

INDUSTRIAL HEMP: BUILDING A SUSTAINABLE FUTURE

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## **Abstract**

The hemp plant has been used throughout the world since ancient times. In the United States, there is a rich cultural and political history associated with this hearty and prolific plant. It is only in the past century that its value has been questioned and cast aside in the name of greed, corruption and immorality. The prohibition of industrial hemp that was instituted in 1957 is currently interfering in the evolution of what could be the preferred material for sustainable building. Traditional building materials such as concrete, fiberboard, and insulation are detrimental to the environment for several reasons, not the least of which is their carbon footprint. Hemp concrete, hemp fiberboard and hemp insulation are poised to become some of the most preferred, and economical, building materials of environmentally-conscious consumers worldwide. Unfortunately, archaic legislation still stands in the way of its mass production and industrial use in the United States. This ban is not just an environmental travesty, but also an economic one, as money for hemp products is pouring into other countries as U.S. farmers face financial hardship. Though progress has been made in recent years, the time has come to fully lift the federal ban on hemp cultivation, processing, and sales in this country.

## **Background**

Hemp is any species of the genus *Cannabis* grown strictly as an agricultural crop for industrial use. The hemp stalk is tall and thin, reaching heights of six to ten feet. It is a compact plant, with little branching, and stalks are hollow except at the tip and base. The leaves are palmate in shape, and flowers are small and greenish-yellow.<sup>1</sup> *Cannabis* is the only plant genus which produces the class of molecules called cannabinoids. The two most well-known cannabinoids are THC (delta-9 tetrahydrocannabinol) and CBD (cannabidiol). THC is responsible for producing a psychoactive effect, while CBD has no psychoactive qualities. Hemp, grown for its fiber and seed, has very low levels of THC and high levels of CBD. Its flowers will not get anyone “high.”<sup>2</sup>

The use of hemp has been widespread for millennia. Archaeologists have carbon-dated its use back to 12,000 years in China.<sup>3</sup> In Russia, hemp seeds and leaves have been found alongside evidence of its use in rope-making from 600-500 BCE. The English wove ropes from the fibers of this versatile plant.<sup>4</sup> The cultivation of hemp in Great Britain dates to 800 C.E. Henry VIII encouraged farmers to plant it to provide the British naval fleet with everything from rigging to maps.<sup>5</sup> Hemp played a vital role in the Western Hemisphere, as well. It was the top cash crop of the thirteen colonies. The

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<sup>1</sup> The Editors of Encyclopaedia Britannica, "Hemp," Encyclopædia Britannica, December 06, 2017, accessed April 28, 2018, <https://www.britannica.com/plant/hemp>.

<sup>2</sup> Ho'oulu Staff, "Industrial Hemp: A History and Overview of the Super Crop-and Its Trillion-Dollar Future," Ho'oulu, January 15, 2016, accessed April 28, 2018, <http://maui.hawaii.edu/hooulu/2016/01/15/industrial-hemp-a-history-and-overview-of-the-super-crop-and-its-trillion-dollar-future/>.

<sup>3</sup> Ibid.

<sup>4</sup> Ibid.

<sup>5</sup> "History of Hemp," Hemp.com, November 15, 2013, accessed April 28, 2018, <http://www.hemp.com/history-of-hemp/>.

founding fathers grew hemp, and used it for a myriad of purposes, from lantern oil to rope.<sup>6</sup> In the seventeenth century, Virginia, Connecticut and Massachusetts farmers were required by law to grow hemp and could be sentenced to jail for failure to do so. Hemp was such an integral component of society that it could be used as legal tender, even to pay one's taxes, for over 200 years in Colonial America, when hemp plantations flourished in the eastern and southern U.S. During that time, the U.S. census often documented up to 8,400 hemp plantations, each at least 2,000 acres in size.<sup>7</sup>

In 1896, the diesel engine was invented with the assumption that it would be powered by a variety of fuels, including vegetable and seed oils. Henry Ford saw the potential of biomass fuels as well, operating a successful biomass conversion plant that produced hemp fuel.<sup>8</sup> In October of 1916, the United States Department of Agriculture released "Bulletin No. 404: Hemp Hurds as Paper-Making Material." The document touted hemp's superiority over wood, both as a crop before production, and in paper-making.<sup>9</sup> It appeared that hemp would continue to play a major role in the United States, however, one man made it his mission to eliminate all forms of cannabis from society. As CBS News reported in 2016, "If you look for the roots of America's ban on cannabis, you'll find nearly all roads lead to a man named Harry Anslinger."<sup>10</sup> Anslinger was the

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<sup>6</sup>"Hemp & Flax in Colonial America," Hemp & Flax in Colonial America: The Colonial Williamsburg Official History & Citizenship Site, Accessed December 02, 2017, <http://www.history.org/foundation/journal/Winter15/hemp.cfm>.

<sup>7</sup> Ibid.

<sup>8</sup> Ibid.

<sup>9</sup> Lyster H. Dewey and Jason L. Merrill, "USDA Bulletin 404: Hemp Hurds as Papermaking Material," Lyster Dewey Diaries, Accessed April 29, 2018, <http://www.lysterdewey.com/usda-bulletin-404-hemp-hurds-papermaking-material/>.

