	
<b>Total</b>	<b>81,570</b>	

**Notes**

Colorado is one of the longest standing regulated Medical Cannabis markets and readily published data for the number of medical patients allows for extrapolation across the UK population. With industry consultations and other market data a forecast of medical oil and flower sales can be produced.

A3 - Topicals (£)	2022E	2023E	2024E	2025E	2026E	2027E
<b>Colorado</b>						
Colorado Total Topicals (\$000s)	\$2,322	\$2,362	\$2,403	\$2,445	\$2,488	\$2,531
Colorado Population ('000s)	5,773,000	5,773,000	5,773,000	5,773,000	5,773,000	5,773,000
<b>UK</b>						
UK Population ('000s)	67,220,000	67,220,000	67,220,000	67,220,000	67,220,000	67,220,000
Creams	£12,080	£12,290	£12,510	£12,720	£12,950	£13,170
Balms	£5,490	£5,590	£5,690	£5,780	£5,890	£5,990
Lotions	£3,290	£3,350	£3,410	£3,470	£3,530	£3,590
Pet lotions	£1,100	£1,120	£1,140	£1,160	£1,180	£1,200
<b>UK Total Topicals Gross Sales (£000s)</b>	<b>£21,960</b>	<b>£22,350</b>	<b>£22,740</b>	<b>£23,130</b>	<b>£23,540</b>	<b>£23,950</b>
Creams sales tax (£000)	£2,420	£2,460	£2,500	£2,540	£2,590	£2,630
Balms sales tax (£000)	£1,100	£1,120	£1,140	£1,160	£1,180	£1,200
Lotions sales tax (£000)	£660	£670	£680	£690	£710	£720
Pet Lotions sales tax (£000)	£220	£220	£230	£230	£240	£240
<b>UK Total Tax (£000)</b>	<b>£4,400</b>	<b>£4,470</b>	<b>£4,550</b>	<b>£4,620</b>	<b>£4,720</b>	<b>£4,790</b>
<b>Assumptions</b>						
	<b>No. / Pct.</b>	<b>Link</b>	<b>Source</b>			
UK Population ('000s)	67,220,000	<a href="#">Link</a>	The World Bank			
COL Population ('000s)	5,773,000	<a href="#">Link</a>	United States Census Bureau			
Colorado Total CBD Sales 2021 (\$000s)	\$192,551	<a href="#">Link</a>	Statista (Including market extrapolation)			
Colorado Topicals Market Share 2021 (%)	1.19%	<a href="#">Link</a>	Headset			
Colorado Topicals CAGR %	1.7%	<a href="#">Link</a>	Internal extrapolation			
Creams market share %	55.0%		Internal estimates			
Lotions market share %	25.0%		Internal estimates			
Balms market share %	15.0%		Internal estimates			
Pet lotions market share %	5.0%	<a href="#">Link</a>	Nielsen IQ			
Sales Tax (%)	20.0%	<a href="#">Link</a>	Based on UK VAT Rate			
June Monthly Exchange Rates - GBP:USD	1.2309	<a href="#">Link</a>	HMRC			
<b>Jobs</b>						
	<b>No.</b>	<b>Source</b>				
Processing & Manufacturing	2,225	Internal estimations based on industry experience				
Laboratories / Quality analytics	1,250					
Distribution / Logistics	1,250					
Retail	2,500					
Administrative	2,500					
<b>Total</b>	<b>9,725</b>					

#### Notes

Topical sales have been forecast on the extrapolation of the Colorado market and the current product sales mix for CBD products.

A4 – Ingestibles (£)	2022E	2023E	2024E	2025E	2026E	2027E
<b>Colorado Total Ingestibles (\$000s)</b>	<b>\$193,587</b>	<b>\$196,963</b>	<b>\$200,397</b>	<b>\$203,891</b>	<b>\$207,446</b>	<b>\$211,063</b>
Colorado Population ('000s)	5,773,000	5,773,000	5,773,000	5,773,000	5,773,000	5,773,000
<b>UK</b>						
UK Population ('000s)	67,220,000	67,220,000	67,220,000	67,220,000	67,220,000	67,220,000
Vapes	£1,065,740	£1,084,330	£1,103,230	£1,122,470	£1,142,050	£1,161,960
Beverages	£642,680	£653,880	£665,290	£676,890	£688,690	£700,700
Capsules	£55,030	£55,990	£56,970	£57,960	£58,970	£60,000
Tinctures & Oils	£45,640	£46,430	£47,240	£48,070	£48,900	£49,760
Gummies	£22,170	£22,560	£22,950	£23,350	£23,760	£24,170
<b>UK Total Ingestibles (£000s)</b>	<b>£1,831,260</b>	<b>£1,863,190</b>	<b>£1,895,680</b>	<b>£1,928,730</b>	<b>£1,962,370</b>	<b>£1,996,580</b>
Vapes sales tax (£000)	£213,150	£216,870	£220,650	£224,490	£228,410	£232,390
Beverages sales tax (£000)	£128,540	£130,780	£133,060	£135,380	£137,740	£140,140
Capsules sales tax (£000)	£11,010	£11,200	£11,390	£11,590	£11,790	£12,000
Tinctures & Oils sales tax (£000)	£9,130	£9,290	£9,450	£9,610	£9,780	£9,950
Gummies sales tax (£000)	£4,430	£4,510	£4,590	£4,670	£4,750	£4,830
<b>UK Total Tax (£000)</b>	<b>£366,260</b>	<b>£372,650</b>	<b>£379,140</b>	<b>£385,740</b>	<b>£392,470</b>	<b>£399,310</b>
UK Population ('000s)	67,220,000	<a href="#">Link</a>	The World Bank			
COL Population ('000s)	5,773,000	<a href="#">Link</a>	United States Census Bureau			
Colorado Total CBD Sales 2021 (\$000s)	\$192,551	<a href="#">Link</a>	Statista (Including market extrapolation)			
Colorado Ingestibles Market Share 2021 (%)	98.81%	<a href="#">Link</a>	Headset			
Colorado Ingestibles CAGR %	1.7%	<a href="#">Link</a>	Internal extrapolation			
Vapes market share %	58.2%		Based on Colorado market share			
Beverages market share %	35.1%		Based on Colorado market share			
Capsules market share %	3.0%		Based on Colorado market share			
Tinctures & Oils market share %	2.5%		Based on Colorado market share			
Gummies market share %	1.2%		Based on Colorado market share			
Sales Tax (%)	20.0%	<a href="#">Link</a>	Based on UK VAT Rate			
June Monthly Exchange Rates - GBP:USD	1.2309	<a href="#">Link</a>	HMRC			
July Monthly Exchange Rates - GBP:EUR	1.1616	<a href="#">Link</a>	HMRC			
Processing & Manufacturing	6,675		Internal estimations based on industry experience			
Laboratories / Quality analytics	3,750					
Distribution / Logistics	3,750					
Retail	7,500					
Administrative	<u>7,500</u>					

