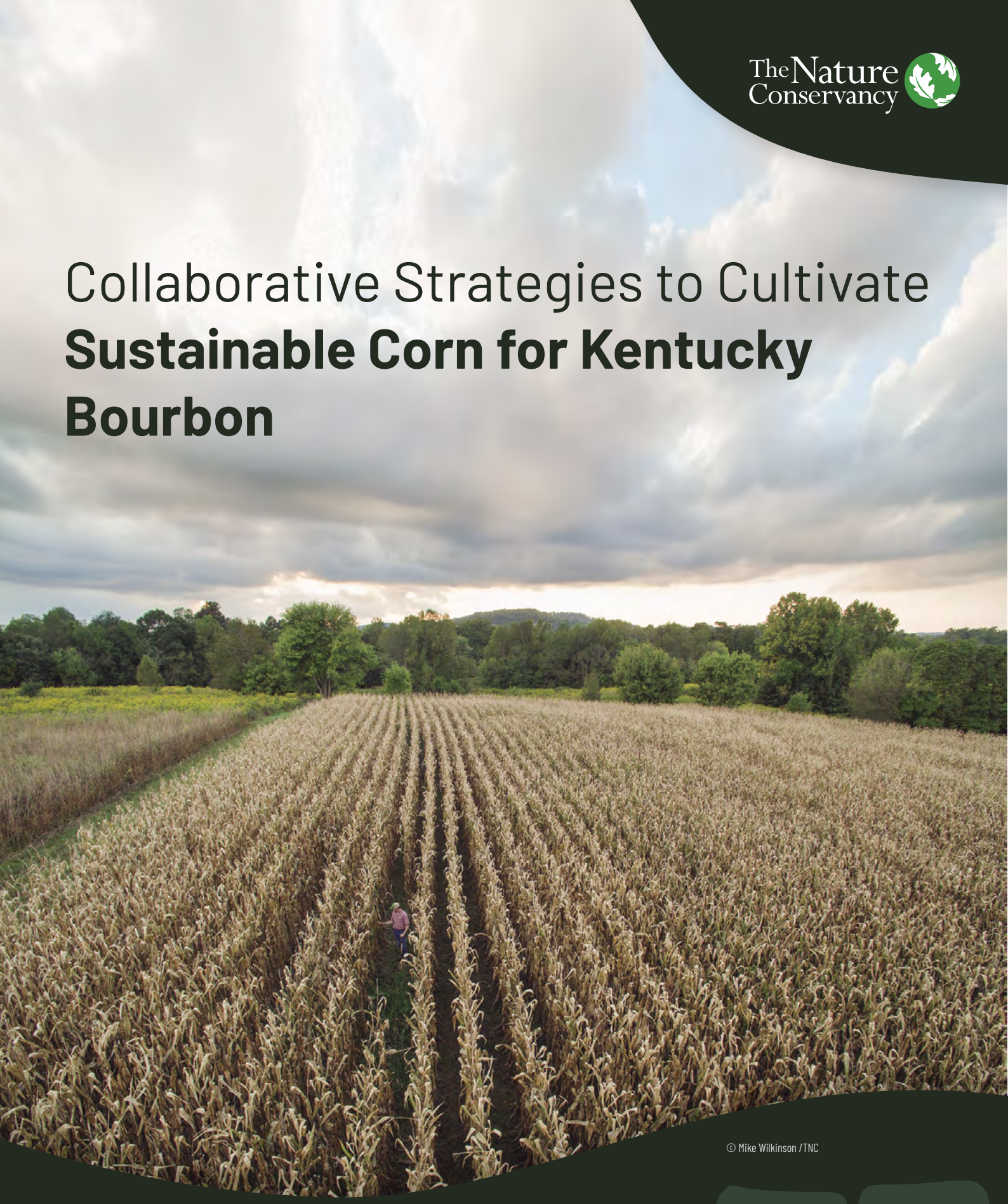
The Nature Conservancy

Collaborative Strategies to Cultivate **Sustainable Corn for Kentucky Bourbon**



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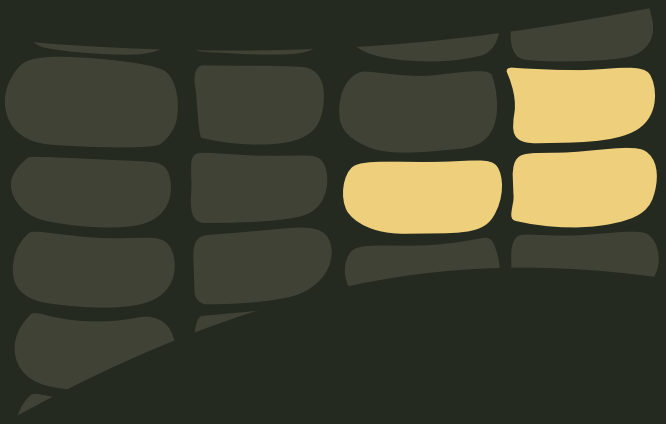

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EXECUTIVE SUMMARY

Kentucky bourbon is a notable spirit due to its geographic production, cultural value, and success as an industry both locally and globally. As the industry grew, it increased its local sourcing of agricultural inputs, creating an opportunity to showcase the distinctive growing characteristics of the corn used in bourbon production and to address decarbonization across the industry. As a clear example, much of Kentucky's corn is produced on highly erodible land, which has significantly driven the adoption of no-till agriculture over the past decades to mitigate soil erosion risks. Within the Kentucky region where bourbon is produced, both large and small distillery operations share their sourcing area, many times relying on the same farms to procure their main ingredient, corn. This determines that most of these businesses' interests and objectives intersect on the ground, which offers a distinctive context for collaborative action. The larger distilleries and their parent companies have set ambitious climate mitigation commitments. Consequently, the bourbon-sourcing region in Kentucky presents a unique opportunity to accomplish these goals through the decarbonization of corn production due to a high level of sourcing traceability and the broader interest from the Kentucky bourbon value chain to address this challenge. Complementary to the decarbonization goals of the larger companies, the smaller distilleries view sustainability as a product differentiation opportunity and a potential cost-saving mechanism, which is driving their eagerness to pilot and try new procurement strategies. In summary, due to the overlap in sourcing regions, the high level of traceability, ongoing sustainability efforts, and the private sector's ambitious climate goals, the Kentucky bourbon industry is well-positioned to collectively tackle the decarbonization of corn production and increase its supply chain resilience.

The Kentucky bourbon industry is poised to successfully decarbonize its value chain:

- Parent companies representing a large percentage of bourbon production have similar, aggressive goals for greenhouse gas (GHG) reduction, no conversion commodities, and other sustainability goals.
- The bourbon industry sources its corn from a very defined, overlapping geography, which means that opportunities and challenges for decarbonizing the corn supply chain are shared.
- The industry is large enough globally and important enough locally to make focused and coordinated efforts around decarbonization in a relatively small sourcing geography feasible, scalable, and impactful.
- The very low raw material cost of corn in bourbon means that a high ROI for decarbonization and sustainability efforts is very possible and could be passed along at a very nominal cost to the consumer.
- On-farm practices that achieve GHG reduction have a high probability of also contributing to the long-term productivity of Kentucky farms and the long-term viability of local corn sourcing for Kentucky bourbon.

This white paper aims to answer the question, "What are the key barriers and opportunities for decarbonizing Kentucky corn used in bourbon production?" An analysis was conducted to address this topic, relying on a desktop literature review as its foundation. The type of materials reviewed included academic literature, publicly available data, and industry reports. To confirm and complement our initial findings from the literature review, we held interviews with key industry stakeholders and other actors supporting the bourbon supply chain. This group of interviewees included farmers, extension agents, distilleries representatives, researchers, people in academia, state and federal government officers, and members of industry associations, among others. This comprehensive analysis enabled the creation of key recommendations for the bourbon industry that will facilitate the effective decarbonization of Kentucky corn used in bourbon production.

Underpinning the specific recommendations included in this document, there is an overarching strategy focused on collaborative action and collective financing across the industry. If the industry were to undertake the recommendations of this white paper, one of the first steps should be to establish a pre-competitive home for this strategy and dedicate funding and personnel to lead the formalization of this effort, creating a shared vision across the supply chain, and developing a concrete action plan that includes discrete objectives, expected milestones, and a feasible timeline. Each recommendation of this strategy could be impactful on its own. However, when implemented together with full industry support, the reach of these efforts will be enhanced by mobilizing all the available resources to tackle the underlying challenges for an effective decarbonization of Kentucky corn production.

KEY RECOMMENDATIONS:

Improve Communication Between Companies and Farmers

The interviews with farmers revealed a high level of interest in better understanding the types of targets companies have set and the contributions of farming activities to the emissions profile of the bourbon being produced. Farmers are interested in learning how the adoption of regenerative practices would affect the greenhouse gas emissions a company is reporting. In addition, the stakeholder interviews revealed that distilleries and companies are not always familiar with the local realities of farming. An increased understanding of farmers' decision-making processes, their economic realities, and the prevalent production practices can lead to more productive conversations and better-designed and implemented programs to address producers' main resource concerns that also mitigate their activities' climate impact.

The industrywide effort, as well as individual companies, should focus on more frequent, clear, and transparent communication with the farmers who are part of their supply chain. In addition to clearer communication with farmers, sustainability professionals at distilleries should familiarize themselves with the unique ecoregional context and production characteristics that produce Kentucky corn. Through an enhanced understanding of Kentucky agriculture and improved communication with farmers, companies will be able to identify concrete pathways to not only achieve company-level sustainability goals but also to better relay the current and future successes of the local farming community.

Enhance Farmer Assistance

Increased adoption of conservation practices on farms will only be successful to the extent that it aligns with the interests of farmers and landowners. This means that the barriers to adopting these practices must be thoroughly understood so that effective solutions can be developed and implemented. Given the high level of adoption of certain conservation practices, like no-till, enhanced assistance for farmers will be critical to address the technical, financial, and social barriers to testing and scaling new practices that improve their productivity and resilience. The programmatic solutions needed to overcome these barriers will require new ideas and flexibility.

To enhance the industry's uptake of on-farm conservation practices, we suggest the following forms of support:

1. Financial: More flexible and responsive cost share programs or "hybrid" incentive structures where farmers are paid a flat amount per practice and an additional amount based on the measured field-level outcomes.

2. Technical: Technical challenges (including logistical/capacity bottlenecks) represent a readily identified but under-addressed hurdle. Improved methods, innovative equipment, and outsourcing of conservation as a service may all be part of the solution and will require the expertise and resources of universities, farm groups, trusted advisors, and agricultural retailers.

3. Social: Meaningful engagement with farmers and landowners to deeply understand conservation adoption barriers is a foundational step to identifying the most impactful opportunities for farmer assistance and the highest ROI on dollars supporting conservation. Understanding these challenges through expansive, open, and honest interviews, focus groups, and surveys will be essential to understanding the social elements of conservation practice adoption. Part of this exploration should also include gaining an understanding of the potential for establishing farmer-to-farmer peer learning networks, which could offer great value tackling technical challenges, providing a sense of collective action, and developing a supporting social system.

Support Critical Research

The bourbon industry has an opportunity to invest in and work with researchers, governmental institutions, and third-party service providers to address key research gaps that will help advance the decarbonization of Kentucky corn. This analysis revealed that there was not a high level of agreement regarding the emissions associated with producing corn in Kentucky, nor on how these emissions contribute to the overall carbon footprint linked to a bottle of bourbon.

In a collaborative and transparent effort, the industry should align on the critical research questions that need to be prioritized and co-invest in better understanding the challenges and potential solutions to these issues. Some examples of key knowledge gaps that emerged through our analysis as potential research investment opportunities are:

1. Up-to-date life cycle analysis - the industry can collectively identify key decarbonization areas to prioritize. It's likely that corn will result as an emissions hot spot, but without a published scientific LCA, creating consensus and action may be more difficult.

2. Refinement of the tools and methodologies to more effectively and regularly assess the adoption rates of conservation agriculture practices within the key bourbon-sourcing counties and the corresponding emissions associated with these practices.

3. Analysis of the carbon benefits associated with the implementation of more innovative conservation practices (beyond no-till and cover cropping) that may further decarbonize Kentucky corn.

4. Research to better understand the land use change dynamics in the key

bourbon-sourcing counties, enhancing land conversion tracking data, identifying key land use change drivers in the past decades, and assessing the potential risks and associated impact scenarios of a further loss of native habitats and perennial crops (e.g., pastureland) in Kentucky.

5. Better understanding and quantifying the cost of erosion through lost soil productivity.

In Kentucky, there are multiple opportunities to partner with universities, governmental institutions and third-party service providers to investigate research questions and disseminate the findings of the research to advance collective learning.

Drive a Strategic Business Case Development

To further support and increase investments in corn decarbonization efforts by the bourbon value chain, there is an opportunity to develop business cases to better understand the benefits, costs, and risks associated with the recommendations in this white paper. The bourbon value chain will benefit from exploring business cases at both the company and the industry scale level, analyzing how collective action can address the priority opportunities to mitigate climate change and adapt to its impact.