<sup>10</sup> Cydney Adams, "The Man Behind the Marijuana Ban for All the Wrong Reasons," CBS News, November 17, 2016, accessed April 29, 2018, <https://www.cbsnews.com/news/harry-anslinger-the-man-behind-the-marijuana-ban/>.

first commissioner of the Federal Bureau of Narcotics (FBN), which eventually became the Drug Enforcement Agency (DEA). Appointed in 1930 as alcohol prohibition was coming to an end, he retained his position for thirty-two years. Early in his career, he went on record as believing that psychoactive cannabis use was not of major concern, calling the assertion that it made people violent or insane an “absurd fallacy.”<sup>11</sup> After his appointment to the FBN, he changed his position. In the book “Chasing the Scream: The First and Last Days of the War on Drugs,” author Johann Hari wrote:

From the moment he took charge of the bureau, Harry was aware of the weakness of his new position. A war on narcotics alone — cocaine and heroin, outlawed in 1914 — wasn’t enough. They were used only by a tiny minority, and you couldn’t keep an entire department alive on such small crumbs. He needed more.<sup>12</sup>

Anslinger began making wild claims, which were the opposite of his previous stance on cannabis, declaring that cannabis use could cause psychosis and insanity. He even went on the radio and addressed the nation, claiming that young people were “slaves to this narcotic, continuing addiction until they deteriorate mentally, become insane, turn to violent crime and murder.”<sup>13</sup>

In 1936, the propaganda film “Reefer Madness” was produced by the French director, Louis Gasnier, and released to the public in an effort to deter the youth from using cannabis recreationally. The movie was a “cautionary tale” featuring “a fictionalized and highly exaggerated take on the use of marijuana” in which a trio of drug dealers led innocent teenagers to become addicted to ‘reefer’ cigarettes by holding wild

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<sup>11</sup> Ibid.

<sup>12</sup> Ibid.

<sup>13</sup> Ibid.

parties with jazz music.”<sup>14</sup> William Randolph Hearst, with financial interests in the timber industry that provided the paper for his newspapers, wrote and published multiple newspaper articles against hemp and cannabis in the 1920’s after the publication of the USDA bulletin. The articles made racist claims, including some about black jazz musicians and Mexican migrant workers using “marihuana,” or “loco weed,” and enticing white women into sexual relations with them. These articles were part of the testimony that Congress used to support the prohibition of the entire genus *Cannabis*. In 1937, Congress passed the Marijuana Tax Act, which recognized no difference between hemp and recreational or medical cannabis, with Anslinger as a major influence.<sup>15</sup>

When Congress passed the Marijuana Tax Act in 1937, the decline of hemp effectively began. The tax and licensing regulations of the act made hemp cultivation nearly impossible for American farmers. Anslinger, the chief promoter of the Tax Act, argued for anti-marijuana legislation around the world.<sup>16</sup>

In 1942, hemp prohibition was lifted, due to trade bans, and the U.S.D.A. made the film “Hemp for Victory,” encouraging the growth of hemp for the war effort. Farmers were given benefits and rewards for growing it to make parachutes, ropes, shoes, clothes, sails, and more. The government even formed a private company called War Hemp Industries, which subsidized hemp cultivation, and oversaw the cultivation of one million acres of hemp across the Midwest. After World War II ended, the war on all things cannabis was renewed, and in 1957, hemp itself was officially banned again. The last

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<sup>14</sup> "Reefer Madness (1936)," IMDb, accessed April 29, 2018, <http://www.imdb.com/title/tt0028346/>.

<sup>15</sup> Cydney Adams, "The Man Behind the Marijuana Ban for All the Wrong Reasons," CBS News, November 17, 2016, accessed April 29, 2018, <https://www.cbsnews.com/news/harry-anslinger-the-man-behind-the-marijuana-ban/>.

<sup>16</sup> "History of Hemp," Hemp.com, November 15, 2013, accessed April 28, 2018, <http://www.hemp.com/history-of-hemp/>.



legal hemp crop for decades was harvested in 1958. In 1970 the Controlled Substances Act included hemp with “marihuana” as a narcotic.<sup>17</sup> As Linda Booker, director and producer of a 2013 documentary about hemp building called “Bringing it Home,” put it, that was “the last nail in the coffin.”<sup>18</sup>

### **Why Hemp?**

Traditional building materials like concrete, wood, and fiberglass insulation are simply not environmentally optimal. There are valid concerns regarding the sustainability and toxicity of these products, even after they are fully installed in a completed build. Industrial hemp is a sustainable, low-maintenance, and economical crop. After harvest and processing, it maintains those qualities in the form of many products, including building materials.

Medium-density fiberboard, which is traditionally made from the wood of trees, can be made from hemp. The average hardwood timber forest requires at least 20 years of growth before it is ready for harvest, whereas a hemp crop’s growth cycle is approximately four months. When the trees are harvested, the surrounding environment loses the valuable carbon sequestration those trees provided, animals lose their habitat, and it takes another two decades of growth, and water, for newly planted trees to become large enough to sequester significant amounts of the greenhouse gas. Hemp also sequesters CO<sub>2</sub> while growing. A study published in *Science Direct* found that “net

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<sup>17</sup> Ibid.

<sup>18</sup> Tony Marrero, "Hemp Helps Build a House in Tarpon Springs, Likely First in Florida," Tampa Bay, Florida News, August 17, 2014, accessed April 29, 2018, <http://www.tampabay.com/news/humaninterest/hemp-helps-build-a-house-in-tarpon-springs-likely-first-in-florida/2193319>.

carbon sequestration by industrial hemp crop(s) is estimated as 0.67 ton/h/year, which is comparable to all USA urban trees and very close to naturally, regenerated forests.”<sup>19</sup>

With a vastly different growth rate though, hemp fields can be replanted and start sequestering surrounding CO<sub>2</sub> faster than slow-growing tree saplings. While growing, the roots of the hemp plant employ a process called phytoremediation to clean the soil of toxins. Hemp was planted at the site of the Chernobyl nuclear disaster in the Soviet Union in 1998 for that purpose.<sup>20</sup> Agriculturally, hemp is an ideal crop. It can grow in a variety of climates and soil conditions and is naturally resistant to most pests. No fallow time is required between hemp crops planted in the same field, as with corn or cotton. Few weeds can grow in a hemp field, due to the rapid growth rate of seeds planted very close together.<sup>21</sup>

The environmental and agricultural benefits of hemp translate to economic benefits. With such a short growth cycle, no fallow time requirements between crops, and little processing required, hemp can be produced cheaply, and at an alarmingly fast rate, which translates to higher profit margins for farmers. Another key economic development that would be seen with the mass production of hemp would be job creation. The industry would create an immediate demand for growers, harvesters, processors, manufacturers, and retailers. This equates to local and national economic stimulation, and lower

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<sup>19</sup> Muhammad Pervaiz and Mohini M. Sain, "Carbon Storage Potential in Natural Fiber Composites," *Resources, Conservation and Recycling*, February 08, 2003, accessed April 29, 2018, [https://doi.org/10.1016/S0921-3449\(02\)00173-8](https://doi.org/10.1016/S0921-3449(02)00173-8).