#### Notes

Ingestible sales have been forecast on the extrapolation of the Colorado market and the current product sales mix for CBD products.

<b>A5 - Agricultural</b>	<b>2022E</b>	<b>2023E</b>	<b>2024E</b>	<b>2025E</b>	<b>2026E</b>	<b>2027E</b>
No. of Hemp Licenses (Cumulative)	92	170	314	458	674	890
Area of Hemp per License (Ha)	76	112	148	184	220	256
<b>Total Hemp Area (Ha)</b>	<b>6,992</b>	<b>19,040</b>	<b>46,472</b>	<b>84,272</b>	<b>148,280</b>	<b>227,840</b>
<i>% Total UK Cereal Crops</i>	<i>0.2%</i>	<i>0.6%</i>	<i>1.4%</i>	<i>2.5%</i>	<i>4.4%</i>	<i>6.8%</i>
Seed Propagation Area Required	1,032	2,791	5,626	8,901	13,717	18,227
<b>Hemp Area Harvested Excl. Seed Prop (Ha)</b>	<b>5,960</b>	<b>16,249</b>	<b>40,846</b>	<b>75,371</b>	<b>134,563</b>	<b>209,613</b>
<b>Average Biomass Yield (Tns per Ha)</b>	<b>35,758</b>	<b>97,496</b>	<b>265,500</b>	<b>527,596</b>	<b>1,009,223</b>	<b>1,676,902</b>
Flower (Tns)	3,576	9,750	26,550	52,760	100,922	167,690
Fibre (Tns)	8,046	21,937	59,738	118,709	227,075	377,303
Shives (Tns)	16,091	43,873	119,475	237,418	454,150	754,606
Dust (Tns)	8,046	21,937	59,738	118,709	227,075	377,303
<b>Seed Yield (Tns)</b>	<b>3,576</b>	<b>9,750</b>	<b>28,592</b>	<b>60,297</b>	<b>121,107</b>	<b>209,613</b>
Seed Oil (Tns)	1,073	2,925	8,578	18,089	36,332	62,884
Seed Protein (Tns)	1,073	2,925	8,578	18,089	36,332	62,884
Seed Hulled (Tns)	1,073	2,925	8,578	18,089	36,332	62,884
Seed Fibre (Tns)	358	975	2,859	6,030	12,111	20,961
<b>Hemp Flower Wholesale</b>						
Hemp Flower (£/%CBD/kg)	1.41	1.15	0.94	0.77	0.63	0.51
<b>Hemp Flower Value (£000s)</b>	<b>15,097</b>	<b>33,643</b>	<b>74,884</b>	<b>121,628</b>	<b>190,164</b>	<b>258,260</b>
<b>Hemp Fibre Wholesale</b>						
Hemp Fibre (£/kg)	0.53	0.51	0.48	0.46	0.44	0.41
<b>Hemp Fibre Value (£000s)</b>	<b>4,282</b>	<b>11,105</b>	<b>28,762</b>	<b>54,363</b>	<b>98,907</b>	<b>156,310</b>
<b>Hemp Shives Wholesale</b>						
Hemp Shives (£/kg)	0.41	0.39	0.37	0.35	0.34	0.32
<b>Hemp Shives Value (£000s)</b>	<b>6,588</b>	<b>17,084</b>	<b>44,250</b>	<b>83,635</b>	<b>152,164</b>	<b>240,477</b>
<b>Hemp Oil Wholesale</b>						
Hemp Oil (£/kg)	9	8	8	7	6	6
<b>Hemp Oil Value (£000s)</b>	<b>10,023</b>	<b>24,718</b>	<b>65,563</b>	<b>125,053</b>	<b>227,173</b>	<b>355,627</b>
<b>Hemp Protein Powder Metrics Wholesale</b>						
Hemp Protein Powder (£/kg)	3	3	3	2	2	2
<b>Hemp Protein Powder Value (£000s)</b>	<b>4,312</b>	<b>10,904</b>	<b>29,660</b>	<b>58,015</b>	<b>108,079</b>	<b>173,506</b>
<b>Hemp Dehulled Seed Wholesale</b>						
Hemp Dehulled Seed (£/kg)	6	6	5	5	5	4
<b>Hemp Dehulled Seed Value (£000s)</b>	<b>6,853</b>	<b>17,330</b>	<b>47,139</b>	<b>92,204</b>	<b>171,772</b>	<b>275,757</b>
<b>Total Agricultural (£000s)</b>	<b>47,154</b>	<b>114,784</b>	<b>290,258</b>	<b>534,897</b>	<b>948,258</b>	<b>1,459,938</b>
<i>Hemp Flower Tax (£000s)</i>	<i>3,020</i>	<i>6,730</i>	<i>14,980</i>	<i>24,330</i>	<i>38,030</i>	<i>51,650</i>
<i>Hemp Fibre Tax (£000s)</i>	<i>860</i>	<i>2,220</i>	<i>5,750</i>	<i>10,870</i>	<i>19,780</i>	<i>31,260</i>
<i>Hemp Shives Tax (£000s)</i>	<i>1,320</i>	<i>3,420</i>	<i>8,850</i>	<i>16,730</i>	<i>30,430</i>	<i>48,100</i>
<i>Hemp Oil Tax (£000s)</i>	<i>2,000</i>	<i>4,940</i>	<i>13,110</i>	<i>25,010</i>	<i>45,430</i>	<i>71,130</i>
<i>Hemp Protein Powder Tax (£000s)</i>	<i>860</i>	<i>2,180</i>	<i>5,930</i>	<i>11,600</i>	<i>21,620</i>	<i>34,700</i>
<i>Hemp Dehulled Seed Tax (£000s)</i>	<i>1,370</i>	<i>3,470</i>	<i>9,430</i>	<i>18,440</i>	<i>34,350</i>	<i>55,160</i>
<b>Total Agricultural Tax</b>	<b>9,430</b>	<b>22,960</b>	<b>58,050</b>	<b>106,980</b>	<b>189,650</b>	<b>292,000</b>
<b>Assumptions</b>	<b>No. / Pct.</b>	<b>Link</b>	<b>Source</b>			
Licenses Increase (Monthly)	6		Industry Consultations (Jamie Bartley of Unyte Hemp)			
Hectares Increase (Monthly)	3		"			
Licenses (Cumulative)	20		"			
Area Drilled / Licenses (Ha)	40		"			
<i>% Total Cereal Crop</i>	<i>3,347,000</i>	<a href="#">Link</a>	Defra Statistics: Agricultural Facts Page 7			
Seed Propagation Area Required	80		Industry Consultations (Jamie Bartley of Unyte Hemp)			
Yield Growth (Tns per Ha)	0.5		Industry Consultations (Jamie Bartley of Unyte Hemp)			
Average Biomass Yield (Tns per Ha)	6.0		"			
Flower (Tns)	10%		"			
Fibre (Tns)	23%		"			
Shives (Tns)	45%		"			