From our conversations with stakeholders, we identified initial business transformation and adaptation opportunities that should be explored by the industry:

1. An identified opportunity relates to bridging the gap between sustainability and procurement teams. From the interviews with distillery representatives, it was evident that the sustainability staff often worked independently of the procurement and other operational teams. Many times, directives from leadership and objectives for each unit seemed not to be aligned. The bourbon distilleries (or the coalition) should develop a business case as to why integrating sustainability across the industry's operations is critical for the sustainability of the supply chain. Once this is presented to the companies' leadership (i.e., the C-Suites) and recognized as the best path forward, businesses can start adjusting their internal organizational structure to reflect the incorporation of sustainability into their decision making processes.

2. The impact of implementing new regenerative practices in an agricultural system will vary across regions and, mainly, the agronomic and technological starting point of the farmers in that area. As a result, locally relevant financial information about conservation practices is required for farmers to make informed management decisions, especially as they consider enrollment in private ecosystem services payment mechanisms. The industry has the opportunity to develop a business case for particular management practices relevant to Kentucky farmers and share this information to increase their adoption.

3. The Kentucky bourbon industry faces significant financial risks due to its reliance on natural resources and ecosystem services, with disruptions from climate change and resource depletion impacting agricultural supply chains operations, costs, and revenues. To address these risks, the industry can leverage frameworks like the Task Force on Climate-related Financial Disclosures (TCFD) and the Natural Capital Protocol to assess, price, and disclose nature-related risks and opportunities. This white paper recommends that bourbon companies investigate and

further develop their ability to incorporate natural capital into decision-making. To do this, the bourbon companies can use scenario analysis to quantify the price of inaction, evaluate how sustainability efforts can boost brand value and market capitalization, and improve resource efficiency to lower costs and enhance productivity.

4. The cost of corn in bourbon is very small, typically representing only about 1% of the retail price of a $25 bottle of bourbon. This small cost represents an opportunity for the bourbon industry to invest in decarbonization efforts to enhance farmer assistance and support critical research. Hypothetically, every additional dollar that the bourbon industry invests per bushel of corn used could be passed along at the retail point of sale for only 4.5 cents per bottle, given the above 1% assumption. Particularly if the industry were to act in unison in such a commitment to support decarbonization, risk would be well mitigated, and the investment would represent a tremendous return on investment (ROI) towards sustainability goals.

Foster Cross Industry Collaboration and Advance Policy Initiatives

The opportunities for decarbonization and collective action identified in this white paper were developed for the bourbon industry but have a viable application for other industries looking to decarbonize their corn supply chain and engage in collective action. The other industries sourcing corn in Kentucky include animal feed, ethanol, and food production. The bourbon industry should co-identify shared research questions, policies, and sourcing regions to identify shared challenges and areas of opportunity to work with other industries sourcing Kentucky corn.

An example of this approach is the White Oak Resilience Act, which establishes a voluntary and collaborative group of public, private and non-governmental organizations (NGOs) to coordinate the restoration of white oaks in the United States. This initiative directly mentions research gaps, outreach to landowners, and the creation of policy options to improve the quality and quantity of white oak nurseries.

The bourbon industry should stay current on evolving decarbonization opportunities and developments in the other sectors that are sourcing corn from Kentucky. This white paper recommends doing this by:

1. Collaborating and coordinating on state and federal policy initiatives with other industries,
2. Investigating opportunities to collaborate with on-farm conservation opportunities and
3. Identifying shared challenges and research questions with other industries.

Conclusion

In summary, by investing in a collaborative approach that supports research efforts and promotes regenerative and innovative practices, the bourbon industry can lead the way toward a more sustainable future, showcasing how dedication to environmental stewardship can coexist with economic prosperity. New ideas, tools, and partnerships will be needed to reach the high levels of conservation required for a system to meet today's greenhouse gas reduction goals and be sustainable for future generations.

SECTION 1: INTRODUCTION

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STATEMENT OF PURPOSE AND METHODOLOGY

This white paper aims to establish a path forward for the bourbon industry to decarbonize the corn sourced from Kentucky, identifying the status of the climate commitments and emissions of the bourbon value chain and opportunities and barriers to collective action. This effort is focused on the corn production node of the bourbon supply chain but seeks to define an approach that leverages the participation of the entire value chain. Such an approach requires buy-in from a variety of actors to be successful, so our analysis also seeks to articulate the primary stakeholder needs that must be met in potential collaborative programs.

To establish baseline conditions, areas of opportunity, and barriers to action, The Nature Conservancy (TNC) interviewed 34 different stakeholders belonging to six different sections of the value chain. In addition to interviews, TNC hosted two stakeholder workshops, the first to introduce the goals and objectives of this work, and the second to gather feedback and create alignment on the proposed path forward. Throughout, TNC engaged a diverse set of stakeholder groups in the region that included farmers, farmer adjacent organizations (e.g., commodity groups), academics and research institutions, distilleries and brands, and conveners of sustainability initiatives throughout the value chain. TNC adhered to our internal guidance and best practices on stakeholder outreach, which includes ensuring free, prior, and informed consent (The Nature Conservancy, 2024). More information about the stakeholder engagement process and interviewing methods can be found in Appendix 1.

In addition to the extensive stakeholder outreach, TNC conducted a desktop literature review. The goal of the literature review was to assess the publicly available information related to Kentucky corn

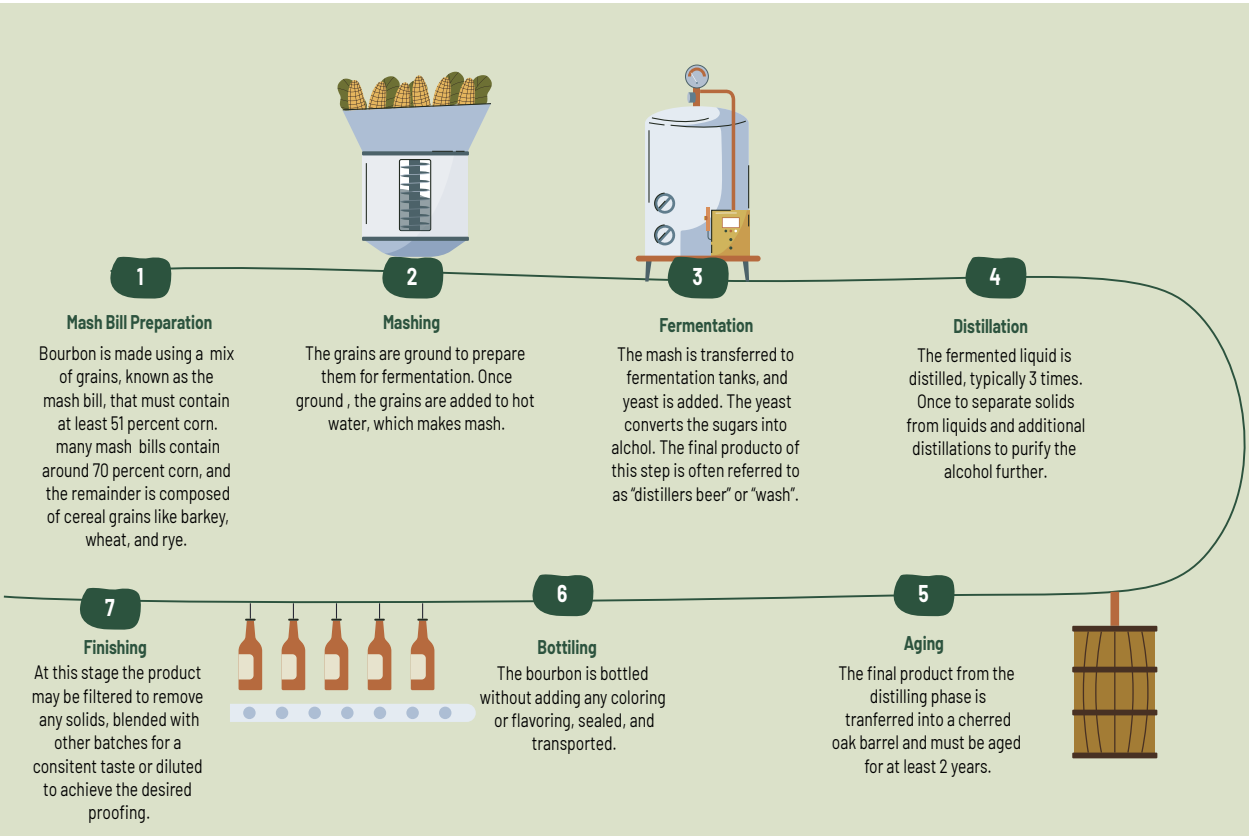
production, bourbon decarbonization, and carbon benefits associated with practice changes. The literature review considered information from academic journals, grey literature (information produced outside of traditional publishing channels), industry reports, and publicly available data sources like the United States Department of Agriculture National Agriculture Statistics Service (USDA NASS). Through this workstream, TNC identified opportunities for further research that would aid in corn decarbonization. Information on the literature review process can be found in Appendix 1.

BACKGROUND ON THE KENTUCKY BOURBON INDUSTRY

Bourbon is referred to as "one of America's unique cultural contributions to the world . . . as uniquely and utterly American as jazz or baseball" (Allen, 1998). Given its strong culture, identity, and geographic indication, bourbon has made a unique contribution to the spirits industry (The Oxford Companion to Spirits and Alcohol, n.d.). The earliest reports of distilling in Kentucky place the beginning of bourbon production in the late 1700s, with distillers and distilleries emerging in the early 1800s. The first known advertisement for "Bourbon Whiskey" was published in 1821 (Fryar, 2009). Bourbon has been around as long as the Commonwealth of Kentucky (founded in 1792) and has co-evolved with the state.

What is bourbon, and how is it made?

Bourbon is defined as a type of whiskey made in the United States and distilled from a combination of grains (mash bill) that has at least 51% corn in addition to rye, wheat and potentially other grains. A typical bourbon will have a mash bill that contains upwards of 70% corn (What is Bourbon? n.d.). The grains are ground and mixed with hot water to convert starches into sugars and fermented with yeast to produce a "wash" or "distillers' beer." The "wash" is distilled a minimum of two times, creating a high-proof spirit that is then aged in a new charred oak barrel for at least two years. After aging, the bourbon is filtered, diluted to the appropriate proof, and bottled. No flavoring or coloring is added as the charred barrels give the bourbon its unique color. The above mentioned steps in the bourbon production process are illustrated in Figure 1.



Bourbon Value Chain and Industry Overview

Bourbon was historically produced in only a few counties in Kentucky, and while most of the production remains centralized within a delimited area, production has expanded throughout the state. According to the 2023 Kentucky Distillers Association (KDA) report, the state license database indicates that there are distilleries in 100 distinct locations, 52 cities, and 42 counties (Figure 2; Coomes & Kornstein, 2023).