<sup>20</sup> "Phytoremediation: Using Plants to Clean the Soil," McGraw Hill Higher Education, February 2000, Accessed April 29, 2018, [http://www.mhhe.com/biosci/pae/botany/botany\\_map/articles/article\\_10.html](http://www.mhhe.com/biosci/pae/botany/botany_map/articles/article_10.html).

<sup>21</sup> Ho'oulo Staff, "Industrial Hemp: A History and Overview of the Super Crop-and Its Trillion-Dollar Future," Ho'oulo, January 15, 2016, accessed April 28, 2018, <http://maui.hawaii.edu/hooulu/2016/01/15/industrial-hemp-a-history-and-overview-of-the-super-crop-and-its-trillion-dollar-future/>.

unemployment rates, especially in rural area where hemp farming would be ideal. The struggling farmers of this country deserve the opportunity to reap the benefits of this invaluable crop.

Consumers across the country are enjoying the benefits of hemp products despite legislation. The United States Congressional Research Service stated in its report, *Hemp as an Agricultural Commodity*, that there are no official figures on hemp sales in the United States, but cited the Hemp Industries Association's (HIA) estimate that United States citizens spent almost \$600 million on retail hemp products in 2015, with sales rising by approximately 15% each year since 2010.<sup>22</sup> Since current drug policy recognizes no difference between industrial hemp and "marijuana," these products must be manufactured using imported hemp, mostly from China and Canada.<sup>23</sup> What are these hemp products that Americans are spending so much money on? The fact is, tens of thousands of products can be made from processed hemp. Food, beauty and health products, clothing, diapers, pet food, paper, plastic, and just about every textile imaginable can be made from hemp. A home or any other building can be made almost entirely of hemp products. From the stucco and mortar, right down to the caulking and carpet, hemp buildings of all types are being erected around the world, with eye-opening results. Three of the most prominent building hemp materials in this blossoming worldwide industry are: hemp concrete, hemp fiberboard, and hemp insulation.

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<sup>22</sup> United States, Congressional Research Service. *Hemp as an Agricultural Commodity*, Renee Johnson, Washington, D.C.: Congressional Research Service, Library of Congress, 2017, Accessed December 2, 2017, <https://www.hsdl.org/?view&did=799560>.

<sup>23</sup> Ibid.

## **Hemp Building Materials v. Traditional Building Materials**

Traditional concrete has a long and interesting history. According to *Popular Mechanics*' article, "The Rock Solid History of Concrete,"

The story of concrete is so ancient that we don't even know when and where it begins. It is a story of discovery, experimentation, and mystery. Emperors and kings became legends for erecting great concrete structures, some of which are still a mystery to engineers today. Many of history's most skilled architects found inspiration in slabs of the gray building material.<sup>24</sup>

Concrete is a mixture of water, sand, gravel, limestone, and clay. The earliest concrete structure dates to 12,000 years and was discovered in present-day Turkey. The Romans dominated early concrete building until it began to spread across the developed world between the sixteenth and eighteenth centuries.<sup>25</sup>

The primary concern with traditional concrete is CO<sub>2</sub> emissions. A study by Hasanbeigi, et al found that:

Globally, the cement industry accounts for approximately 5 percent of current anthropogenic carbon dioxide (CO<sub>2</sub>) emissions. World cement demand and production are increasing significantly, leading to an increase in this industry's absolute energy use and CO<sub>2</sub> emissions. Development of new energy-efficiency and CO<sub>2</sub> emission-reduction technologies and their deployment in the market will be key for the cement industry's mid- and long-term climate change mitigation strategies.<sup>26</sup>

Hemp-based concrete offers a safe, sustainable alternative to traditional concrete. Often referred to as "hempcrete", it is a bio-composite material made of the inner woody

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<sup>24</sup> Jonathan Schifman, "How the Secret of Concrete Was Found, Lost, and Found Again," *Popular Mechanics*, February 15, 2018, accessed April 29, 2018, <https://www.popularmechanics.com/technology/infrastructure/a28502/rock-solid-history-of-concrete/>.

<sup>25</sup> Ibid.

<sup>26</sup> Ali Hasanbeigi, Lynn Price, and Elina Lin, "Emerging energy-efficiency and CO<sub>2</sub> emission-reduction technologies for cement and concrete production: A technical review," *Science Direct*, April 2012, accessed April 29, 2018, <https://doi.org/10.1016/j.rser.2012.07.019>.

core of the hemp plant, called the “shiv”, mixed with a lime-based binder. The shiv boasts a high silica content which allows it to bind well with lime- a property unique to hemp among all-natural fibers. The resulting compound is a lightweight cement-like insulating material weighing only about a seventh or an eighth of the weight of concrete. After mixing, hempcrete blocks harden to become a nearly indestructible brick, yet fully cured hempcrete blocks will float in a bucket of water.<sup>27</sup> Hempcrete is flame, pest and mold-resistant. It has excellent thermal qualities and sequesters CO<sub>2</sub> for its lifetime, which is believed to be considerable, as a hemp concrete bridge abatement built in the 6<sup>th</sup> century was discovered in France. More recently, hempcrete re-emerged in France in the mid-eighties when Charles Rasetti used it in the restoration of ‘Maison de la Turque’ in Nugent-sur-Seine. The idea spread throughout Europe in the 1990’s. Currently, France, Italy, the United Kingdom, Spain, the Netherlands, Ireland and Belgium are home to hemp building product manufacturers.<sup>28</sup> In 2013 French scientists confirmed that “hemp concrete contributes to reduce climate change as photosynthesis-mediated carbon sequestration and carbonation serve to reduce atmospheric carbon dioxide.”<sup>29</sup> Since hempcrete’s rediscovery, it has been growing in popularity as a building material in Europe. Given that the French bridge survived 15 centuries, it is expected that hempcrete buildings will have a long life. Another benefit of hemp-based concrete construction is that building site clean-up is easy, as the leftover hempcrete materials can simply be tilled

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<sup>27</sup> "What Is Hempcrete?" American Lime Technology Website RSS, accessed April 28, 2018, <http://www.americanlimetechnology.com/what-is-hempcrete/>.