Dust (Tns)	23%	"
Yield Growth (Tns per Ha)	0.1	Industry Consultations (Jamie Bartley of Unyte Hemp)
Seed Yield (Tns)	0.6	"
Seed Oil (Tns)	30%	"
Seed Protein (Tns)	30%	"
Seed Hulled (Tns)	30%	"
Seed Fibre (Tns)	10%	"
Ave. % CBD Potency	3%	Internal estimations based on industry experience
Hemp Flower % Price Compression	-20%	Internal estimations based on industry experience
Hemp Flower (£/kg) Wholesale	£1.72	<a href="#">Link</a> CanXChange June 2022 Benchmark Report Page 20
Hemp Fibre % Price Compression	-5.0%	Internal estimations based on industry experience
Hemp Fibre (£/kg) Wholesale	£0.56	<a href="#">Link</a> CanXChange June 2022 Benchmark Report Page 23
Hemp Shives % Price Compression	-5.0%	Internal estimations based on industry experience
Hemp Shives (£/kg) Wholesale	£0.43	<a href="#">Link</a> CanXChange June 2022 Benchmark Report Page 22
Hemp Oil % Price Growth	-10.0%	Internal estimations based on industry experience
Hemp Oil (£/kg) Wholesale	10.33	<a href="#">Link</a> CanXChange June 2022 Benchmark Report Page 40
Hemp Protein Powder % Price Growth	-7.5%	Internal estimations based on industry experience
Hemp Protein Powder (£/kg) Wholesale	3.25	Industry Consultations (Jamie Bartley of Unyte Hemp)
Hemp Dehulled Seed % Price Growth	-7.5%	Internal estimations based on industry experience
Hemp Dehulled Seed (£/kg) Wholesale	6.89	<a href="#">Link</a> CanXChange June 2022 Benchmark Report Page 39
Tax (%)	20.0%	<a href="#">Link</a> Based on UK VAT Rate
<b>Jobs</b>	<b>No.</b>	<b>Source</b>
Cultivation	12,000	Based on industry consultations
Manufacturing	7,500	
Processing	10,000	
Administrative	13,430	
<b>Total jobs</b>	<b>42,930</b>	
<b>Assumptions</b>		
July Monthly Exchange Rates - GBP:USD	1.2309	<a href="#">Link</a>
July Monthly Exchange Rates - GBP:EUR	1.1616	<a href="#">Link</a>

## Notes

Building Material and other textiles forecasts have been built using a bottom approach coupled with industry consultations similar to the Carbon Credit calculation on A8.

Applying industry biomass yields to the Hemp hectareage drilled the total dry weight of Hemp Flower, Shiv, Fibre and Plant waste is calculated. The following five year value can be calculated based on current wholesale prices from industry reports and estimated future price compression.