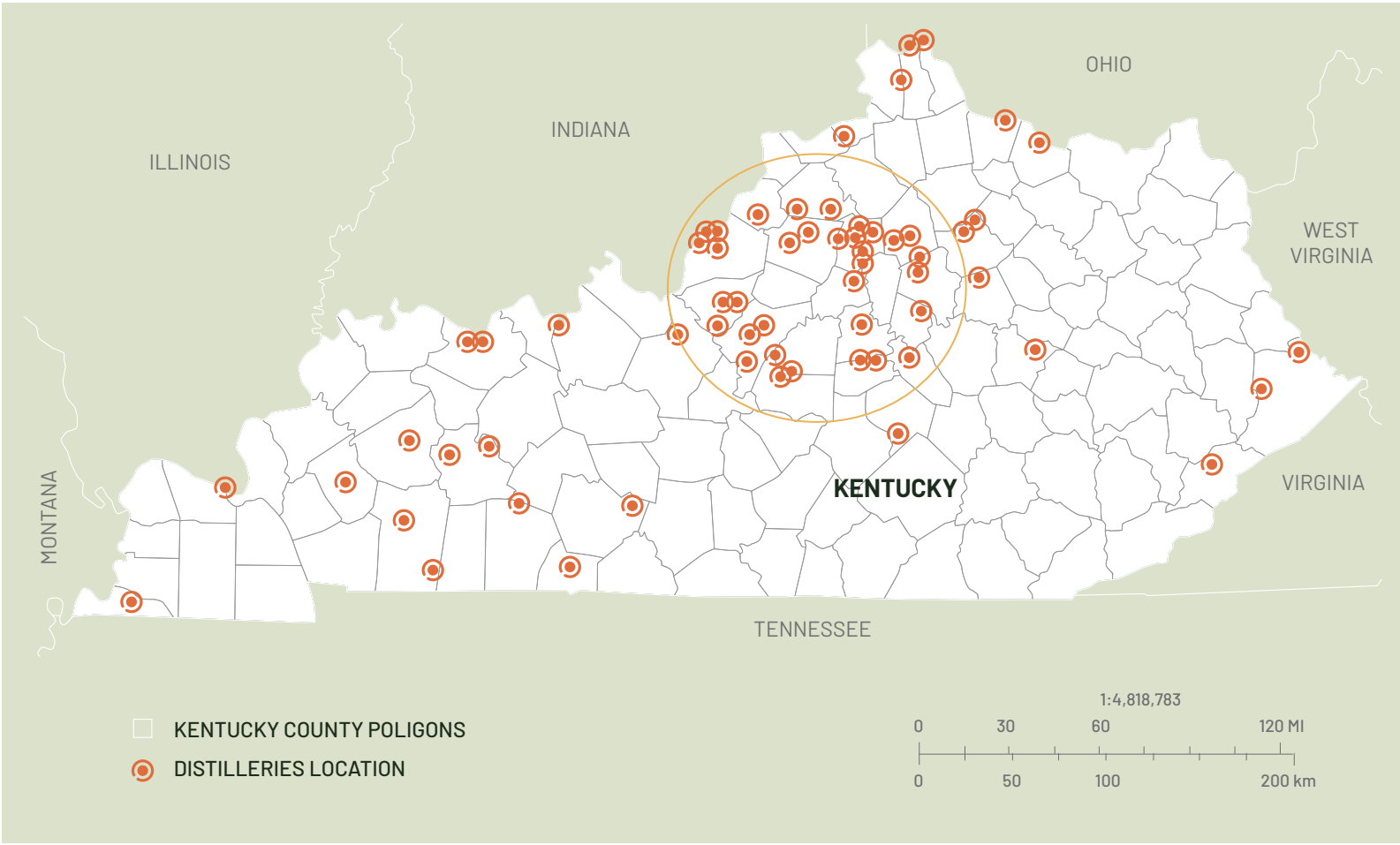
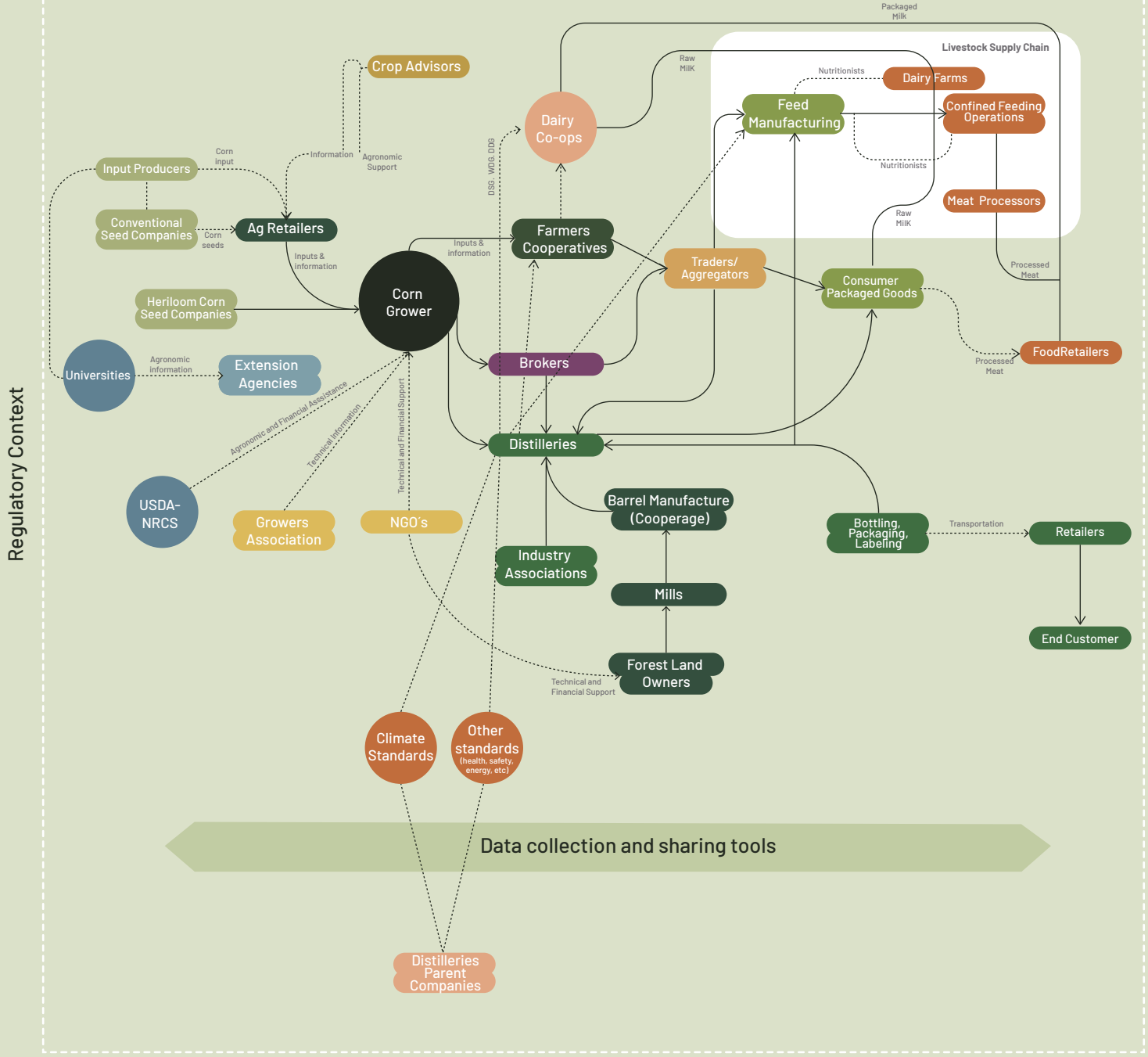


Figure 2: Map of Kentucky's bourbon distillery locations (List of Licensed Kentucky Distilleries, 2022). The distilleries are concentrated in the Inner and Outer Bluegrass Physiographic Regions of the state, marked within the green circle.

Kentucky produces 95% of the world's bourbon and has an organized value chain to support the production, processing, transportation, and sales of the bourbon. Similar to other value chains dependent on agricultural commodities, bourbon is embedded in a complex interplay of various supply chains that rely on the land's productive capacities. Figure 3 illustrates the complexities and interdependencies that exist within and are connected to the Kentucky bourbon industry.

This work aims to understand and evaluate opportunities for decarbonizing the corn production associated with this supply chain. Thus, the farmer is shown as the center of this value chain matrix. A network of organizations supports farmers, including agronomists, input producers, ag retailers, extension agents, local NGOs, NRCS, and growers' associations outlined in Figure 3. The bourbon sector is closely linked to the feed sector in Kentucky because the by-product of distilling can be used as feed

for livestock in both dried down and wet forms. The supply chain operates within a complex policy and economic context, which is not fully illustrated through the figure but is explored and analyzed as part of this work. Also illustrated in this graphic is the cooperage (barrel production) industry, which has been successful in implementing some sustainability strategies that contribute to advancing positive collective action. The entire bourbon value chain is complex, but because the distilleries and farmers operate in close geographic proximity, there is a great opportunity to explore improvements, pilot projects, and share learnings related to grain production and its procurement strategies.



Bourbon production has steadily increased over the past 10 years (Figure 4). This increase in production has partly happened due to large distilleries increasing their manufacturing capacity, as well as the increase in the number of smaller craft distillers. However, bourbon's year-over-year growth has begun to slow down; the sales volume of U.S. whiskey, including bourbon, dropped 1.2% in 2023, which was the first decrease since 2002 (Chaudhuri, Saabira, 2025). Although current reports suggest a slowdown, long term the industry is still projected to grow.

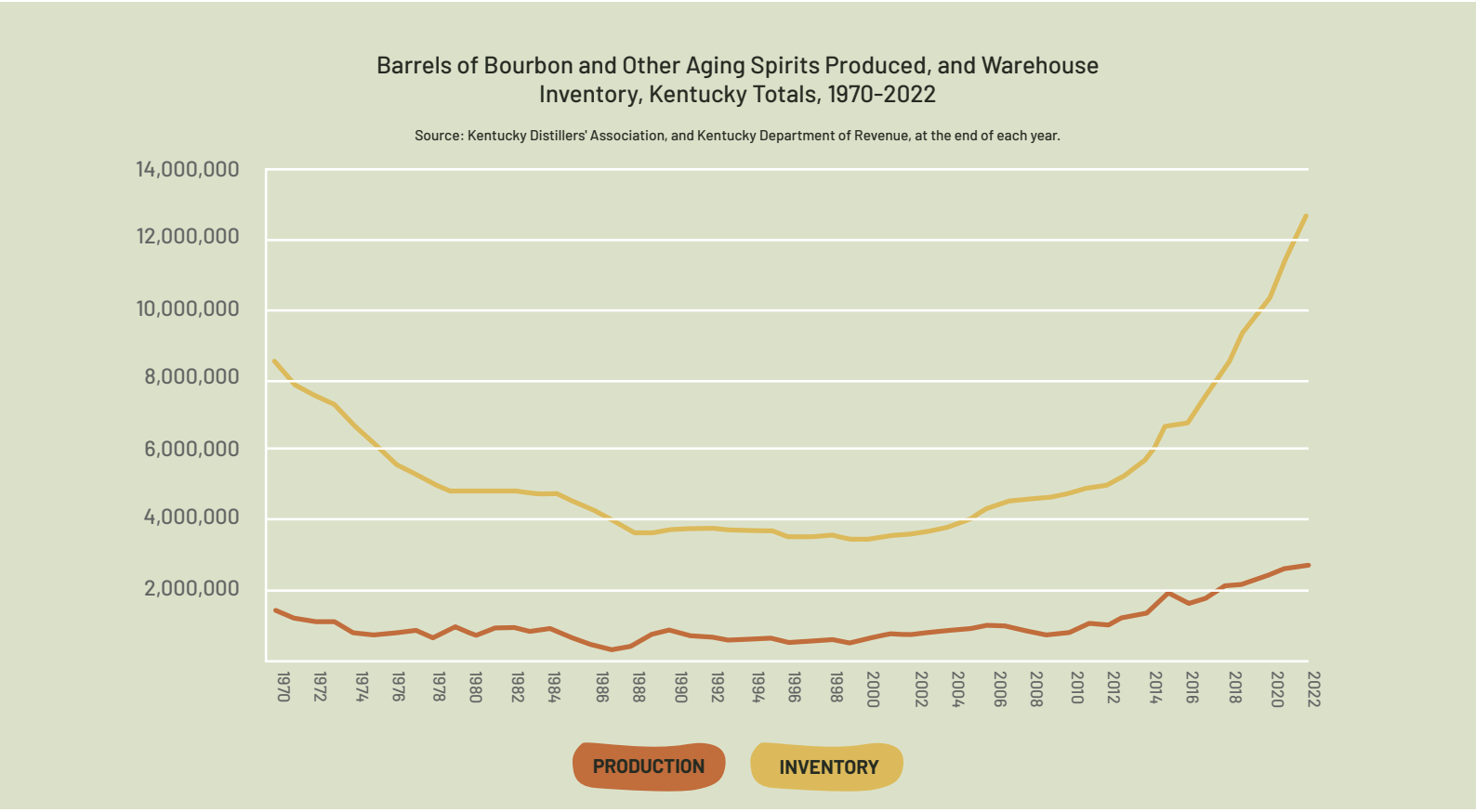


Figure 4: Bourbon production and warehouse inventory, showing a steady increase since the early 2000s due to what is known as the Bourbon Boom. Source: 2023 KDA Report.

Aside from producing a culturally significant good, the bourbon industry represents an important tax base and is a consistent employer of people in Kentucky. As of 2023, there were 100 distilling locations operated by 84 companies. According to the latest available data, in 2022, distillers produced 2.7 million barrels of bourbon, and 12.6 million barrels are aging in storage. Despite the traditional dominance of Kentucky in the distilling industry, the rapid increase of craft distilleries across the United States has led to a reduction in the state's share of the national distilling industry from 24% to 6% over the period from 2001-2022 (Coomes & Kornstein, 2023). Regardless of the decline in production representativeness, the bourbon industry remains profoundly significant to the people of Kentucky. This enduring importance is evident in the automatic connection to this State that comes to mind when anyone mentions "Bourbon"—a true testament to its deep-rooted cultural legacy in the region.

Bourbon's unique contribution to Kentucky's economy

The 2023 Kentucky Distillers Association (KDA) report indicates that the distilling industry significantly benefits Kentucky's economy, supporting approximately 23,100 jobs and generating around $9 billion in economic output (Coomes & Kornstein, 2023). This benefit directly translates into a positive influence of the bourbon industry on the state's employment rates and tax contributions. In 2022, distillers generated a remarkable $226.8 million in state and local tax revenues from production-related taxes and an additional $130.6 million from consumption-related taxes. Furthermore, distillers in Kentucky paid $1.96 billion in federal excise taxes on alcohol production (Coomes & Kornstein, 2023).

THE BOURBON INDUSTRY'S CONNECTION TO AND INFLUENCE ON KENTUCKY AGRICULTURE

Kentucky distillers have built their brands and products around producing a bourbon that is unique to Kentucky. The KDA began reporting increases in locally sourced grains, including corn, in 2014 (for more detailed information, see Appendix 2). In prior years, there was minimal mention of the role of localized grain sourcing in the production of bourbon. Through stakeholder interviews, it was noted that some farmers have been selling their products to bourbon distilleries since the 1950s, emphasizing the strong relationship and mutual commitment that exist between many farmers and this industry. While there has always been some level of local sourcing, the prioritization of locally sourced grain for bourbon production was enhanced during the 'bourbon boom' of the early 2000s. Prior to this period, most of the corn needed for this beverage was sourced from neighboring midwestern states. However, distillers recognized the opportunity to minimize transportation logistics, as well as deepen their relationship with farmers and generate a unique story to tell the industry's customers. As a consequence of this localization process, the corn growers in the region have also evolved and adapted to meet the needs of the growing bourbon industry. The deep connection between the producers and the industry is unique because the growers sell either directly to distilleries or go through local aggregators that sell the grains to nearby bourbon producers. This means that the number of intermediaries between the farm and the manufacturing node is small, and much of the corn used in distilling Kentucky bourbon does not travel farther than 50 miles. This is very different from the corn supply chains associated with other types of consumer-packaged goods, where a corn grower sells their crop to the nearest elevator and then loses visibility into the rest of its processing journey. The more localized model has created closer relationships between corn growers, aggregators, and distilleries that allow for increased communication and product specificities.