<sup>28</sup> "Material of the Month - January - Hempcrete," A&DS, January 09, 2017, accessed April 29, 2018, <https://www.ads.org.uk/material-of-the-month-january-hempcrete/>.

<sup>29</sup> Sylvie Prétot, Florence Collet, and Charles Garnier, "Life Cycle Assessment of a Hemp Concrete Wall: Impact of Thickness and Coating," *Building and Environment*, November 16, 2013, accessed April 29, 2018, <https://www.sciencedirect.com/science/article/pii/S0360132313003247>.

into the soil or recycled for the next build.<sup>30</sup> Hemp masonry is pleasing to the eye, so it isn't necessary to render, plaster, or paint hemp buildings if the builder or buyer doesn't want to. Hempcrete buildings appear like any other stucco-finished building. The inside can be left natural or finished with lime plaster for a traditional look.<sup>31</sup>

Medium-density fiberboard is made from wood and commonly used in homes for cabinetry, floors, shelving, and doors. Apart from the environmental concerns already mentioned with regards to harvesting trees, it also raises health concerns. The adhesive used to bind the wood fibers contains urea-formaldehyde. What many people do not know is that even after a build, wood fiber board continues to compromise indoor air quality through the ongoing release of volatile organic compounds, or VOC's. That "new house smell" that many people enjoy is the result of this off-gassing. This is unhealthy for any living thing and made more so when considering that people in the United States are spending an average of 90% of their time indoors. For those with respiratory illnesses, or who are immuno-compromised, "off-gassing" is even more dangerous.<sup>32</sup> A study by the Center for Disease Control and Prevention found that high levels of urea-formaldehyde can not only irritate the delicate skin, eye, nose and throat tissue, but also increase chances of getting cancer.<sup>33</sup> The Environmental Protection Agency has also recognized the health risks associated with this common building material. According to its website,

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<sup>30</sup> "What Is Hempcrete?" American Lime Technology Website RSS, , accessed April 29, 2018, <http://www.americanlimetechnology.com/what-is-hempcrete/>.

<sup>31</sup> Paul Benhaim, "Build a Hemp House," The Hemp Builder, accessed April 29, 2018, <http://www.thehempbuilder.com/>.

<sup>32</sup> Tunga Salthammer, Sibel Mentese, and Rainer Marutzky, "Formaldehyde in the Indoor Environment," *Chemical Reviews*, April 14, 2010, accessed April 29, 2018, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2855181/>.

<sup>33</sup> "Formaldehyde in Your Home: What You Need to Know," Centers for Disease Control and Prevention, February 10, 2016, accessed April 29, 2018, <https://www.atsdr.cdc.gov/formaldehyde/home/index.html>.

new formaldehyde emission standards will go into effect on December 12, 2018. This date also triggered “additional requirements for manufacturers, importers, fabricators (e.g., furniture makers), distributors, retailers, third party certifiers (TPCs) and accreditation bodies (ABs).”<sup>34</sup> Also beginning December 12, 2018, all regulated composite wood products must be certified as compliant with the Toxic Substances Control Act (TSCA) by an EPA- recognized TPC.<sup>35</sup> These health concerns should be reason enough for consumers, builders, and the government to embrace hemp at least as an alternative to treated wood products but it is certainly not the only one.

Hemp fiberboard is a non-toxic and sustainable alternative to traditional wood chip fiberboard. Made of compressed hemp hurds and the bast fibers of the plant, it is stronger, lighter, and at least as elastic as its wood predecessor. When it is combined with a phenolic resin, it becomes even more fire and water resistant. Like hempcrete, it is fungus, moisture and mold resistant, pest resistant, carbon negative, lightweight, and thermally beneficial. In the early 90’s, C&S Specialty Builder’s Supply of Harrisburg, Oregon imported bales of hemp from France to begin experimenting with the idea of creating a hemp-based medium-density fiberboard, or MDF as it is known in the building industry.<sup>36</sup> They soon went to Paul Maulburg, the head of Washington State University’s Wood Engineering Laboratory with their ideas and research, asking for his help in bringing their idea to life. He was happy to oblige, calling hemp the “King Kong of

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<sup>34</sup> "Formaldehyde Emission Standards for Composite Wood Products," EPA, April 04, 2018, accessed April 29, 2018, <https://www.epa.gov/formaldehyde/formaldehyde-emission-standards-composite-wood-products>.

<sup>35</sup> Ibid.

<sup>36</sup> "Conde & Seber: Building Toward The Future With Hemp," Global Hemp, February 03, 2011, Accessed April 29, 2018, <http://www.globalhemp.com/1994/07/conde-seber-building-toward-the-future-with-hemp.html>.

fiber”.<sup>37</sup> Early production was brought to standstill when the strength of the hemp fibers caused machines to jam. After redesigning the process of breaking down the fibers, production resumed with resounding success, and an MDF was created that was 1.5 times stronger than wood, with 3 times the elasticity. When fully hardened, Maulburg considers hemp MDF to be stronger than steel.<sup>38</sup>

Unfortunately, there are only two known retail manufacturers and distributors of hemp fiberboard in the world- Hemp Technologies, and Alibaba of China. As Paul Maulburg at Washington State University discovered, the only requirement for using the same machinery that is used for wood fiberboard to produce hemp fiberboard is that the dense fibers be mechanically broken down properly first. Hemp Technologies makes the following claim about their hemp medium-density fiberboard: “Hemp Board has excellent internal bond strength and other performance characteristics that meets or exceeds the American Natural Standard Institute’s (ANSI) requirements for commercial particleboard”.<sup>39</sup> It is used in their hemp construction projects for doors, cabinetry, and shelving. It can also be used to build furniture, such as entertainment centers or aquarium stands.<sup>40</sup> As with all hemp products, the only roadblock to mass hemp fiberboard production in the United States is legislation.