<b>A6 - Industrial Manufacturing</b>	<b>2022E</b>	<b>2023E</b>	<b>2024E</b>	<b>2025E</b>	<b>2026E</b>	<b>2027E</b>
No. of Hemp Licenses (Cumulative)	92	170	314	458	674	890
Area of Hemp per License (Ha)	76	112	148	184	220	256
<b>Total Hemp Area (Ha)</b>	<b>6,992</b>	<b>19,040</b>	<b>46,472</b>	<b>84,272</b>	<b>148,280</b>	<b>227,840</b>
<i>% Total UK Cereal Crops</i>	<i>0.2%</i>	<i>0.6%</i>	<i>1.4%</i>	<i>2.5%</i>	<i>4.4%</i>	<i>6.8%</i>
Seed Propagation Area Required	1,032	2,791	5,626	8,901	13,717	18,227
<b>Hemp Area Harvested Excl. Seed Prop (Ha)</b>	<b>5,960</b>	<b>16,249</b>	<b>40,846</b>	<b>75,371</b>	<b>134,563</b>	<b>209,613</b>
<b>Average Biomass Yield (Tns per Ha)</b>	<b>35,758</b>	<b>97,496</b>	<b>265,500</b>	<b>527,596</b>	<b>1,009,223</b>	<b>1,676,902</b>
Flower (Tns)	3,576	9,750	26,550	52,760	100,922	167,690
Fibre (Tns)	8,046	21,937	59,738	118,709	227,075	377,303
Shives (Tns)	16,091	43,873	119,475	237,418	454,150	754,606
Dust (Tns)	8,046	21,937	59,738	118,709	227,075	377,303
<b>Dust metrics - Biochar</b>						
Pyrolysis Yield (Est. 20% Yield)	2,005	5,466	14,884	29,577	56,577	94,007
<b>Biochar Value (£000s)</b>	<b>1,002</b>	<b>2,733</b>	<b>7,442</b>	<b>14,788</b>	<b>28,288</b>	<b>47,003</b>
<b>Hempcrete</b>						
Hempcrete (Tns)	36,162	98,595	268,493	533,543	1,020,600	1,695,807
Hempcrete (£/Tn) Wholesale	1,001	903	816	736	665	600
<b>Hempcrete Value (£000s)</b>	<b>36,189</b>	<b>89,073</b>	<b>218,972</b>	<b>392,817</b>	<b>678,330</b>	<b>1,017,483</b>
<b>UK Thermal Insulation Market</b>	<b>2022E</b>	<b>2023E</b>	<b>2024E</b>	<b>2025E</b>	<b>2026E</b>	<b>2027E</b>
UK Thermal Insulation Market (£000s)	962,407	986,397	1,010,986	1,036,187	1,062,017	1,088,491
<i>% Hemp Feed Market Share Cumulative</i>	<i>8.3%</i>	<i>16.7%</i>	<i>25.0%</i>	<i>33.3%</i>	<i>41.7%</i>	<i>50.0%</i>
<b>Hemp Insulation Share</b>	<b>80,201</b>	<b>164,400</b>	<b>252,746</b>	<b>345,396</b>	<b>442,507</b>	<b>544,245</b>
Biochar Tax	200	550	1,490	2,960	5,660	9,400
Hempcrete Tax	7,240	17,810	43,790	78,560	135,670	203,500
Hemp Thermal Insulation Tax	16,040	32,880	50,550	69,080	88,500	108,850
<b>Total Industrial Manufacturing Tax</b>	<b>23,480</b>	<b>51,240</b>	<b>95,830</b>	<b>150,600</b>	<b>229,830</b>	<b>321,750</b>
<b>Processing Facility Metrics</b>						
<b>Processing Facility</b>	<b>3</b>	<b>4</b>	<b>10</b>	<b>19</b>	<b>33</b>	<b>53</b>
# of Large 1ry Processing Facility	1	1	3	6	10	16
# of Large 2ry Processing Facility	1	1	3	6	10	16
# of Small Biochar Facilities (Tns/Hr)	1	2	4	7	13	21
<b>Total Direct Manufacturing Jobs</b>	<b>94</b>	<b>104</b>	<b>292</b>	<b>574</b>	<b>970</b>	<b>1,554</b>
Large 1ry Processing Facility	54	54	162	324	540	864
Large 2ry Processing Facility	30	30	90	180	300	480
Total Direct & In-Direct Biochar Jobs (Each)	10	20	40	70	130	210
<b>Total In-Direct Jobs</b>	<b>40</b>	<b>40</b>	<b>120</b>	<b>240</b>	<b>400</b>	<b>640</b>
1ry Facility Sales & Admin	25	25	75	150	250	400
2ry Facility Sales & Admin	15	15	45	90	150	240
<b>Total Jobs</b>	<b>134</b>	<b>144</b>	<b>412</b>	<b>814</b>	<b>1,370</b>	<b>2,194</b>
<b>CAPEX Annual Investment (£000s)</b>	<b>2,000</b>	<b>4,000</b>	<b>4,000</b>	<b>78,000</b>	<b>160,000</b>	<b>242,000</b>
<b>UK Building Completions</b>						
Equivalent 1,500ft <sup>2</sup> house (kg)	2,542	6,932	18,877	37,513	71,757	119,230
No. of UK Building Completions	177,347	180,759	184,236	187,780	191,393	195,075
<i>% of UK Building Completions</i>	<i>1.4%</i>	<i>3.8%</i>	<i>10.2%</i>	<i>20.0%</i>	<i>37.5%</i>	<i>61.1%</i>
<b>Assumptions</b>	<b>No. / Pct.</b>	<b>Link</b>	<b>Source</b>			
Licenses Increase (Monthly)	6		Industry Consultations (Jamie Bartley of Unyte Hemp)			
Hectares Increase (Monthly)	3		"			
Licenses (Cumulative)	20		"			
Area Drilled / Licenses (Ha)	40		"			
<i>% Total Cereal Crop</i>	<i>3,347,000</i>	<a href="#">Link</a>	Defra Statistics: Agricultural Facts England Page 7			
Seed Propagation Area Required	80		Industry Consultations (Jamie Bartley of Unyte Hemp)			
Yield Growth (Tns per Ha)	0.5		Industry Consultations (Jamie Bartley of Unyte Hemp)			
Average Biomass Yield (Tns per Ha)	6.0		"			
Flower (Tns)	10%		"			
Fibre (Tns)	23%		"			
Shives (Tns)	45%		"			