About 9% of Kentucky's corn production enters the bourbon supply chain, 60% is used for livestock and poultry feed, 10% is grown for ethanol, and the remaining 20% is used for food products (Lee, et al., 2022; Corn Is All around You., n.d.). In Kentucky, corn is grown throughout the state, but most of the production is located in western Kentucky (Figure 5). However, as noted before, bourbon production is not the only or primary destination of the corn produced in Kentucky. In fact, the corn grown in the western half of the state, where production is highest, is being used for animal feed or being sold to aggregators for other uses like ethanol.

According to the 2023 KDA report, based on member surveys projected onto the industry at large, it is estimated that the entire Kentucky distilling industry purchased 28.3 million bushels of corn, 19 millions of which are estimated to be sourced from Kentucky (Coomes & Kornstein, 2023). The bourbon industry also utilizes other grains such as wheat, rye, and barley (which are most common in a bourbon mash bill). In 2023, it purchased 2.6 million bushels of these other grains from Kentucky farmers and 13.2 million bushels in total. Not captured in the report is the distinction between GMO and non-GMO corn being sourced locally and from other places. From stakeholder interviews and desktop reviews, it appears the larger "heritage" distillers are sourcing non-GMO corn to comply with export regulations in some countries (Nielson, 2025). Distilleries that responded to the KDA survey also reported that they source 70% of their corn from Kentucky, which is an increase from the first report released in 2014, which stated that they only sourced 40% of their grain from this State. In comparison to the typical commodity markets, corn for bourbon has a constrained and consistent geographic footprint, which translates into a key opportunity for the industry to collaborate and co-invest.

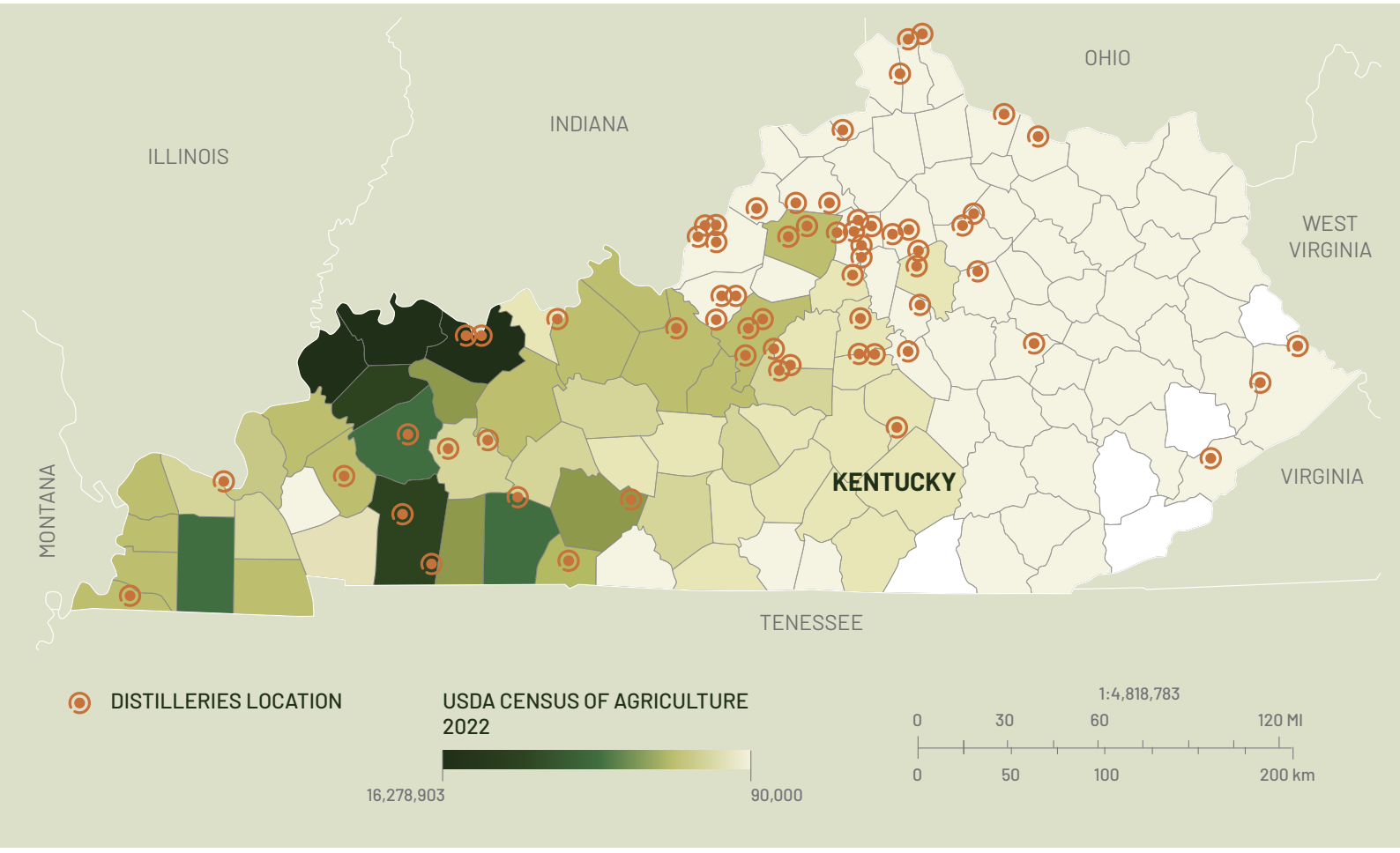


Figure 5: Kentucky Corn Production in 2022 from USDA NASS and location of Kentucky distilleries across the State (Knopf et al., 2024).

As part of this work, TNC conducted a series of interviews with farmers to gain an in-depth understanding of how the corn is delivered to the distilleries. There are significant differences between corn entering the bourbon value chain and corn being transported to an elevator for other uses. Most

notably, corn delivered to a distillery is delivered 'just in time,' meaning, a specific amount at the request of the distillery when needed. Whereas a farmer would prefer to deliver a large portion or all of the harvested crop to an elevator, a distillery only wants to keep enough corn on site for a few days of production. Because of this dynamic, farmers and aggregators supplying to the distilleries must invest in storage and transportation infrastructure to meet the 'on-time delivery' requests of the industry. Distilleries also require corn to be cleaned and dried to 14%; this is 1.5% higher than the percentage level required by most grain elevators. Increased drying requirements likely translate to increased use of corn dryers, which require fossil fuels to operate, leading to higher greenhouse gas (GHG) emissions on farms (Tallaksen, n.d.). Like on-farm storage bins, the drying requirements represent an added specification from the bourbon industry.

These additional requirements have created an opportunity for some farms in the area to serve as aggregators, cleaners, driers, and transporters of corn to the distilleries. This local aggregator role has emerged to meet the demands of a growing bourbon industry, especially benefiting the smaller farmers who do not produce enough to sell directly to distilleries or lack the on-farm equipment to meet their specifications.

Corn acres in Kentucky peaked in 1917 with 3.85 million (1.6 million hectares) and have remained at approximately 1.2 million to 1.5 million acres (490,000-600,700 hectares) since the 1970s. The main reason behind the decrease in average corn acreage after 1917 was the technological advancements that made it possible to produce more corn on less land. Also, soybeans emerged as a major commodity, competing for acres and defining a typical crop rotation in Kentucky.

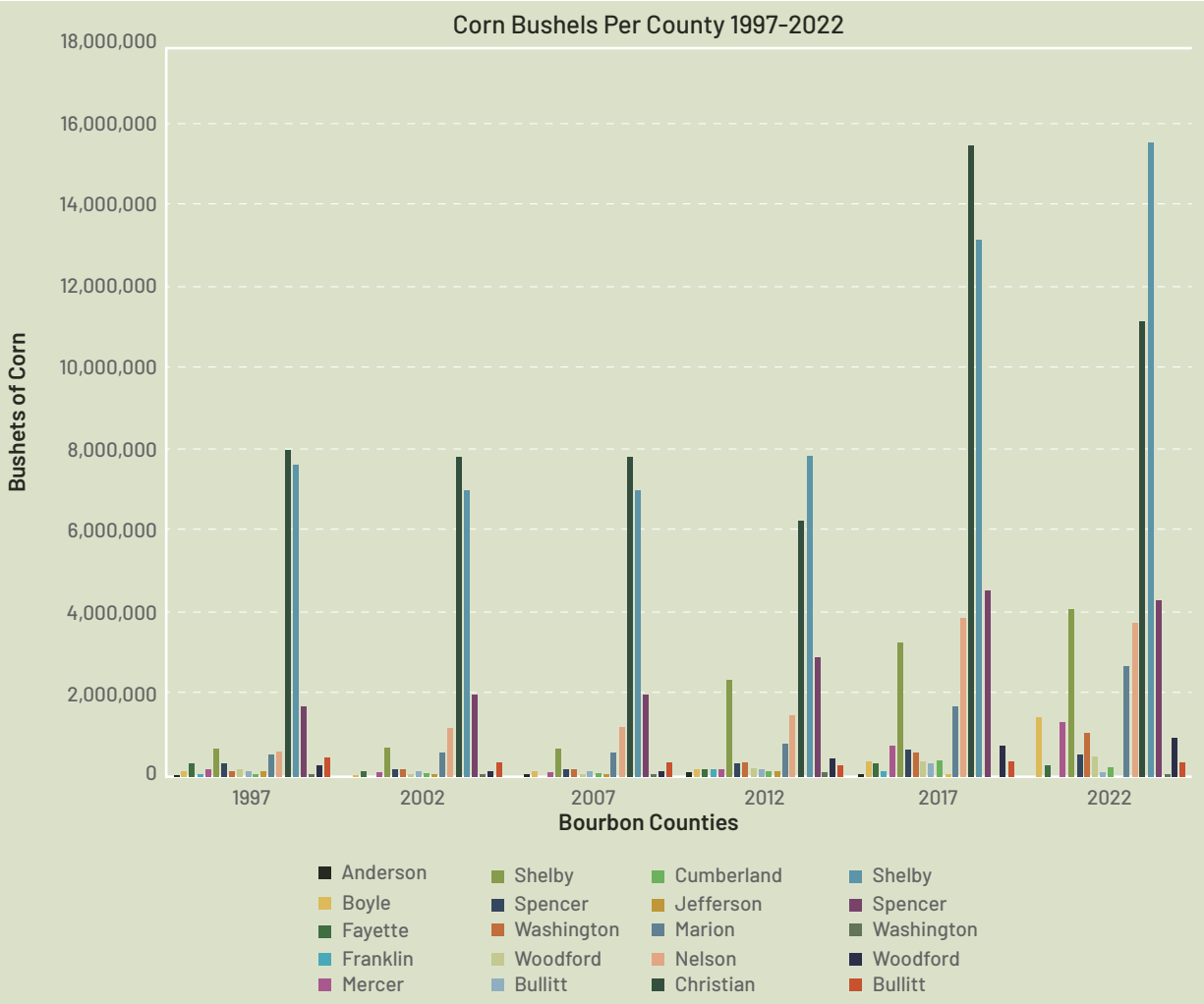


Figure 6: Bar graph illustrating bushels of corn produced in key counties from 1997 to 2022 using USDA NASS (United States Department of Agriculture National Agricultural Statistics Service, 2022).

Figure 6 is a subset of key-bourbon-producing counties and shows bushels per county of corn produced from 1997-2022 using the USDA NASS data (Appendix 3 has the table of values used to generate this graph). As this data shows, corn production has consistently increased in these counties since 1997. This analysis attempts to understand the implications of increased corn production and better characterize the land use associated with the acres that are now producing corn.

In Kentucky, both yellow-dent corn and white-dent corn are grown, but bourbon production relies primarily on yellow-dent. Other typical uses for this product are animal feed, ethanol, corn sugar in foods, yellow cornbread mixes, and other distilled whiskey. White-dent corn, on the other hand, is mainly grown for human consumption, such as cornbread, corn grits, tortillas, polenta, and other food items. Cornstarch is used in absorbents, biodegradable plastics, and for other uses, and corn oil is used for food. The intention of this white paper is to focus on the corn going into the bourbon value chain, but the characteristics of this product and the way it is produced are often similar to the corn entering the above-mentioned value chains. Consequently, much of the information and recommendations included in this document are also relevant to these other industries and sectors and call for a collaborative and comprehensive approach to decarbonization that impacts all connected value chains.

During the interviewing process, many stakeholders emphasized how advanced Kentucky farmers are relative to their peers in the rest of the country, in terms of their rate of adoption of certain regenerative practices. This is confirmed by an analysis The Nature Conservancy conducted in 2017, assessing no-till and cover crop adoption rates across the state. According to NASS data, at this time, there was a 68% adoption of no-till acres. While in 2022, this value dropped to 64%, Kentucky maintains one of the highest no-till adoption rates in the United States, in part because much of Kentucky farmland is highly erodible (see Appendix 4 for more details), and over time, producers have incorporated practices that prevent soil erosion and enhance their productivity. For comparison, in 2022, the no-till adoption rate across the United States was 38%. Figure 7 illustrates the distribution of no-till adoption across different counties in Kentucky in 2017. The highlighted counties represent where much of the bourbon production occurs, and it evidences the high rate of adoption of no-till practices in this area, even compared to the rest of Kentucky.