The most commonly used type of insulation is fiberglass, which is exactly what it sounds like- a fiber made of glass. It is sold in rolls, often dyed a cotton candy pink color,

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<sup>37</sup> Bill Conde, "Hemp Medium Density Fiberboard," Filmed March 28, 2011 at Oregon Cannabis Tax Act News Conference, Portland, OR. Video, 1:13, Accessed April 29, 2018, <https://www.youtube.com/watch?v=-K9QhdhEgOU>.

<sup>38</sup> "Conde & Seber: Building Toward The Future With Hemp," Global Hemp, February 03, 2011, Accessed April 29, 2018, <http://www.globalhemp.com/1994/07/conde-seber-building-toward-the-future-with-hemp>.

<sup>39</sup> "Hemp Board," Hemp Technologies Global, Accessed April 29, 2018, <https://hemptechglobal.com/hemp-board/>.

<sup>40</sup> Ibid.



but not always. It works well as an insulator in structures, as it slows the spread of cold and heat, and traps pockets of air to maintain room temperatures. It also poses no known fire hazard. According to the National Association of Certified Home Inspectors (NACHI), any form of thermal insulation conserves “12 times as much energy as is lost in its production, and it may reduce residential energy costs by up to 40%.”<sup>41</sup> This is why it is essential for any efficient home to have some form of insulation. It is also essential that one understands the procedures and risks associated with the installation, removal, and disposal of fiberglass insulation. According to the NACHI, small particles of fiberglass have the potential to lodge in the pores of the skin, causing itching, irritation and rashes. If inhaled, the particles of glass can lead to nosebleeds, coughing and other respiratory ailments, especially when lodged deep within the lungs. Any disturbance or movement of fiberglass insulation releases particles that can lead to health problems, so protective clothing, gloves, and goggles must be worn when working with or around it. A respirator with a filter for particulate matter should be worn, as well. This protocol includes everyone from builders and property inspectors to residents doing remodeling projects.<sup>42</sup>

Hemp insulation is a far cry from the pink rolls of fluff that many people think of as the only option when considering insulation. The brownish-green fiber is completely non-toxic, mold and pest-resistant, and has the same excellent thermal benefits that hempcrete offers. Black Mountain Insulation in the United Kingdom is considered the leading hemp insulation company in the world. The company claims to use up to ninety

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<sup>41</sup> Nick Gromicko and Kenton Shepard "Fiberglass Installation: History, Hazards and Alternatives," International Association of Certified Home Inspectors, Accessed April 29, 2018, <https://www.nachi.org/>.

<sup>42</sup> Ibid.

percent less energy in manufacturing than traditional insulation products. Their hemp insulation is biodegradable, as well, requiring no special procedures or locations for disposal. According to Black Mountain Insulation's performance and technical standards research, the thermal conductivity of their product is low, making hemp an ideal insulation material. The higher thermal mass associated with plant-based materials provides them with the unique ability to absorb heat during the day and radiate it at night, adding to their energy efficiency, especially in areas with large swings in temperature. This also creates a building that stays warmer in the cold of winter and cooler in the summer. Additionally, "hemp insulation can absorb twenty percent of its weight in moisture with no deterioration in thermal performance".<sup>43</sup> The strength of hemp fiber eliminates the problem of slumping and shrinking that occurs with alternative insulations over time. Hemp insulation is flame-retardant and treated with a non-toxic chemical solution so that it will not start or exacerbate a fire. Installation is easy with no masks or special clothing required. Installers simply cut the pieces of insulation to fit and place it in the desired location.<sup>44</sup> This type of easy, efficient and safe installation cuts time, and means that almost anyone can do it. As with hempcrete, hemp insulation can also combat rising CO<sub>2</sub> levels. *Science Direct* reported that:

Comparative life cycle analysis focused on non-renewable energy consumption of natural and glass fiber composites shows that a net saving of 50 000 MJ (~3 ton CO<sub>2</sub> emissions) per ton of thermoplastic can be achieved by replacing 30% glass fiber reinforcement with 65% hemp fiber.<sup>45</sup>

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<sup>43</sup> "NatuHemp - Natural Hemp Insulation," Black Mountain Natural Insulation, Accessed April 29, 2018, <https://www.blackmountaininsulation.com/products/natuhemp>.

<sup>44</sup> Ibid.

<sup>45</sup> Muhammad Pervaiz and Mohini M. Sain, "Carbon Storage Potential in Natural Fiber Composites," *Resources, Conservation and Recycling*, February 08, 2003, accessed April 29, 2018, [https://doi.org/10.1016/S0921-3449\(02\)00173-8](https://doi.org/10.1016/S0921-3449(02)00173-8).

This calculation is based on both production emissions and sequestration properties of the finished product.

The possibilities for building with hemp materials are limited only by the imagination and U.S. legislation. Hemp concrete, medium density fiberboard, and insulation can create the foundation for building sustainable, economical, and aesthetically-pleasing structures. The short growth cycle of hemp could create an opportunity to face the housing crisis in this country head on- quickly and efficiently. The job growth that these budding industries has to offer is not something that the United States should refuse. Many United States citizens suffer from illnesses that could be alleviated or made more tolerable by improving indoor air quality. Deforestation could be reduced with the use of hemp as a wood alternative. Family and small-farming operations could become fruitful again. It is incomprehensible that this plant remains largely illegal for mass production in the United States due to archaic laws, presumably rooted in greed and willful scientific ignorance. As with many issues concerning environmental sustainability and progress, this nation is falling behind. Elsewhere in the world, hemp has already made its comeback as a building material, without concerns for its legality.