Dust (Tns)	23%		"
Pyrolysis Yield (Est. 20% Yield)	24.9%		Industry Consultations (Jamie Bartley of Unyte Hemp)
Biochar Value per Ton	£500		Industry Consultations (Jamie Bartley of Unyte Hemp)
Hemp Shiv : Binder	2.2	<a href="#">Link</a>	Hempire Calculator
Hemp Crete per Ton (£)	1,109	<a href="#">Link</a>	Hempire Calculator
HempCrete % Price Compression	-10.2%		Internal estimations
Hemp Market Share 2021	0.0%		Internal estimations
Hemp Market Share Growth	0.7%		Reaches 50% Market Share in 2027
Sales Tax (£000)	20.0%	<a href="#">Link</a>	Based on UK VAT Rate
<b>Processing Facility Metrics</b>			
# of Large 1ry Processing Facility (Tns/Hr)	12		Industry Consultations (Jamie Bartley of Unyte Hemp)
# of Small Biochar Facilities (Tns/Hr)	2		"
Large 1ry Processing Facility Direct Jobs	54		"
Large 2ry Processing Facility Direct Jobs	30		"
Total Direct & In-Direct Biochar Jobs (Each)	10		"
1ry Facility In-direct Jobs	25		"
2ry Facility In-direct Jobs	15		"
<b>CAPEX Investment (£000s)</b>			
	<b>£</b>		
Large 1ry Processing Facility CAPEX (£000s)	17,000		Industry Consultations (Jamie Bartley of Unyte Hemp)
Large 2ry Processing Facility CAPEX (£000s)	20,000		"
Small 1ry Processing Facility CAPEX (£000s)	2,000		"
UK Thermal Insulation Market CAGR %	2.5%	<a href="#">Link</a>	AMA - Building Insulation Market Report Page 25
UK Thermal Insulation Market (£000s)	939,000	<a href="#">Link</a>	AMA - Building Insulation Market Report Page 25
Hemp Market Share	100.0%		Industry Target
Equivalent 1,500ft <sup>2</sup> house (kg)	6,329	<a href="#">Link</a>	Review of Hempcrete as a Sustainable Building Material Page 6
No. of UK Building Completions	174,000	<a href="#">Link</a>	AMA - Building Insulation Market Report Page 25
<b>Jobs</b>		<b>No.</b>	<b>Source</b>
Processing	2,190		Based on industry consultations
Construction	10,000		
Retro-fitting	5,000		
Administrative	4,430		
<b>Total</b>	<b>21,620</b>		
<b>Assumptions</b>			
July Monthly Exchange Rates - GBP:USD	1.2309	<a href="#">Link</a>	
July Monthly Exchange Rates - GBP:EUR	1.1616	<a href="#">Link</a>	

#### Notes

Construction and other textiles forecasts have been built using a bottom approach coupled with industry consultations similar to the Carbon Credit calculation on A8.

Thermal Insulation market share has been calculated using a top down approach.

<b>A7 - Animal Feed</b>	<b>2022E</b>	<b>2023E</b>	<b>2024E</b>	<b>2025E</b>	<b>2026E</b>	<b>2027E</b>
UK Animal Fodder Production (£000s)	6,335,880	6,580,881	6,835,357	7,099,672	7,374,208	7,659,361
<b>Feed Production Tonnes (000s)</b>						
Cattle	5,439	5,478	5,517	5,557	5,597	5,637
Pigs	2,371	2,401	2,432	2,462	2,494	2,526
Poultry	7,179	7,391	7,609	7,833	8,065	8,303
Others	1,489	1,489	1,488	1,487	1,486	1,486
<b>Total</b>	<b>16,478</b>	<b>16,758</b>	<b>17,046</b>	<b>17,340</b>	<b>17,642</b>	<b>17,951</b>
<b>UK Hemp Feed Market Value (£000s)</b>	0.00	0.00	0.01	0.01	0.02	0.04
<i>% Hemp Feed Market Share Cumulative</i>	<i>2.5%</i>	<i>4.0%</i>	<i>5.5%</i>	<i>7.0%</i>	<i>8.5%</i>	<i>10.0%</i>
UK Cattle Feed Market Hemp Share	52,283	86,048	121,689	159,272	198,865	240,538
UK Pigs Feed Market Hemp Share	22,790	37,714	53,628	70,575	88,603	107,758
UK Poultry Feed Market Hemp Share	69,008	116,091	167,814	224,509	286,529	354,251
UK Others Feed Market Hemp Share	14,316	23,382	32,814	42,621	52,810	63,389
<b>Total UK Hemp Feed Market (£000s)</b>	<b>158,397</b>	<b>263,235</b>	<b>375,945</b>	<b>496,977</b>	<b>626,808</b>	<b>765,936</b>
Cattle	10,460	17,210	24,340	31,850	39,770	48,110
Pigs	4,560	7,540	10,730	14,120	17,720	21,550
Poultry	13,800	23,220	33,560	44,900	57,310	70,850
Others	2,860	4,680	6,560	8,520	10,560	12,680
<b>Total Tax (£000)</b>	<b>31,680</b>	<b>52,650</b>	<b>75,190</b>	<b>99,390</b>	<b>125,360</b>	<b>153,190</b>
<b>Carbon Credit Value per category</b>	<i>£000s</i>					
<i>Dairy</i>	<i>4,812</i>					
<i>Pigs</i>	<i>217</i>					
<i>Poultry</i>	<i>347</i>					
<b>Assumptions</b>	<b>2021</b>	<b>Link</b>	<b>Source</b>			
CAGR	3.8%	<a href="#">Link</a>	IBIS World			
UK Animal Fodder Production (£000s)	6,100	<a href="#">Link</a>	IBIS World			
<b>Feed Production Tons (000s)</b>						
Cattle	5,400	<a href="#">Link</a>	FEFAC Statistics			
Pigs	2,341	<a href="#">Link</a>	FEFAC Statistics			
Poultry	6,973	<a href="#">Link</a>	FEFAC Statistics			
Others	1,490	<a href="#">Link</a>	FEFAC Statistics			
<b>UK Hemp Feed Market Share</b>	<b>%</b>					
Hemp Market Share 2021	1.0%		Internal estimations			
Hemp Market Share Growth	0.1%		Reaches 10% Market Share in 2027			
<b>Potential GHG Reduction</b>						
Reduce dietary N and P - Dairy Tns CO <sub>2</sub> e	111,000	<a href="#">Link</a>	DEFRA - Agri Climate Report 2021			
Reduce dietary N and P - Pigs Tns CO <sub>2</sub> e	5,000	<a href="#">Link</a>	DEFRA - Agri Climate Report 2021			
Reduce dietary N and P - Poultry Tns CO <sub>2</sub> e	8,000	<a href="#">Link</a>	DEFRA - Agri Climate Report 2021			
Sales Tax (£000)	20.0%	<a href="#">Link</a>	Based on UK VAT Rate			
<b>Jobs</b>	<b>No.</b>		<b>Source</b>			
Manufacturing	4,000	<a href="#">Link</a>	IBIS World			
Administrative	5,505					