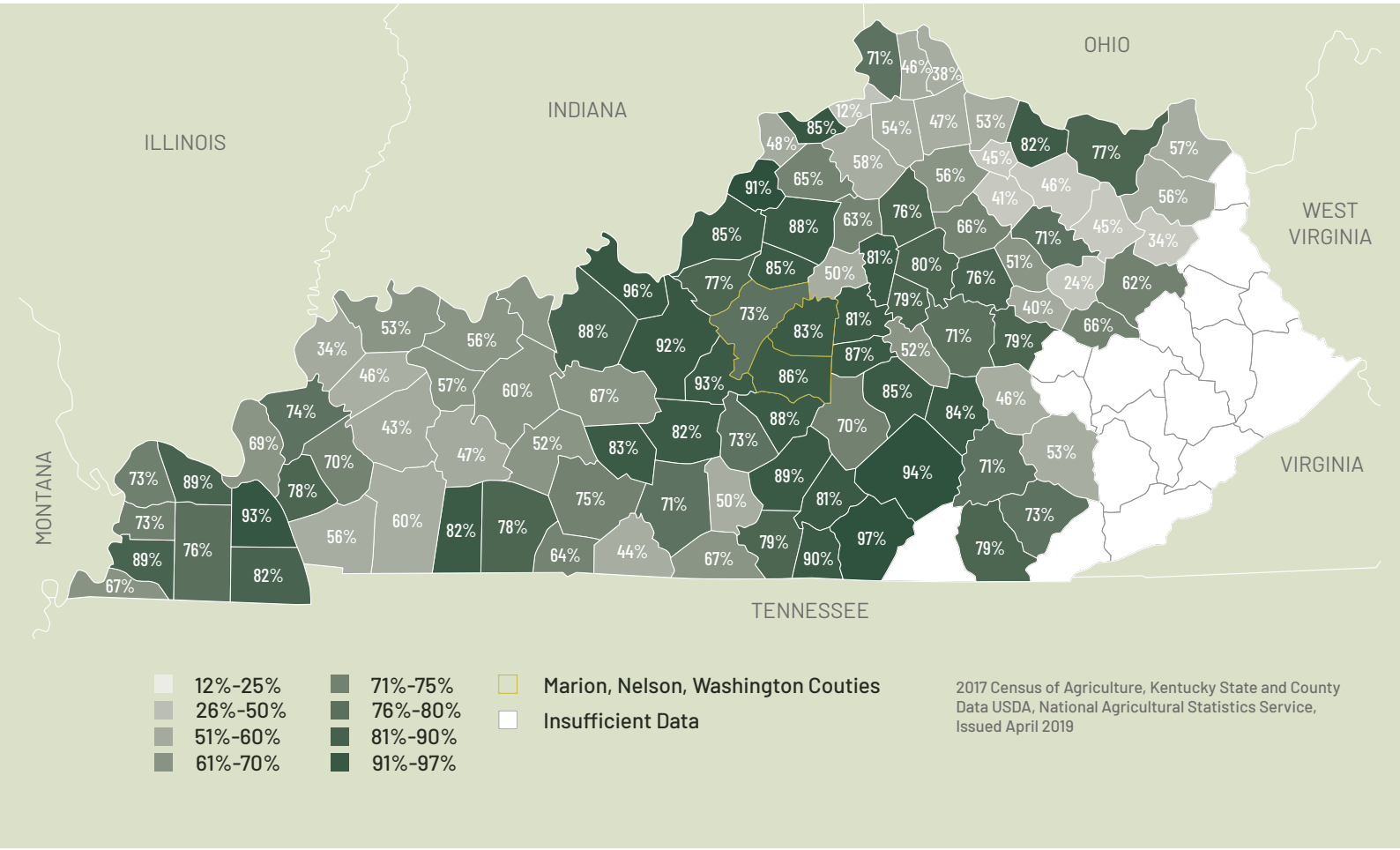


Figure 7: No-till or reduced tillage practices in Kentucky bourbon counties, according to the 2017 USDA NASS data.

According to the information accessed through this analysis, a typical rotation in this region is composed by corn-soybeans or corn-wheat-soybeans. To better characterize the existing crop rotations and land use dynamics, we undertook an analysis of the crop rotations in key bourbon counties, as well as an assessment of the land use types over the past 16 years.

An overall increase in corn acres in key bourbon counties, along with anecdotal mentions of rising row crop acres at the expense of pastureland, prompted us to investigate land use change more thoroughly. Understanding land use change is crucial not only for grasping greenhouse gas dynamics but also for achieving the right balance between various land use types and meeting the needs of nature and people.

For this analysis, key bourbon counties were isolated, which can be found in Appendix 3, based on the list of counties included in the Kentucky Distillers Association reports. This assessment was performed using R and ArcGIS Pro, and the NASS Cropland Data Layer (NASS-CDL) from the years 2017-2024. The initial analysis conducted with pixel-level data revealed some inconsistent classifications within the fields. For example, a single forest pixel in 2021 appears as cropland in 2020 and 2022 while being fully surrounded by other cropland pixels. Such single-pixel anomalies resulting in conversion misclassification are a result of normal error from the underlying data. To reduce the noise in estimating conversion from natural land cover to cropland, the Crop Sequence Boundaries data

was also analyzed. While this data is informed by NASS-CDL, it assigns a single majority land cover class to an entire field, minimizing the occurrence of single-pixel errors. Additionally, the results were refined by excluding fields with improbable rotation patterns. For instance, there were several cases where a field was classified as cropland one year, forest the next, and then back to cropland the following year. Such transitions between cropland and forest require several years to occur and do not happen annually, so removing these fields from the analysis could be done with a high level of confidence.

The outcomes of this initial analysis show that there has been consistent annual conversion into cropland, which appears at least once in the rotation for the entire analysis period. The analysis estimated the largest area converted in 2017 and 2018, with additional conversion each year, tapering to about 15% of the area estimated during this period. The estimated conversion acreage from 2017 to 2018 and 2023 to 2024 are likely overestimated because they may include some false natural land cover classification for 2017 and false cropland classification for 2024, respectively. These cases can be further investigated using high-resolution satellite imagery to gauge the magnitude of conversion and spatial concentrations, particularly potentially recent conversion. Regardless, the more conservative annual conversion estimates for 2018-2023 substantiate the order of magnitude estimate for the bookend years and support the hypothesis that cropland is expanding. It is important to note that this analysis does not assign causality, and we recommend that the bourbon industry and other value chains sourcing Kentucky corn perform additional analysis to better understand the context and main drivers of this conversion. This could be achieved by pinpointing specific fields and farms for interviews or by conducting a broader analysis of conversion factors in Kentucky, such as comparing the profitability of corn with that of livestock. Finally, this analysis has also shown that the conversion rates into cropland have slowed down. However, if the industry continues to grow and increases the amount of corn sourced locally, understanding the potential risks of re-expanded land conversion and the possible losses of biodiversity and stored carbon will be crucial to mitigating bourbon's environmental impact. For summary values used in this analysis, see Appendix 10.

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SECTION 2: SUSTAINABILITY IN THE KENTUCKY BOURBON INDUSTRY

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BACKGROUND ON RELEVANT CLIMATE STANDARDS AND EXISTING BOURBON SUSTAINABILITY GOALS

The bourbon sector relies on productive lands by sourcing grains and white oak barrels to manufacture its products. Because bourbon is made from agricultural goods, the land sector activities contribute to the industry's greenhouse gas emissions and create sector-wide and individual climate risks and dependencies. The industry's reliance and impact on nature and climate creates an opportunity for the sector to address its climate and other environmental impacts, while inaction represents a business risk. To aid companies in understanding, measuring, and monitoring their climate and nature impacts, as well as the supply chain risks associated with both, there has been an increase in the expansion of standards and frameworks. This report focuses on climate and the need to decarbonize Kentucky corn production but also acknowledges that corn production does not happen without impacting nature overall, even beyond the inherent interactions between climate change and biodiversity loss. In Appendix 5 there is a summary of the organizations and standards most relevant to the bourbon industry's climate impact, measurement, and reporting. Corporate climate reporting frameworks focus on an individual company's supply chains and individual actions that can be taken, quantified, and incorporated as progress toward a company's climate targets.

The proliferation of climate standards and target-setting frameworks has created a set of guidance and incentives for companies to address their climate impact. One remaining gap is how companies should appropriately capture the impact of supply chain initiatives in their greenhouse gas inventories. By collectively addressing both shared value chain emissions and decarbonization challenges, the industry and individual companies can reduce greenhouse gas emissions and enhance carbon removals, leading to tangible progress on their climate commitments.

In order for companies to successfully decarbonize their operations and value chains, they must: 1) inventory their direct (scope 1) and indirect (scope 2 and 3) emissions, 2) set a science-based and time-bound target for reducing those emissions, 3) establish a strategy to deliver on their target, and 4) implement new initiatives and strategies to reduce these emissions (SBTi Corporate Net-Zero Standard V1.2, 2024). Finally, this progress must be tracked and incorporated into an updated inventory to demonstrate progress (Figure 8).

Figure 8: Steps for a company to inventory their emissions, set targets and reduce emissions.

Developing a greenhouse gas (GHG) inventory is a critical step in corporate climate action, enabling companies to identify GHG-emitting hotspots in their own operations and value chains, set emissions-reduction targets, plan and implement strategies to reduce their climate footprint, and report on their contributions to national and international climate goals. For most food and beverage sector companies, the large majority of emissions (typically ~ 90 percent or more) arise from activities occurring upstream and downstream of the company's owned assets or operations (Mckinsey, 2024). Based on our stakeholder interviews and analysis of publicly available sustainability reports, this holds true for the distilleries and spirits companies as well, with over 80% of their emissions coming from their supply chain activities (Table 1, Appendix 6). There are not publicly available GHG inventories for individual distilling operations located in Kentucky; therefore, these estimates are based on companywide GHG inventories.

Supply chain emissions are not directly controlled by a company and are classified and inventoried as scope 3 emissions by the Greenhouse Gas Protocol (GHGP). Because of the outsized impact of value chain activities, comprehensive scope 3 inventories and corresponding reduction strategies are foundational for organizational climate goals in the agriculture sector. The importance of corporate awareness and reporting of their supply chain emissions mainly relies on the fact that businesses are part of an economic and productive system, and the actions of one node in the value chain can impact the decisions made by its corporate peers, suppliers and customers. Most actors in a supply chain are interdependent, and analyzing the climate impact of one company by only focusing on its direct emissions undermines the importance of their decisions' impact on other supply chain activities. In the context of the bourbon industry, examples of activities that generate scope 3 emissions and may be influenced by the rest of the value chain include the production and processing of agricultural inputs (e.g., fertilizers), the purchase of agricultural commodities (e.g., corn), land use change, land management, glass bottle purchasing, and product transportation.

The Greenhouse Gas Protocol Land Sector and Removals Guidance (GHGP-LSRG) draft outlines appropriate methodologies to account for and report GHG emissions and removals from agriculture, forestry, and land use change. These methodologies involve understanding the extent (and, where possible, the specific location) of relevant value chain activities, relating this information to the quantity of GHGs emitted or carbon sequestered by those activities, and, finally, aggregating across all land-based activities within the boundaries of a company's value chain.

A scope 3 inventory is based on activity data and emission factors that can be developed using primary or secondary data, or a combination of the two. Primary data is specific to an individual company's value chain and is obtained through direct measurement or collection, whereas secondary data is generic and includes industry or regional averages, proxy data, and publicly available databases, statistics, or literature, among other sources. The GHGP requires reporting on 15 scope 3 categories; those most relevant to upstream land-based emissions are below (Table 1).

Table 1: Examples of categories and activities included in a scope 3 inventory with land-based emissions.

Scope 3 Category	Examples of Primary Data
Purchased Goods and Services (Category 1)	↘ A supplier- specific emission factor calculated utilizing insights about specific on-farm practices, like cover cropping and tillage.
Fuel and Energy Related Activities: not in scope 1 or 2 (Category 3).	↘ Combustion rates and fuel amounts from on-farm fossil fuel use

Due to the scale of most companies' value chains and the lack of traceability within them, it is typically difficult and costly to collect primary data to quantify GHG emissions of all activities within the boundaries of a scope 3 inventory. Therefore, companies usually rely on standardized values from secondary data sources to estimate the emissions factors associated with their value chain activities within a specified geographic scope. In the Kentucky bourbon industry, because 70% of the corn is sourced locally, there is an opportunity to collect data and calculate refined emissions factors. According to the GHGP LSRG, including net carbon removals in a scope 3 inventory requires more precision than is afforded by an emissions factor, necessitating the use of primary data derived from direct measurement to accurately estimate net changes in carbon stocks. It is also important to note that while it may not be feasible at the scale of an entire inventory, primary data can be obtained from specific suppliers or supply-sheds and used to improve the accuracy of a company's scope 3 inventory. Direct or on-site measurement can also be applied at a project level to better understand emissions sources and trial emissions reduction strategies, as well as refine existing models and emissions factors.