### **Notable Hemp Buildings**

The Adnams Southwold Distribution Centre, according to its website, is “A building hidden away in the rolling East Anglian countryside barely visible to the naked eye; a building so in tune with the environment that the very British rain that falls on it is

used internally and the sunshine powers the activity inside.”<sup>46</sup> Adnams is a brewery and distillery with a vision in Southwold, UK. The bricks that form its walls are made from locally-grown hemp, lime, and chalk. As this was the first large-scale build of its kind, machinery had to be invented to make the approximately 90,000 bricks that compose its walls.<sup>47</sup> The center measures 4400m<sup>2</sup> in area, and has “outstanding thermal performance,” with the heating bills to prove it.<sup>48</sup> Data collected by Green Suffolk, an environmental non-profit, showed that “there is the equivalent of 100 to 150 tonnes of CO<sub>2</sub> locked up within the walls at Adnams Distribution Centre.”<sup>49</sup>

The Orwell Housing Association’s Clay Field neighborhood in Suffolk, U.K., was designed by the firm Riches Hawley Mikhail Architects, and completed in 2008. The builders chose a spray application of Tradical Hemcrete® for this 26-unit eco-housing project. The Clay Field project is an excellent example of low-income housing with extremely low CO<sub>2</sub> output during construction and low-energy requirements while in use. As well as being eco-friendly, it was cost effective to build and is aesthetically pleasing in design. This could be an excellent option for the United States, where affordable housing is a concern and many people are homeless.

The first hemp house in the United States was designed by architectural firm Push Design and built with hemp materials made by sustainable low-carbon building system company American Lime Technology. The Martin-Korp residence, or “Push House” as it

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<sup>46</sup> Emma (last name unknown), "Adnams Distribution Centre," Adnams Southwold, January 15, 2008, Accessed April 29, 2018, <http://adnams.co.uk/about/news/company-news/doing-the-right-thing/adnams-distribution-centre/>.

<sup>47</sup> Ibid.

<sup>48</sup> "Adnams Distribution Centre," Suffolk: Creating the Greenest County, Accessed April 29, 2018, <http://www.greensuffolk.org/sgbn/suffolk-case-studies/adnams-distribution-centre/>.

<sup>49</sup> Ibid.

is known in the hemp building industry, was built in Asheville, N.C. in 2010. It took a team that included forty volunteers who were eager to be a part of this groundbreaking project two-and-a-half weeks to construct the shell of the Push House, with a building cost of \$133 per square foot. The structure is expected to remain stable for 700 years, and owner and former Asheville Mayor Russ Martin saw a 60% reduction in his homeowner's insurance rate after moving into his hemp home. The amount of land that it took to grow enough hemp for the construction of this home was 1.5 acres, grown in a mere 12 weeks.<sup>50</sup>

Another notable hemp house in the U.S. is retired mechanical engineer Bob Clayton's home in Tarpon Springs, FL. In 2012, Clayton wanted to know if a hemp building could stand up to Florida's humid, sometimes intense, weather conditions. Working with an architect, he designed a three-bedroom, 2-bathroom, inconspicuous home. A contractor was originally hired to complete the build, but Clayton ended up letting him go and relying on his own engineering skills and experience to finish the job himself. He built the walls a foot thick and claims that they can withstand winds up to 150 miles per hour. Roughly 3 acres of hemp was used to build the house, and his electric bill peaked at \$90 over his first summer living in it. The estimated cost for the build was a steep \$350,000, which included granite countertops, maple cabinetry, and hickory floors, but Clayton believes "cost would come down with a trained labor force working with materials grown stateside."<sup>51</sup>

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<sup>50</sup> Paul Benhaim, "Build a Hemp House," The Hemp Builder, Accessed April 29, 2018, <http://www.thehempbuilder.com/>.

<sup>51</sup> Tony Marrero, "Hemp Helps Build a House in Tarpon Springs, Likely First in Florida," Tampa Bay, Florida News, August 17, 2014, accessed April 29, 2018,

More recently, hemp building company Hempitecture partnered with Idaho Basecamp, a non-profit organization, to design and build the United States' first public use hemp building in Ketchum, Idaho. The Borah Basin Building was constructed in 2017 from hempcrete and recycled and renewable materials that would have otherwise gone to a landfill. The project, financed mostly by grassroots funding and fundraising, took three years to complete. "We raised over 27,000 dollars on Kickstarter to buy all the hemp material for the wall," said 26-year-old founder of Hempitecture, Mattie Mead. He contends that the build was a group effort, stating, "I cannot take sole credit for this building project because there were a lot of people who were so instrumental in the construction of this building. So to be a part of a community experience like that in Idaho was really special."<sup>52</sup> This feeling of community echoes the efforts of the volunteers who helped build the Push House, and were happy just to be a part of the revolution. These projects speak of the power of grassroots efforts, which have also been key in enacting legislation aimed at increasing industrial hemp production in the United States.<sup>53</sup>

### **Bringing it (Back) Home**

According to American Lime Technology, "Hemp is grown legally in Europe, the UK and Canada through a system of licensed growers producing seed certified low in THC (<.05%). Farmers must buy their seed from these seed growers and their fields are inspected periodically. A new plant to process the hemp core is being built in Canada so

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<http://www.tampabay.com/news/humaninterest/hemp-helps-build-a-house-in-tarpon-springs-likely-first-in-florida/2193319>.

<sup>52</sup> Devan Kaney, "First Public Hemp Building in the U.S. Opens in Idaho," KOMO, August 16, 2017, Accessed April 29, 2018, <http://komonews.com/news/local/first-public-hemp-building-in-the-us-opens-in-idaho>.