## Notes

Animal feed market share has been calculated using a top down approach.

<b>A8 - Carbon Credits</b>	<b>2022E</b>	<b>2023E</b>	<b>2024E</b>	<b>2025E</b>	<b>2026E</b>	<b>2027E</b>
No. of Hemp Licenses (Cumulative)	92	170	314	458	674	890
Area of Hemp per License (Ha)	76	112	148	184	220	256
<b>Total Hemp Area (Ha)</b>	<b>6,992</b>	<b>19,040</b>	<b>46,472</b>	<b>84,272</b>	<b>148,280</b>	<b>227,840</b>
<i>% Total UK Cereal Crops</i>	<i>0.2%</i>	<i>0.6%</i>	<i>1.4%</i>	<i>2.5%</i>	<i>4.4%</i>	<i>6.8%</i>
Seed Propagation Area Required	1,032	2,791	5,626	8,901	13,717	-
<b>Hemp Area Harvested Excl. Seed Prop (Ha)</b>	<b>5,960</b>	<b>16,249</b>	<b>40,846</b>	<b>75,371</b>	<b>134,563</b>	<b>227,840</b>
<b>CO<sub>2</sub> Sequestered Harvested (Above Ground)</b>						
Total CO <sub>2</sub> Sequestered Harvested (Tns)	87,490	238,540	599,620	1,106,440	1,975,390	3,344,690
CO <sub>2</sub> Credit £ per Ton	53	66	81	99	122	150
<b>Carbon Credit Value - Harvested (£000s)</b>	<b>4,664</b>	<b>15,641</b>	<b>48,352</b>	<b>109,729</b>	<b>240,933</b>	<b>501,707</b>
<b>Total CO<sub>2</sub> Sequestered In-Situ (Below Ground)</b>						
Total CO <sub>2</sub> Sequestered In-Situ (Tns)	131,230	357,810	899,430	1,659,670	2,963,080	5,017,040
CO <sub>2</sub> Credit £ per Ton	53	66	81	99	122	150
<b>Carbon Credit Value - CO<sub>2</sub> In-Situ (£000s)</b>	<b>6,996</b>	<b>23,461</b>	<b>72,529</b>	<b>164,594</b>	<b>361,399</b>	<b>752,561</b>
Total CO <sub>2</sub> Sequestered during cultivation (Tns)	218,720	596,350	1,499,050	2,766,110	4,938,470	8,361,730
CO <sub>2</sub> Credit per Ton	53	66	81	99	122	150
<b>Total Carbon Credit Value - CO<sub>2</sub> (£000s)</b>	<b>11,661</b>	<b>39,101</b>	<b>120,881</b>	<b>274,323</b>	<b>602,331</b>	<b>1,254,267</b>
CO <sub>2</sub> sequestered during construction (Tns)	33,182	90,470	246,368	489,577	936,497	1,556,064
<b>Total Carbon Credit Value - CO<sub>2</sub> (£000s)</b>	<b>433</b>	<b>1,181</b>	<b>3,215</b>	<b>6,389</b>	<b>12,222</b>	<b>20,308</b>
CO <sub>2</sub> sequestered during cultivation tax	£2,330	£7,820	£24,180	£54,860	£120,470	£250,850
CO <sub>2</sub> sequestered during construction tax	£90	£240	£640	£1,280	£2,440	£4,060
<b>Total Tax (£000)</b>	<b>£2,420</b>	<b>£8,060</b>	<b>£24,820</b>	<b>£56,140</b>	<b>£122,910</b>	<b>£254,920</b>
<b>Assumptions</b>						
Licenses Increase (Monthly)	No. / Pct.	6	Link	Source	Industry Consultations (Jamie Bartley of Unyte Hemp)	
Hectares Increase (Monthly)	3				Industry Consultations (Jamie Bartley of Unyte Hemp)	
Licenses (Cumulative)	20				Industry Consultations (Jamie Bartley of Unyte Hemp)	
Area Drilled / Licenses (Ha)	40				Industry Consultations (Jamie Bartley of Unyte Hemp)	
<i>% Total Cereal Crop</i>	3,347,000	Link			Defra Statistics: Agricultural Facts England Page 7	
Seed Propagation Area Required	80.00				Industry Consultations (Jamie Bartley of Unyte Hemp)	
CO <sub>2</sub> Sequestered Harvested	40%				Industry Consultations (Jamie Bartley of Unyte Hemp)	
Total CO <sub>2</sub> Sequestered In-Situ (Tns)	60%				Industry Consultations (Jamie Bartley of Unyte Hemp)	
Total CO <sub>2</sub> Sequestered (Tns per HA)	36.70				Industry Consultations (GM)	
<i>% Price Growth</i>	21%				Internal estimations based on industry consultations	
CO <sub>2</sub> Credit per Ton	£43.35	Link			Unilever - Internal Carbon Pricing	
New Build Home CO <sub>2</sub> e captured (Tons per Home)	13.1	Link			Internal Calculations based on wall thickness of 300mm	
Biochar CO <sub>2</sub> e captured per 1Tn dry Hemp (Tons)	0.658				Industry Consultations (Jamie Bartley of Unyte Hemp)	
Sales Tax (%)	20.0%	Link			Based on UK VAT Rate	
<b>Jobs</b>						
Research & Development	No.	2,300			Based on industry consultations	
Laboratory / Quality analysis	10,000					
Agronomists	12,570					
Administrative	6,780					