Emissions Inventorying vs. Impact Reporting

An emissions factor (EF) is a value that approximates the quantity of net GHGs in carbon dioxide equivalents (CO_2e) released to the atmosphere per unit of an activity in a given location. EFs are used to estimate corporate scope 3 GHG inventories by multiplying the extent or rate of an activity by the appropriate EF. For example, to account for upstream transportation and distribution of a purchased product in a company's scope 3 inventory, the mass, distance, and mode of each shipment (i.e., extent/rate of activity) is multiplied by the appropriate mass-distance EF for the vehicle used in the following formula:

$$\textbf{CO}_2\textbf{e emissions from fertilizer application} = EF_{fertilizer}\,(kg\ CO_2e/kg) \times Rate\ fertilizer(kg/ha) + EF_{fuel}\,(kg\ Co_2e) \times Rate_{fuel}\,(liters/ha)$$

When considering more complex processes that contribute to a company's scope 3 inventory, like the production of purchased agricultural commodities, information related to the extent and impact of multiple activities must be combined. Each activity that contributes to the product has its own EF, which can be combined in such a way to obtain an EF representing the impact of producing the commodity on a mass/volume or area basis. For example, determining the contribution of the production of purchased corn would require a company to combine activity data and EFs from fertilizer production, fertilizer application, tillage, other land management practices and conversion.

Depending on what the company wants to measure, they may use either an inventory (emissions factor) or an intervention approach, per the draft GHGP LSRG.

If a company wants to measure and report its total annual scope 3 emissions in alignment with GHGP, they must use an inventory accounting approach. If the company wants to measure the change in emissions in mt CO2e resulting from a specific activity or project, GHGP has draft guidance for monitoring the out-of-scope benefits using intervention accounting (often also referred to as project or consequential accounting). These will generally be activities a company can undertake to better understand the impact of specific actions if they were scaled across their supply base, i.e., for their eventual inventory. While these out-of-scope benefits are not counted in a scope 3 inventory, they are still useful to inform decision making supporting the scopes. Note that GHGP received many comments on this inventory versus intervention bifurcation in the draft LSRG guidance, so it is likely to be refined in the final guidance. See the GHGP memo on inventory and intervention accounting for more detailed information (Greenhouse Gas Protocol, 2023).

Scope 3 emissions reductions, removals, and carbon credits are often confounded in the current language surrounding corporate decarbonization. Currently, there is no pathway for carbon credits outside of a company's value chain to be included in their GHG inventory or for the credits to be used to progress towards a company's SBTi commitment. Carbon credits generated within a company value chain are called "insets" and can be reported outside of a company's inventory as a separate line item. Currently, the Science Based Targets initiative does not allow for the use of carbon credits to make progress on a company's science-based target, except in the case where the company has reached its net zero target year and needs to neutralize residual emissions. Table 2 outlines the distinct characteristics between scope 3 projects designed to update a company's inventory compared to carbon credit projects. For more detailed information on the difference between a Scope 3 and crediting approach, see Appendix 7.

Bourbon companies and distilleries should refer to the latest guidance from SBTi, GHGP, SASB, and VCI when inventorying their emissions, setting targets, and designing implementation strategies to reduce their emissions. It is essential that the bourbon industry account for their scope 3 emissions to better understand their climate footprint and areas of collective opportunity to decarbonize their value chain. The climate standards space is nascent and evolving, which makes individual and collective action imperative to create actionable ways to implement the guidance from these standards and decarbonize the bourbon value chain. Despite this uncertainty, it is still possible to take action. The larger brands and distilleries have begun undertaking this effort using these standards and frameworks to inventory emissions and set science-based targets (Appendix 8).

Bourbon distilleries and their parent companies have made significant climate, water, and other sustainability commitments (Appendix 8). Among the climate commitments, there is a trend of setting a commitment to be net zero across the entire value chain by 2050. These commitments demonstrate that there is interest and opportunity to work collaboratively to decarbonize the bourbon value chain. None of the companies have made specific commitments around bourbon. Still, because of its high degree of traceability and low raw material cost, bourbon presents an opportunity for

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companies to update emissions factors based on primary data and make progress on their scope 3 climate commitments. Even though the larger distilleries have set specific climate commitments, there is no overarching industry commitment to create connectivity between the larger distilleries, mid-size distilleries, and craft distilleries. Companies only focusing on their own value chain emissions limits overall connectivity and opportunities for shared learning, leading to collective emissions reductions.

CLIMATE IMPACT OF THE KENTUCKY BOURBON INDUSTRY

In order to address emissions associated with the production of corn in Kentucky, there needs to be a concrete and agreed-upon high-level emissions assessment of bourbon as a product and corn's contributions as a critical ingredient for its production. The literature review indicated that the climate impact of bourbon, as a distinctive spirits product, hasn't been adequately assessed and published. There is no publicly available Life Cycle Analysis (LCA) for bourbon that the industry can use to identify and act upon key GHG emitting categories and processes. An LCA evaluates environmental, social, and economic impacts. Originally developed over 40 years ago for hazardous materials management, LCA methods stem from risk assessment and mitigation strategies (Matlock et al., 2022). From the perspective of corporate climate reporting, life cycle analyses can enhance the precision of Scope 3 data inputs for a GHG inventory and facilitate a deeper exploration of GHG inventory Scope 3 areas, including purchased goods and services. Additionally, LCAs can be utilized to comprehend a product's production impact on other environmental factors, such as air pollution and water availability and quality, among others, allowing for a more comprehensive understanding of the industry's influence and dependence on ecosystem services.

Leveraging LCAs to better plan for sector-wide action is not new to the beverage industry. The Beverage Industry Environmental Roundtable (BIER) conducted a study to quantify the emissions associated with the North American Spirits production and allocate them across the various inputs and activities involved in this process (Beverage Industry Environmental Roundtable, 2012). This was done in addition and to complement the individual company efforts to quantify their emissions in alignment with GHG inventory standards. The pie chart below characterizes the findings of this study (Figure 9, Appendix 9). The study was conducted using both column and pot distillation, but because bourbon is typically distilled using column distillation only the values for column distillation are included in this section.

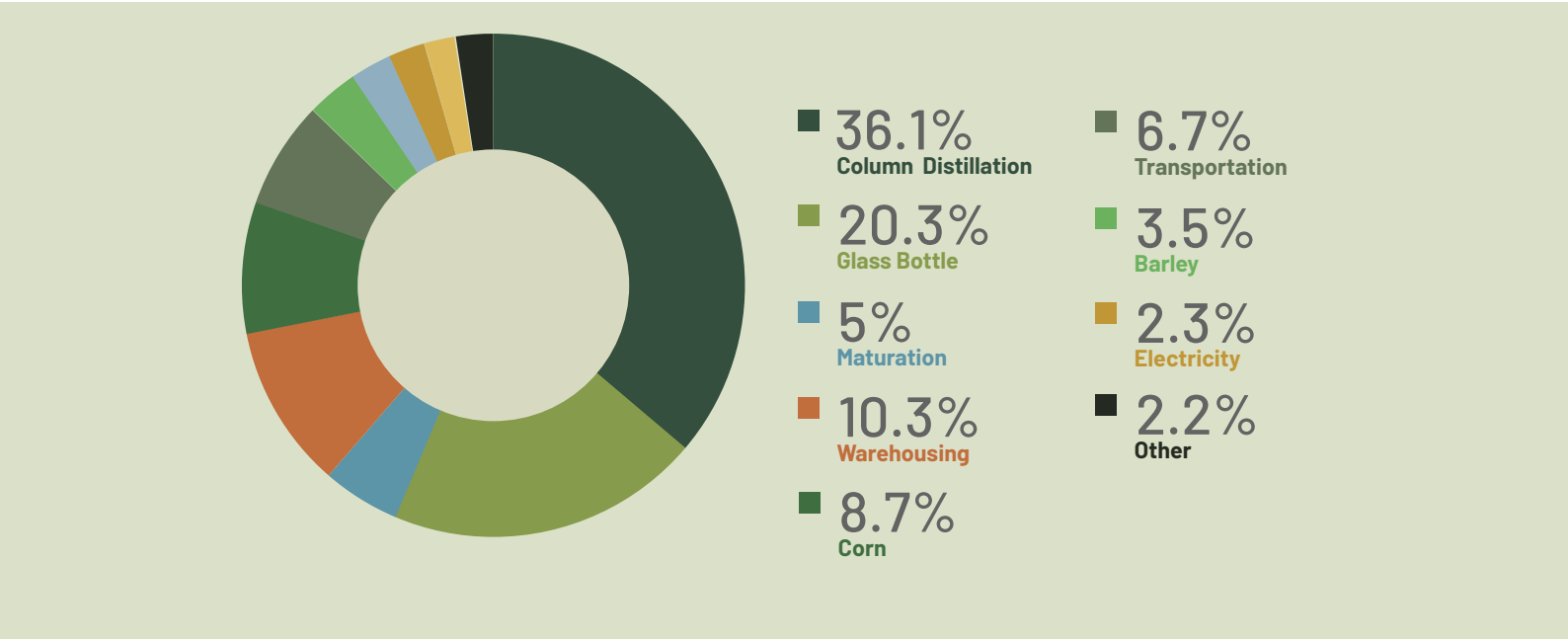

Figure 9: Pie chart of the emissions categories associated with producing a North American Spirit. Source: BIER LCA Analysis.

This high-level overview of a North American spirit's LCA lays the foundational understanding of the major emissions categories the bourbon industry should pay attention to. The analysis indicates that corn makes up approximately 9% of total emissions for a North American spirit distilled using column distillation. This LCA was conducted using a functional unit of a 750 ml glass bottle. Emissions per one 750ml glass bottle are 2750 grams (2.7 kg) of CO_2e, which is the equivalent of 7 miles driven by an average gasoline-powered passenger vehicle (Environmental Protection Agency, n.d.-b). From our interviews with farmers, they identified a need to understand how much their corn is contributing to the carbon footprint of bourbon. While BIER's analysis offers enough information about the representation of this commodity in the spirits industry's emissions profile to satisfy some of the farmers' questions, it lacks the specificity needed for concrete and coordinated action across companies and the supply chain to reduce this impact.

The emissions categories and their values, presented by the BIER, broadly align with the LCAs published for other types of spirits. For example, a cradle-to-gate economic and environmental LCA conducted for Spanish whiskey found that for every liter of this product there were 2.2kg of CO2e being emitted (Beverage Industry Environmental Roundtable, 2012). This analysis highlighted that the hotspots for Spanish whiskey production are linked to the manufacturing phases of glass bottle packaging, distilling the grain into alcohol, and the grain production.

Cradle-to-farm-gate greenhouse gas emissions from corn production include upstream inputs, on-farm operations, land use, and post-harvest activities. Fertilizer production, particularly nitrogen-based fertilizers, is energy-intensive and results in significant CO_2 and N_2O emissions, alongside emissions from pesticide and herbicide manufacturing. On the farm, soil emissions from nitrogen application contribute to N_2O release, while fuel combustion in tractors, irrigation pumps, and other machinery emits CO_2. Land use change, tillage, and residue decomposition further impact emissions by releasing stored carbon from soil and biomass. Additionally, energy use for grain drying, storage, and transportation contribute to the overall emissions profile of corn. The total emissions depend

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on farm-specific management practices, including fertilizer application, tillage, irrigation, rotations, and baseline conditions like soil type and weather.

OVERVIEW OF TOOLS TO MEASURE GHG OUTCOMES

LCA's are typically focused on calculating emissions and removals associated with a product. Empirical (or primary) data is essential for accurately calculating carbon removals in agriculture systems because it provides site-specific measurements of carbon fluxes and emissions. Without empirical data, removals estimates rely on assumptions, general models, or indirect calculations that may not fully represent the actual conditions of a given area, practice, or system.

Currently, there is a disconnect between on-farm emissions calculators (e.g., Cool Farm Tool) and the values companies are using in their inventories. This disconnect is one of scale, where some companies are aggregating EFs derived from various scales, which can mask locally- or farm-specific challenges or opportunities. The more specific data is incorporated into a company's inventory, the more tailored their action plan can be. These on-farm GHG calculators are currently used to conduct farm level emissions estimations but require significant data entry from their operations. The Cool Farm Tool (CFT) is an online greenhouse gas (GHG) calculator designed to help farmers, agribusinesses, and food supply chains measure and reduce their carbon footprint. Developed by the Cool Farm Alliance, it provides insights into GHG emissions, carbon sequestration, biodiversity, and water use associated with different farming practices. Cool Farm Tool is seen as a preferable tool by multi-national companies because it can be used across many geographies, and it is relatively simple to utilize. However, this calculator still relies on global or national-level emission factors. Locally developed tools or models allow for more tailored results that can still be plugged into corporate climate inventories while better reflecting the specific regions' realities. The COMET-Farm Tool (Carbon Management and Emissions Tool) is an example of a US based GHG emissions tool using a biogeochemical model to estimate farm and ranch greenhouse gas (GHG) emissions that has been developed by the USDA and Colorado State University. It helps farmers, ranchers, and land managers estimate the carbon footprint of their agricultural operations and explore strategies to reduce emissions and enhance carbon sequestration. On-farm GHG calculators offer a systematic way for farmers, their advisors and companies to collect primary data and calculate emissions while tracking the progress being made through time as the industry implements initiatives to reduce their climate impact.

On-farm GHG calculators offer a systematic way for farmers, their advisors and companies to collect primary data and calculate emissions while tracking the progress being made through time as the industry implements initiatives to reduce their climate impact.