<sup>53</sup> Ibid.

there should be a North American supplier soon.”<sup>54</sup> This is a huge, and necessary development, as American Lime Technology also claims that the lack of a North American hemp supplier has affected the environmental benefits of hemp, and their Tradical Hemcrete®, product in the following ways:

Added shipping reduces the carbon-negative feature of hempcrete in North America and adds to production costs. It causes additional logistic costs since we had to buy a 40-foot container of material and store it on site. You must have people waiting for the truck with rented equipment to empty it, and you need dry weather. The truck charges nearly a hundred dollars an hour wait time while you unload for half a day. We filled a two-car garage with our material leaving a 4-foot margin for work around the edges. You have to keep this material dry until used so plan for adequate tarps.<sup>55</sup>

Clearly, hemp used to create hemp building materials in this country should be grown here. Until recently, that was impossible to do legally in any capacity. Thanks to the efforts of grassroots organizations like Vote Hemp!, farmers, and a handful of politicians, glimmers of hope are starting to appear for the future of industrial hemp in the United States. Linda Booker of “Bringing it Home” asserts that “We now have some politicians that have seen we're cutting American farmers out of an opportunity that 31 other industrialized nations are taking advantage of.”<sup>56</sup> Though current legislature is nowhere near allowing enough hemp to be produced to start manufacturing the multitude of products that can be made with it, the government has formally recognized industrial

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<sup>54</sup> "FAQ." American Lime Technology Website RSS. Accessed April 29, 2018, <http://www.americanlimetechnology.com/american-lime-technology-faq/>.

<sup>55</sup> Ibid.

<sup>56</sup> Tony Marrero, "Hemp Helps Build a House in Tarpon Springs, Likely First in Florida," Tampa Bay, Florida News, August 17, 2014, accessed April 29, 2018, <http://www.tampabay.com/news/humaninterest/hemp-helps-build-a-house-in-tarpon-springs-likely-first-in-florida/2193319>.

hemp as being different than its intoxicating counterparts, and steps are being taken to get U.S. farmers growing the crop once more.

### **Federal Legislation**

The recent history of federal industrial hemp legislation is quite short. In 2005, Representative Ron Paul (R-TX) sponsored the first federal industrial hemp bill since the government outlawed hemp farming in this country in 1957. The bill, written with the help of the grassroots group Vote Hemp!, proposed to remove restrictions on growing non-psychoactive cannabis, exclude it from the definition of “marihuana” in the Controlled Substances Act, and assign authority over its cultivation and processing to the states. Rep. Paul introduced H.R. 3037, the Industrial Hemp Farming Act of 2005, at a Capitol Hill luncheon that June, where “Congressional staffers were treated to a delicious gourmet hemp lunch while listening to various prominent speakers tout the myriad benefits of encouraging and supporting a domestic hemp industry.”<sup>57</sup> Eleven additional co-sponsors signed on. Assigned to committee, the never saw a hearing or vote. This pattern continued ever legislative year until 2013, with the same bill being introduced, and Rep. Paul leading the charge until his retirement in 2011. By that time, the bill had thirty-seven cosponsors. Sen. Ron Wyden (D-OR) joined the fight with the introduction of a Senate companion bill in August of 2012.<sup>58</sup> Senator Wyden had already introduced S.AMDT.2220 in June of 2012. This proposed amendment would include industrial hemp in the existing farm bill. It failed to attach to the 2012 Farm Bill but was successful in drawing cosponsors for the introduction of S. 3501, The Industrial Hemp Farming Act of

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<sup>57</sup> Vote Hemp: Information: Political: Legislation: Federal, accessed April 28, 2018, <http://www.votehemp.com/federal>.

<sup>58</sup> Ibid.



2012. Sen. Wyden attempted to amend the Farm Bill again in 2013 with S.AMDT.952 and was unsuccessful.

In 2014, President Obama signed the 2014 Farm Bill, or Agricultural Act of 2014. The bill included, for the first time, a section allowing for the cultivation of industrial hemp for limited purposes by universities and state departments of agriculture. Section 7606 includes the following provisions:

- (1) the industrial hemp is grown or cultivated for purposes of research conducted under an agricultural pilot program or other agricultural or academic research; and
- (2) the growing or cultivating of industrial hemp is allowed under the laws of the state in which such institution of higher education or state department of agriculture is located and such research occurs.<sup>59</sup>

The bill also required grow sites to be state-certified and registered, departing from the Controlled Substances Act's federal stance on hemp as an undistinguishable form of a psychoactive, dangerous drug with no medicinal value. For the first time since 1957, hemp could be grown legally in the United States.

The fight to allow farmers to grow industrial hemp continued, however, with the introduction of the 2015 Industrial Hemp Farming Act of 2015 (S. 134) by Sen. Wyden and a group of bipartisan U.S. Senators.<sup>60</sup> Concurrent House bill H.R. 525 was introduced a few weeks later. In July of 2017, Rep. James Comer (R-KY) sponsored the Industrial Hemp Farming Act of 2017. H.R.3530 was introduced with fifteen bipartisan cosponsors. For the first time, it included some changes from the previous versions. Vote Hemp! advocated for these changes to the bill, which would allow Native Americans tribes to

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<sup>59</sup> "State Industrial Hemp Statutes," National Conference of State Legislatures, accessed April 29, 2018, <http://www.ncsl.org/research/agriculture-and-rural-development/state-industrial-hemp-statutes.aspx>.

<sup>60</sup> Ibid.

cultivate cannabis on their land. It also included an increase of legal THC levels to 0.6 percent for more extensive research for commercial cultivation.<sup>61</sup>

### **State Legislation**

By 2017, there were nineteen states with hemp pilot programs. Currently there are at least 27. These programs are administered by state agencies or institutions of higher learning. The focus is to study cultivation techniques, processing and the economics of industrial hemp, and programs can have time limits and require reporting from both participants and state agencies to ensure compliance. Some states have established rules, goals, and regulatory agencies or committees to oversee pilot programs. They may also require coordination between the programs and specific universities, but in some states that coordination is optional. Though most state industrial hemp pilot programs focus on cultivation, processing, and economic impacts, there are several that have their own unique research goals.

Colorado S.B. 184 (2014) created an Industrial Hemp Grant Research Program that allows state universities to research and develop strains of hemp that are best suited for industrial use. In 2017, Colorado S.B. 109 directed the commissioner of agriculture to form a group that would study hemp as a feasible addition to animal feed options.