**Notes**

*Carbon Credit forecasts have been built using a bottom approach using data obtained industry consultations. As the licencing regime open up increased adoption is seen across the UK resulting increased hectarage of hemp under cultivation.*

*Using industry Carbon metrics the Carbon sequestered above ('harvested') and below ('in-situ') the ground using regenerative techniques can be used to calculate the CO<sub>2</sub>e Carbon Credit based on Unilever's internal carbon pricing per ton.*

# Acknowledgements





The Secretariat Advisory Board (SAB) to the APPG on CBD Products is a collection of the UK's leading hemp and cannabis trade bodies and groups.

The board's role is to provide advice to the APPG Secretariat, Tenacious Labs, on latest industry views, innovation and research. The Secretariat works for the APPG at the direction of the offices of the Chairman, Crispin Blunt MP and Co-chair Baroness Manzoor CBE. It provides a singular voice for the industry, and delivers research, reports and advice on industry advances and funding for events.

SAB members include the Medical Cannabis Clinicians Society (MCCS), Cannabis Industry Council (CIC), Cannabis Trades Association (CTA), European Industrial Hemp Association (EIHA) and British Hemp Alliance (BHA).



**Nicholas Morland**

CEO, Tenacious Labs  
Co-Chair, Secretariat SAB

Nicholas is the co-founder and CEO of Tenacious Labs (TL), an international consumer products group developing a new wave of health and wellness brands, and a founding partner of Delarki Investments. He currently heads the Secretariat Advisory Board to the APPG on CBD Products and serves as Chairman of the CSAB, the Jersey Cannabis industry body advising the Jersey government.

TL serves as the Secretariat to the All-Party Parliamentary Group for CBD Products.



The European Industrial Hemp Association (EIHA) represents the common interests of hemp farmers, producers and traders working with hemp fibres, shivs, seeds, leaves and cannabinoids. Our main task is to serve, protect and represent the hemp sector in the EU and international policymaking. EIHA covers different areas for the application of hemp, namely its use for construction materials, textiles, cosmetics, feed, food and supplements.



**Lorenza Romanese**

Managing Director, EIHA

Based in EIHA's Brussels office, Lorenza Romanese is an experienced policy advisor and communication manager at the European level. She has led EIHA's efforts in Brussels since February 2019, having worked with a number of MEPs to propose reforms affecting hemp in the EU's Common Agriculture Policy. Lorenza previously advised interests in the oil and gas sector and led the European Association of independent Winegrowers.



**Tony Reeves**

Board Member, EIHA

Tony Reeves is a board member of the EIHA, a consultant to several major North American and UK organisations including THG. He is a member of the UKAS-led CBD Food Product Approval Expert Group, the Food & Drink Federation's (FDF) CBD Working Group and holds an MBA from Warwick Business School



**Jade Proudman**

UK Representative, EIHA  
Founder, Savage Cabbage

Jade Proudman is a global advocate for hemp and cannabis and the legitimisation of the industry in the UK. She holds a master's degree in education and is passionate about promoting the social, environmental, economic and wellness benefits that the hemp industry can provide. As an especially well-known voice within the UK industry, she is regularly asked to comment in the published and broadcast media. Jade is the UK country representative for EIHA.



The Cannabis Industry Council (CIC) acts as a collective voice for the medical cannabis and hemp sector, bringing together organisations, businesses, and advocacy groups to promote the cause for medicinal cannabis and hemp. Agreed on by a members' vote, the CIC's objectives are to challenge current guidelines on cannabis and hemp, to increase patient access to medical cannabis, to commission and publish research around cannabis and hemp and its access, and finally to influence decision-makers to bring greater compliance and regulation in the cannabis and hemp market. The CIC supports all currently legal cannabis activities and is not currently lobbying for adult / recreational cannabis use. It has only made factual contributions to the information in this report.



**Jamie Bartley**

Executive Board Member, CIC  
CEO, Unyte Capital

Jamie Bartley is a serial entrepreneur, working across multiple industrial sectors, focused on the improvement of human and planetary health. Jamie is CEO of the Unyte Capital group, working across both the medical cannabis and industrial hemp sectors. He sits on the executive board of the CIC and chairs the industrial hemp subgroup.

Special thanks to Unyte and the CIC industrial hemp subgroup for the industry data this business plan uses in its modelling.



The Medical Cannabis Clinicians Society (MCCS) is a group which supports education in cannabis for all doctors and allied professionals. It supports all current legal activities in the sector but is not a lobby organisation and is not able to lobby for any currently illegal cannabis activities. It has factually contributed to the Medicinal Cannabis section of this report.



### **Professor Mike Barnes**

Chair, CIC & MCCA

Professor Mike Barnes is a neurologist and has been working in cannabis medicine for about 20 years. He was responsible for the first cannabis prescription in 2018 and, after the law change, set up the Medical Cannabis Clinicians Society and remains chair of that Society. He also now chairs the CIC and is a director of Maple Tree Medical Cannabis Consultancy and Chief Medical Officer of Drug Science / T21 project.



Established in 2016, the Cannabis Trades Association (CTA) formed to challenge and subsequently work with the MHRA in relation to CBD products. The CTA is a not-for-profit company whose key objective is to widen and open markets and ease trading restrictions for our members in the UK, Europe and the rest of the World. The CTA seeks to improve the business environment, increase product quality, uphold consumer safety, and create better environmental & production practises.