OVERVIEW OF INDUSTRY INITIATIVES ADDRESSING SUSTAINABILITY CHALLENGES TO DATE

The Kentucky bourbon industry has already taken collective steps toward addressing material sustainability issues within the value chain. Throughout the stakeholder interview process, four initiatives were mentioned the most frequently: the Kentucky Rye Initiative, the White Oak Initiative, a recently announced multi-stakeholder project focused on corn production, and the sustainability meet-ups hosted by the Kentucky Distillers Association. These efforts demonstrate that the industry is ready and willing to work together to address sustainability, climate, water, and biodiversity challenges. These projects offer initial lessons learned and a foundation to build a more cohesive sustainability strategy and a collective action model for the industry.

The White Oak Initiative

This initiative is a collaborative effort aimed at ensuring the long-term sustainability of white oak forests in the United States (White Oak Initiative: Who We Are, 2025). White oak is a critical hardwood species used in the production of bourbon barrels. Declining regeneration rates and forest management challenges threaten its future supply. The White Oak Initiative has successfully established an agreed-upon problem across the industry and brought together a diverse set of stakeholders to address long-term sustainability of white oak tree populations. In order to establish this collective effort, Brown-Forman and the Dendrifund made an initial investment, and an ask of other distilleries to match their investment, which created a collective where distilleries had buy-in, and a foundation to bring other relevant stakeholders to the table. This effort has resulted in resources for an assessment and conservation plan report, and the introduction of the White Oak Act (White Oak Resilience Act, 2024). The White Oak Act addresses white oak shortages expected in the next 10-15 years. It emphasizes white oaks' crucial role in ecological health, economic stability, and the bourbon industry. Key provisions in the act empower the Department of the Interior (DOI) and the Forest Service to engage in restoration efforts, promote private investment, and create a dedicated restoration fund to ensure sustainable white oak regeneration on national forests (Barr Introduces Legislation to Ensure Longevity of Kentucky Bourbon Industry, 2023).

The Kentucky Rye Initiative

This initiative is another collaborative effort by the bourbon industry to reintroduce commercial rye production to Kentucky, benefiting local agriculture and industries, which includes bourbon. Historically, rye was widely cultivated in Kentucky, but its production declined over the past several decades(American Farmland Trust, n.d.). The initiative seeks to reverse this trend by encouraging farmers to integrate cereal rye into their crop rotations. The initiative has garnered support from industry partners like Woodford Reserve, which has committed to purchasing rye from Kentucky farmers over a five-year period. This effort collaborates with the University of Kentucky to research rye varieties suitable for the state's climate. This partnership aims to develop a locally adapted rye variety, reducing reliance on imports and strengthening the local supply chain while at the same time establishing a local demand for the rye. By introducing rye into a rotation farmers are able to diversify their rotation with an additional winter crop, and if the rye is harvested this represents additional revenue for the farmer. Currently, this effort is continuing the slow work of adapting the

rye to the Kentucky context and ensuring it meets the same quality standards of rye being sourced from outside of Kentucky. This work demonstrates that the bourbon industry is willing to invest in innovation to support the diversification of Kentucky farmers' rotations

Regenerative Corn Farming Pilot

A coalition of four spirits companies—Brown-Forman, Diageo North America, Heaven Hill Brands, and Suntory Global Spirits—along with the Kentucky Distillers' Association (KDA) is launching a five-year, $2.8 million initiative to support Kentucky corn farmers. Partnering with Precision Conservation Management (PCM) and the Kentucky Corn Growers Association (KYCGA), the project aims to promote regenerative agriculture in the bourbon industry by providing farmers with resources and expert guidance. Beginning in 2025, the initiative will fund additional specialists to assist farmers in capturing data related to implementing sustainable corn-growing practices across 100,000 acres in central Kentucky. These efforts are intended to help farmers reduce administrative burdens, improve land health, and enhance economic and environmental sustainability. Participants will receive financial incentives for adopting practices such as reduced tillage, cover cropping, and optimized nitrogen use, benefiting both the agricultural sector and the bourbon supply chain. The initiative also includes PCM's financial benchmarking program, offering farmers free access to data-driven insights to inform conservation decisions from an economic perspective (Kentucky Corn, 2025).

The Kentucky Distillers Association's Sustainability Meet-ups

The Kentucky Distillers Association (KDA) is a non-profit trade organization representing the interests of Kentucky's bourbon and distilled spirits industry. The KDA advocates for members in legislative spaces and through economic growth opportunities and plays an essential role in convening distilleries in pre-competitive spaces to advance the shared goals of the industry. The KDA has four levels of membership: heritage, proof, craft, and educational, which correspond to a number of barrels in the inventory. Heritage members have an inventory of over 50,000 barrels, while Craft members have fewer than 10,000 barrels. The major producers in the distilling industry in Kentucky are the Bardstown Bourbon Company, Beam Suntory, Brown-Forman, Campari, Castle & Key, Diageo, Four Roses, Heaven Hill, Bacardi, MGP, Michter's, Pernod Ricard, Sazerac and Willett. All of these, except Sazerac, are KDA members. The KDA is an essential avenue for competitors to work together to address sustainability issues throughout the bourbon value chain and has demonstrated this by hosting sustainability meetups for KDA and non-KDA members to share lessons learned, new ideas, and sustainability challenges.

These various sustainability efforts strongly suggest that there is an opportunity and interest in working collectively between competitors. Furthermore, the industry has a chance to catalyze the current efforts into more extensive collective actions by incorporating not only the entire value chain, but also entities from value chains connected to and reliant on the same Kentucky natural resources and ecosystem services. By leveraging and expanding the existing efforts, there is an opportunity to truly advance the industry's sustainability efforts.

SECTION 3: RECOMMENDATIONS FOR DECARBONIZATION IN KENTUCKY CORN

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BOURBON INDUSTRY COLLABORATIVE STRATEGY

The purpose of this white paper is to identify areas of opportunity to decarbonize the Kentucky bourbon grain supply chain. The stakeholder interviews provided the best source of information in combination with existing literature to identify key opportunities for the industry to address this purpose collectively. A primary finding from this process was the existence of various examples of collaborative sustainability initiatives across the industry that involve different areas of the value chain while also engaging researchers. Still, there lacks a cohesive effort to address supply chain emissions, set actionable targets and develop a strategic roadmap to address these goals.

The Scotch Whiskey Association (SWA) serves as an example of a concrete, industrywide sustainability strategy that has been developed and tested for over 15 years (Sustainability in the Scotch Whisky Industry, n.d.). In 2009, the Scotch Whiskey Association developed their initial sustainability strategy, which was then updated in 2021 to reflect new learnings, data, and progress. A critical component of their updated sustainability strategy is to conduct a greenhouse gas emissions inventory for the entire industry that focuses on scope 1, 2 and 3 emissions (Sustainability in the Scotch Whisky Industry, n.d.). Creating a comprehensive, industrywide inventory lays the groundwork for collective and strategic decarbonization. This strategy calls out scope 3 (value chain) emissions as the most difficult hurdle that needs to be overcome by the industry. The legal implications of this type of pre-competitive and industrywide strategy need to be further evaluated for anti-trust implications in the United States.

In addition to inventorying the industry's emissions, SWA has set industrywide targets that include decarbonization of direct operations by 2040, and decarbonization across all scopes by 2045. The SWA

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strategy does not only focus on climate, but it is modeled after the United Nations' Sustainable Development Goals (SDG's) and includes goals around circular economy, responsible water use, and responsible land use (Sustainability in the Scotch Whisky Industry, n.d.; United Nations Department of Social and Economic Affairs, n.d.). To reflect this, the industry has set additional commitments to circular packing production, contributing to the conservation of peatland, and using water responsibly. The example of the SWA strategy has important lessons to be learned by the bourbon industry to mobilize finance and advance the industry collectively. The SWA was able to mobilize finance by emphasizing to their members the cost savings associated with co-funding and emphasis on maintaining a stable supply to produce their spirit. Like bourbon, scotch is being produced in a limited geographic area with deep cultural ties to the place. Investing in the industry as a whole and unifying disparate sustainability efforts under a cohesive strategy would invite the participation of the entire value chain (not just large distillers). This would also increase opportunities for data sharing and lessons learned and would lead to quicker sustainability advancement across the entire industry.

Figure 10 proposes a high-level model of the bourbon industry sustainability collective approach that would amplify existing collective action efforts and create avenues for holistic involvement by the entire value chain. This strategy needs to be developed through a coordinated multi-stakeholder initiative that creates a shared vision across the supply chain and develops a concrete action plan that includes discrete objectives, expected milestones, and a feasible timeline. A common concern among the interviewees was the challenge of coordinating across different types of organizations without an entity or individual being responsible for this task. Consequently, one of the first steps should be to establish a pre-competitive home and coordinator for this strategy and dedicate funding and personnel to lead the formalization of this effort. Establishing a rhythm of activities and a neutral moderator for the discussions that arise during decision-making processes is essential for creating a space that invites diverse voices to the table and advances the agreed-upon objectives. When implemented together with full industry support, the reach of these efforts will be enhanced by mobilizing all the available resources to tackle the underlying challenges for an effective decarbonization of Kentucky corn production.

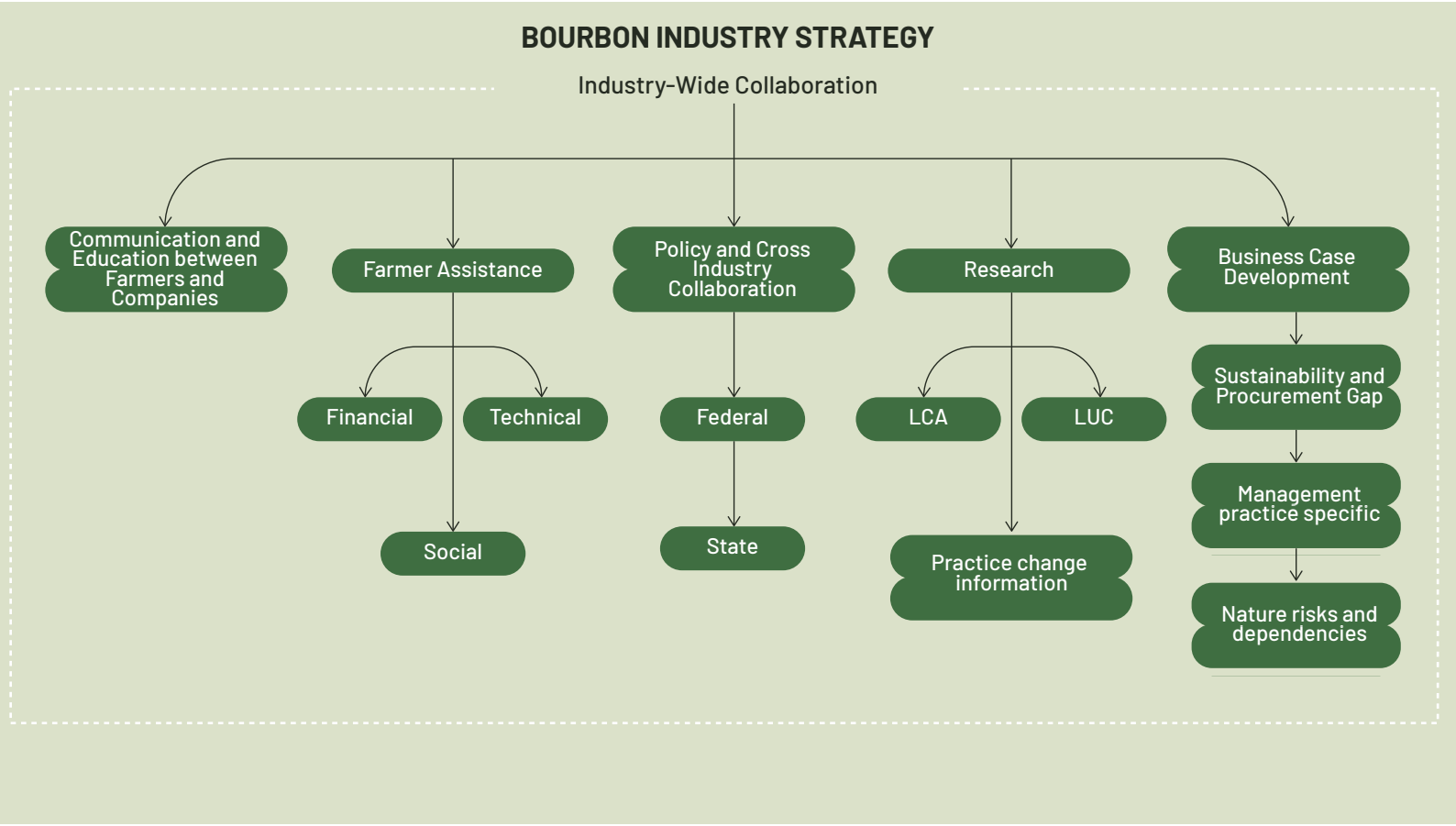

Figure 10: Proposed high-level model for a bourbon industry sustainability strategy and the identified opportunities for collaborative action.

DESCRIPTION OF OPPORTUNITIES

Developing a collective sustainability strategy creates the foundation to catalyze the decarbonization of corn being produced in Kentucky. Collective and strategic action takes time, but the interviews and literature review also revealed immediate opportunities for decarbonizing the corn supply chain. A collective strategy creates the opportunity to involve the entire value chain and delineate clear pathways for each value chain actor to contribute to the ongoing decarbonization efforts.