Kentucky has taken the lead in environmental research related to hemp, with its research program studying the benefits and/or impacts of the plant on the natural world and its systems and the potential of hemp as a biofuel or other energy source. Kentucky's program is also studying the results of worldwide agronomy (the study of soil management and crop production) research for the purpose of determining the most ideal

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<sup>61</sup> Vote Hemp: Information: Political: Legislation: Federal, accessed April 28, 2018, <http://www.votehemp.com/federal>.

growing conditions for hemp crops. The North Carolina Hemp Commission is collaborating with two state universities to study soil conservation and restoration in relation to hemp farming.<sup>62</sup>

One challenge presented by the legislative limitations of the state pilot programs is access to viable hemp seed. Obtaining seed that falls under the legal definition of hemp is difficult because hemp is still listed under the Controlled Substances Act. States have taken it upon themselves to regulate seeds in response to the problem, ensuring that they are in compliance with the definition of hemp seed, which requires it to contain less than 0.3 percent THC. California, Indiana, Maine and Oregon have even established certification and licensing programs for producers and distributors of hemp seed through their respective departments of agriculture. States where pilot programs are active have removed hemp from their controlled substances list when grown within regulations.<sup>63</sup>

### **The Future of U.S. Hemp Legislation**

In April of 2018, Senate Majority Leader Mitch McConnell (R-KY) introduced the Hemp Farming Act of 2018. The act would allow farmers and processors of hemp to operate within federal law, removing restrictions that currently exist on banking and water access, as well as other roadblocks that prevent them from growing freely. State departments of agriculture would regulate local production of hemp, with the USDA providing oversight for those agencies.<sup>64</sup> The Hemp Farming Act also provides USDA

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<sup>62</sup> "State Industrial Hemp Statutes," National Conference of State Legislatures, accessed April 29, 2018, <http://www.ncsl.org/research/agriculture-and-rural-development/state-industrial-hemp-statutes.aspx>.

<sup>63</sup> Ibid.

<sup>64</sup> Tom Angell, "Here's Mitch McConnell's New Hemp Legalization Bill," Forbes, April 12, 2018, Accessed April 29, 2018, <https://www.forbes.com/sites/tomangell/2018/04/12/heres-mitch-mcconnells-new-hemp-legalization-bill/#1366bf415b5b>.

research funding and crop insurance to farmers and gives Native American tribes the right to cultivate and process industrial hemp.<sup>65</sup> McConnell, joined on the Senate floor by Sen. Wyden, told the Senate that:

As the tobacco industry has changed, some farmers in states like Kentucky have been searching for a new crop that can support their families and grow our agricultural economy, and many believe they've found such a product: industrial hemp. But the federal government has stood in the way. Mr. President, it's time to change that.<sup>66</sup>

Sen. Wyden concurred, adding:

It is really a milestone to have the majority leader of the Senate working with a bipartisan group of us to lift a restriction that is anti-farmer, certainly anti-consumer and anti-common sense. The only thing you're going to accomplish by smoking hemp is wasting your breath, wasting your time and wasting lighter fluid.<sup>67</sup>

Congressman James Comer (R-KY) will be introducing the companion version in the House of Representatives.<sup>68</sup> The bipartisan nature of this effort is a breath of fresh air in the current political climate of this country, and The Hemp Farming Act of 2018 is the most promising development to date in the fight to fully lift the federal ban on industrial hemp farming.

## **Conclusion**

As legislation continues to evolve, so will the production, manufacture, and uses of the hemp plant. With that evolution, the keen eye of the people who made it possible must

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<sup>65</sup> "Senators Introduce Bipartisan Bill to Legalize Hemp," U.S. Senator Mitch McConnell, Accessed April 29, 2018, <https://www.mcconnell.senate.gov/public/index.cfm/2018/4/senators-introduce-bipartisan-bill-to-legalize-hemp>.

<sup>66</sup> Tom Angell, "Here's Mitch McConnell's New Hemp Legalization Bill," Forbes, April 12, 2018, Accessed April 29, 2018, <https://www.forbes.com/sites/tomangell/2018/04/12/heres-mitch-mcconnells-new-hemp-legalization-bill/#1366bf415b5b>.

<sup>67</sup> Ibid.

<sup>68</sup> "Senators Introduce Bipartisan Bill to Legalize Hemp," U.S. Senator Mitch McConnell, Accessed April 29, 2018, <https://www.mcconnell.senate.gov/public/index.cfm/2018/4/senators-introduce-bipartisan-bill-to-legalize-hemp>.

remain fixed on the ultimate goals, and stay vigilant, so that the greed and corruption that created a disturbance in the natural progression of the industrial hemp industry do not do so again. In the meantime, the average citizen can make their voice heard in the industrial hemp revolution.

The best way to support the future of mass industrial hemp production in the United States is by supporting, and most importantly, voting for pro-hemp candidates in every election. A quick visit to a candidate's webpage will tell you where they stand on the issue. If it not made clear there, an email or call to the campaign should elicit a clear response as to the candidate's stance. Public officials already in office should have open lines of communication with their constituents, as well. Writing, emailing and calling elected officials is a good way to let them know that the people they represent are eager for them to join the fight for industrial hemp cultivation in this country.

Voting with one's dollar is a popular concept in today's consumerist society. When shopping, consider whether there is a hemp alternative to the product that you want to purchase. Many hair and body products contain hemp oil. Hemp hearts, oil and seeds are healthy additions to salads, smoothies and other foods. Hemp oil supplements are a vegetarian and non-smelly alternative to fish oil for omega fatty acid supplements. adidas® shoes has been producing hemp sneakers for decades, of which the author of this thesis has owned several pair, and can attest to the structural integrity, durability, and again, non-smelliness of. Hemp clothing, while not yet as economical as hemp sneakers and other products, is attractive, durable, and breathable. One can only assume that if there were mass manufacture of hemp fabrics in the United States, prices for hemp

clothing would go down, much like it has been predicted that the costs of hemp building materials would.

Humanity and hemp have had a long and fruitful relationship. The circumstances surrounding this country's departure from a naturally interwoven destiny with this life-giving plant are blasphemous and bizarre, but a revolution is happening. In the grand scheme of time, that period of separation was but a blip. Through the power of people united in common goals of sustainability, freedom, and prosperity, there is hope for the future of industrial hemp, and all of its uses, in this country.

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