### **Marika Graham-Woods**

Executive Director, CTA

Marika Graham-Woods's background is in FMCG, heavy industry, paper making, government and as an internet entrepreneur and business angel. She has a Post-Grad DIP CIM & MA in International Marketing. Marika joined the CTA in 2020 and became the Executive Director in late 2021.



### **Sian Phillips**

Executive Director, CTA

Sian Phillips has been in the cannabis sector since 2015 and joined the CTA in 2017 as a member. With a background in communications, PR, media and events, she became a director at the end of 2018. As of June 2020, she was voted in to lead the CTA. Since late 2021, Sian has been working alongside Marika Graham-Woods as Executive Director.



British Hemp Alliance

The British Hemp Alliance (BHA) was set up in 2019 as a platform to lobby for political and industry change and to remove barriers standing in the way of growth for the UK hemp industry. It comprises businesses, farmers, NGO's, environmental organisations, and individual advocates that support progressive changes in hemp legislation, stating that an unrestricted and thriving hemp industry would deliver a range of environmentally friendly and carbon negative products that would actively contribute to mitigating climate change, and kickstart a new green industrial revolution that would boost the post-Brexit economy.



### **Rebekah Shaman**

Managing Director, BHA

Rebekah Shaman is Managing Director of the BHA, working as a changemaker and advocate for hemp to support mental and environmental wellbeing. Rebekah educates on the importance of hemp to reach net zero by 2050. Her work supports the movement to reignite a plant-based economy, using hemp as a carbon offset tool, and manufacturing it into biodegradable and sustainable products, such as biochar and biofuels, to create jobs and help ignite the circular and bio economy.



**Mark Tucker**

CEO, TTS Pharma

Mark Tucker's extensive pharmaceutical experience includes licensing the first nicotine patch technology to Novartis in 1989. He worked with pre-eminent leaders of cannabinoid R&D that published the 2004 pharmaceutical research *Transdermal Delivery of the Synthetic Cannabinoid*. He is CEO of TTS Pharma, which has 16 hemp-derived CBD novel food dossiers. TTS also co-sponsors clinical studies under Home Office licences and is working with Academia to generate the missing evidence needed to support this fast-evolving sector.



**Adrian Clarke**

Chief Commercial Officer, Tenacious Labs

Adrian Clarke is the co-founder of TL and founding partner of Delarki Investments. He is a serial entrepreneur and investor specialising in the F&B and broader discretionary spend sectors. Adrian has founded several companies including, Mustard Venture Studio and Axia, and holds directorships in a number of start-ups.



**Jessica Billingsley**

Chair, US Cannabis Council (USCC)  
CEO, Akerna Corp.

Jessica Billingsley is Chair of the US Cannabis Council (USCC) and CEO of cannabis tech business Akerna Corp. She is an accomplished innovator, executive, and board member in public and private international technology with more than 20 years of experience. At USCC, Jessica oversees the broadest and most diverse collection of organisations, businesses, and individuals ever to assemble to legalise cannabis in the United States.



**Shawn Hauser**

Partner, Vicente Sederberg LLP

Shawn Hauser is a partner at Vicente Sederberg LLP, a US law firm specialising in cannabis law and policy. Serving as the co-chair of the Hemp & Cannabinoids Department, Shawn advises businesses, state and federal government on cannabis and hemp legislation. She is widely recognised as one of the top cannabis and hemp lawyers in the United States.



**Dan Houseago**

Group Director, Economy, Department for the Economy, Government of Jersey

Dan Houseago is the Group Director for Economy in the Government of Jersey. He is the architect of the Economic Development Framework for cannabis Investment in Jersey, which established the Jersey Cannabis Agency and precipitated a targeted amendment to the Proceeds of Crime law, opening up Jersey to structuring and investment in legalised cannabis ahead of other jurisdictions in the world. Dan is the Chairman of the Jersey's cross-government Cannabis Coordination Group and provides support and advice to the industry-led Jersey Cannabis Advisory Group (CSAB) and the All-Party Parliamentary Group for CBD Products.



**Andrew Livingston**

Director of Economics & Research, Vicente Sederberg LLP

Andrew Livingston is based in Vicente Sederberg's Denver office, where he serves a unique role as an economist, business analyst, and general cannabis policy wonk. As the firm's director of economics and research, he assists clients with developing and expanding their enterprises across cannabis markets nationally and internationally.



**Andy Cutbill (co-author)**

Head of Communications, Tenacious Labs

Andy Cutbill is Communications Director at TL and is Secretariat coordinator for the Westminster All-Party Parliamentary Group for CBD Products and Secretariat Advisory Board. Previously Executive Creative Director at Mustard Venture Studio, Andy was a key part of the operations team originating the TL brand, and since then has focused on the legislative, regulatory and investment elements of the business. Andy has held senior and partner roles in various international innovation and creative strategy agencies including What If (now a part of Accenture), Albion, RGA and AKQA. He has written TV series for the BBC and ITV, and published books with HarperCollins with sales of more than a million worldwide.



**Renata Legierska (co-author)**

CSAB Member and Co-founder, Trinity Craft

Renata Legierska is a co-founder of Trinity Craft, a Jersey-based licensed cannabis producer, and a member of the Cannabis Services Advisory Board in Jersey. She joined the cannabis sector in 2017 and worked in some of the UK's first cannabis companies engaged in medicinal production and branded retail of CBD/wellness products. Over the past three years she has overseen the successful licensing of two cannabis facilities and established relationships with regulatory agencies, pharmaceutical distributors, medical professionals and patient organisations.



**Charles Sampson (co-author)**

Tenacious Labs

Charles Sampson is a Chartered Accountant with the Institute for Chartered Accountants for England Wales (ICAEW). He has been involved in the cannabis sector for four years across several different jurisdictions. Most recently he has been working for a Canadian family office helping them to deploy strategic capital into the European medicinal cannabis space.