Improve Communication Between Companies and Farmers

During the stakeholder outreach, TNC identified a clear opportunity for distilleries to better communicate their sustainability targets and approach to the farmers they are sourcing from. The interviews with farmers revealed a high level of interest in better understanding the types of targets companies have set and the contributions of farming activities to the emissions profile of the bourbon being produced. Moreover, they are interested in learning how the adoption of regenerative practices would affect the GHG emissions a company is reporting. Without the availability of a Kentucky bourbon-specific LCA or quantitative estimates of the impacts of certain farming practices on the industry's GHG emissions, wider education and adoption of on-farm GHG estimation tools like Cool Farm Tool and

COMET-Farm Tool can provide an immediate opportunity for farmers and companies to understand the emissions profile of the corn they are producing. This effort could in turn inform the industry's efforts in generating an industry-specific LCA.

In addition to improved communication on target setting and GHG emissions, interviewed farmers expressed a need for companies to clearly differentiate corporate decarbonization efforts from those being implemented by carbon credit developers. As discussed in Section 2, there are key differences between a company's internal decarbonization efforts and the generation of a carbon credit that could be sold outside of the bourbon value chain. Due to the strong connection between Kentucky farmers and the bourbon industry, farmers can better relate to the decarbonization efforts of a value chain they are clearly a part of. This means that producers shouldn't just be the target or audience for many of the bourbon industry's initiatives but rather partners and active contributors.

In addition to this farmer interest, the stakeholder interviews revealed that distilleries and companies are not always familiar with the realities of farming. Therefore, increased understanding of farmers' decision making, economic realities and production practices can lead to more productive conversations and better designed and implemented programs to address greenhouse gases. Farmers in the bourbon supply chain have proven their willingness to meet the industry's expectations on grain quality and are now eager to continue deepening their understanding and relationships with distilleries and spirits companies as they advance in their sustainability journeys that can position Kentucky Bourbon as a differentiated product in retail store aisles.

Enhance Farmer Assistance

Farmers interviewed through this project were asked about the types of financial incentives and technical support that were most attractive to them, and the role the bourbon industry could play in supporting their operations to reduce GHG emissions. Unsurprisingly, there was a variety of answers, but some key areas of agreement. First was, the identification of the financial and labor barriers to implementing cover crops on additional acres. All interviewed farmers can be considered advanced in their adoption of conservation agriculture and have adopted cover crops to some degree across their operations, which has given them a good insight into the resources needed to incorporate this practice at various scales. Most producers cited the lack of flexibility of local NRCS programs that provided cost-share incentives, like planting date and seeding rate. More importantly, farmers cited that financial constraints were not the only barrier to increased adoption, but that the additional labor needed to plant more cover crops presented another limitation. This is a unique challenge that will require innovative solutions to tackle, such as scaling of new cover crop planting methods or increasing capacity through custom applicators or ag retailers expanding to offer conservation as a service. Expanding cover crop acreage can play a significant role in mitigating climate impacts in Kentucky corn systems. By capturing atmospheric CO_2 through photosynthesis and increasing soil organic matter, cover crops contribute to carbon sequestration while also controlling soil erosion and improving soil health. If farmers incorporate legumes into their cover crop mix, they can also increase the available nitrogen in the soil and potentially reduce the need for synthetic fertilizers.

The stakeholder interviews with farmers did not reveal a clear preference for payments for outcomes over payments for participating in programs. Farmers did mention that the reason they did not more actively participate in NRCS cost share programs was due to the inflexible structure of these programs which are designed to maximize conservation benefits but may not fully consider year over year weather or other extraneous factors. There is an opportunity to trial a hybrid payment structure funded by companies which could offer a fixed payment for participation in the program and would allow the farmer to access the financial support needed for implementation. In addition to the fixed payment per acre, farmers would have the opportunity to increase payment received based on the outcomes generated to ensure that farmers are maximizing ecosystem benefits. Per bushel premiums result in lower payments when the yield is less, which creates more financial uncertainty for the farmer. This hybrid method would provide a complement to federal programs, by providing more flexible payments and implementation guidance, while still incentivizing farmers to contribute to ecosystem services.

The collaborative project with the KDA, KDA members, PCM and the KYCGA offers an initial opportunity for farmers to access technical and financial resources that are directly supported by multiple distilleries. This opportunity will provide agronomic and data entry to support and can serve as an opportunity for farmers to better understand the sustainability strategies of the companies participating in this effort. The elevators, and farmers acting as aggregators are an essential node in the value chain to disseminating information about the types of programs corporates are offering to farmers. This effort should be looked to as a key case study and learning opportunity for the bourbon industry.

In addition to technical and financial assistance there needs to be an effort focused on meaningful engagement with farmers and landowners to deeply understand conservation adoption barriers. This is a foundational step to identifying the most impactful opportunities for farmer assistance and the highest ROI on dollars supporting conservation. Understanding these challenges through expansive, open, and honest interviews, focus groups, and surveys will be essential to understanding the social elements of conservation practice adoption. Part of this exploration should also include gaining an understanding of the potential for establishing farmer-to-farmer peer learning networks, which could offer great potential in terms of tackling technical challenges, providing a sense of collective action and a supporting social system.

Finally, when designing programs for farmer assistance, it is essential to consider the climate and nature impacts associated with conversion. Although converting land from pasture or forest to row crops can be economically beneficial to the producer at the time of the conversion event, companies sourcing from that farmer are required to account for the GHGs associated with the conversion event. This applies to any land that was converted in the past 20 years. Many companies have set no conversion commitments and are developing structures to track and reduce commodities being sourced from converted land. When designing programs for farmer assistance, companies and farmer adjacent organizations should develop strategies to financially incentivize farmers to maintain their pasture and forestland. This also presents an opportunity for cross-industry collaboration with the livestock and forestry sector to ensure that the land in those production contexts is healthy, and economically viable, which will minimize the economic incentive of the farmer to convert land into row crops. If conversion has already happened, ensuring farmers appropriately

report this conversion will aid companies in refining their emissions factors and improve their reporting.

Support Critical Research

The desktop literature review and interviews revealed key research gaps that can be addressed through collective funding by the bourbon industry. Firstly, there is no bourbon-specific LCA, and without an updated and representative LCA, it's difficult to align stakeholders, accurately pinpoint emissions hotspots, and estimate the entire bourbon industry's climate impact with accuracy. By investing in an up-to-date life cycle analysis, the industry can collectively identify key decarbonization areas to work on. It's likely that corn will result as an emissions hot spot, but without a published scientific LCA, creating consensus and action may be more difficult. This LCA could be conducted leveraging the existing and future initiatives aiming to support farmers as they implement regenerative practices, including data collection and GHG emissions quantification as a component of the undertaken activities that could inform the experts' analysis.

In addition to an industry-wide LCA, there should be dedicated research on adoption rates of regenerative practices across the critical counties for the bourbon industry. The current best practice is to use the USDA NASS census data to track practice adoption rates, but this official survey only occurs every 5 years and relies upon self-reported data to a significant degree. This makes it hard to properly evaluate the short-term impact of implemented initiatives and to adjust emission factors at the supply shed level with confidence. The industry should consider other methods of conservation practice data collection, including staying appraised of emerging remote sensing products that can identify conservation practices on the landscape.

The industry should undertake an analysis of the feasibility and carbon benefits of new technologies, products and practices not commonly used by Kentucky farmers. This commitment to test new ideas and push boundaries should help to decarbonize Kentucky corn to an extent not possible through more widely accepted conservation practices such as no till, cover crops, and variable rate fertilizer. Collaboration with experts to identify likely candidates will be essential. An initial, non-exhaustive list of practices and technologies to consider for further investigation of feasibility

and net carbon impact include:

- Alternative winter cash crops to add to crop rotation to accelerate expansion of winter cover
- Sensor technology that adjusts nitrogen fertilizer rates based on cover crop species and quantified biomass.
- Biological and bio stimulant products with the potential to reduce the need for synthetic fertilizer.
- Green ammonia, which is produced using renewable energy sources can be used as a low-carbon source of nitrogen for crops.
- Spent stillage from bourbon distilling is recycled into fertilizer that can be applied to cropland. 3 Rivers Energy Partners, Brown-Forman, and Suntory Global Spirits are already involved in this work.
- Perennial grass grown for annual harvest for packaging material, or other novel use cases in marginal or highly erodible areas of cropland; agroforestry, or white oak restoration efforts on marginal or recently converted cropland.
- Re-integration of livestock onto cropland seasonally to graze cover crops or as part of a rotation with row crops.

By further investigating these practices and their carbon benefits the bourbon industry can innovate with farmers to meet their climate goals, scale additional adoption of conservation practices, and share these learnings with other industries in Kentucky.

The literature review also revealed a lack of research on the prevalence of land use change dynamics in Kentucky. Our initial hypothesis, based largely on USDA NASS and cropland data layer products, is that there has been an increase in cropland acres in key bourbon producing counties to meet the demand

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for locally sourced corn. While there is both anecdotal and empirical evidence of an increase in row crop acres in these counties that far outpaces the Kentucky state average, additional research is needed to understand the type of land use change occurring, the greenhouse gas emissions associated with the conversion event, and the extent to which corn supplying the bourbon industry comes from ground converted in some way in the last 20 years. For example, if land use change is taking place from a pasture to row crop, there will be emissions associated, but currently there is not sufficient data to characterize the land use change, and the circumstances under which it occurred.

Lastly, the long-term productivity of local cropland and, therefore, the long-term viability of Kentucky bourbon's sourcing of Kentucky corn is reliant on soil. As already stated, counties producing corn for bourbon contain a very high percentage of highly erodible land, meaning land that has the potential to erode at a rate eight or more times what USDA NRCS considers tolerable. Many of the conservation practices that reduce erosion, such as no till, grass waterways, and grass buffers, can also have a net carbon benefit. While there is universal agreement that soil loss is detrimental to production, there is no tool currently available

that allows a quantification of lost productivity over time because of erosion. Research and development of a soil loss model with improved accuracy (leveraging new technologies such as LIDAR and artificial intelligence) that also estimates productivity loss over time and as modified by various conservation practice scenarios would be highly valuable, allowing farmers and other bourbon industry stakeholders to make more informed decisions based on the economics of soil loss.

Universities especially can act as key partners to the bourbon industry for research purposes. The University of Kentucky already has strong connections within the bourbon industry and is involved in a wide range of relevant research. Faculty from the University of Kentucky were also helpful, for purposes of this white paper, offering their time, insights and perspectives. The University of Kentucky's research facilities and extension staff are well respected within the state. Likewise, the bourbon industry should consider strengthening ties with Kentucky State University, which is a public historically black university (HBCU) and land grant university located in close proximity to distilleries and local corn producers. Kentucky State University is already engaged in research that has relevance to de-carbonization of corn production, and their research farms and cooperative extension program present an opportunity for education and outreach to producers both large and small. Multiple times during the process of creating this white paper, we met with Kentucky State faculty. These researchers are eager to engage in the questions critical to advancing the decarbonization of Kentucky corn. Other local or regional universities may also offer additional research capabilities to the industry.

Drive a Strategic Business Case Development

To further support and increase investments in corn decarbonization efforts by the bourbon value chain, there is an opportunity to develop key business cases to better understand the benefits, costs, and risks associated with the recommendations in this white paper. An identified opportunity for a business case is bridging the gap between sustainability and procurement teams. From the interviews with distillery representatives, it was evident that the sustainability staff often worked independently of the procurement and other operational teams. Many times, directives from leadership and objectives for each unit seemed not to be aligned. For example, the sustainability team may be in charge of reducing GHG emissions associated with corn and, consequently, developed a corn profile that results in lower emissions, while the procurement team's directive is to purchase the lowest cost and highest quality corn. These different directives often act in opposition to each other, and the sustainability team lacks the necessary governance and team structure to imbue sustainability traits into the procurement team sourcing directive. The bourbon distilleries (or the coalition) should develop a business case as to why integrating sustainability across the industry's operations is critical for the sustainability of the supply chain. Once this is presented to the companies' leadership (i.e., the C-Suites) and recognized as the best path forward, businesses can start adjusting their internal organizational structure to reflect the incorporation of sustainability into all business decisions.

For most companies, interactions with nature do not currently impact their market value, the prices of their products, and they rarely affect their short-term cash flows or risk profiles.

Even when such impacts exist, they are not easily reflected in a company's profit and loss statement or on its balance sheet. They remain as "externalities," or issues without internal consequences. However, when companies heavily rely on natural resources and ecosystem services, such as corporations in the food and beverage industries that are highly dependent on agricultural commodities, evidence shows that there are significant costs associated with inaction due to supply chain disruptions caused by extreme weather events and the rapid depletion of natural resources, which represent a major financial risk. Consequently, it is critical that companies integrate natural capital into all decisions so that, ultimately, it becomes an integral part of business as usual (for example, improving soil health to mitigate yield loss from climate extremes, resilience when facing flooding or drought events, or incrementing forested areas in key places where they can provide critical protection against floods or strong winds). Some frameworks have already been developed so companies can assess their impact and associated risks to climate and nature:

- The Task Force on Climate-related Financial Disclosures (TCFD) and its sister initiative, the Task Force on Nature-related Financial Disclosures (TNFD), offer a series of recommendations for companies to appropriately assess, price, and disclose climate and nature-related risks and opportunities.
- The Natural Capital Protocol aims to support better decisions by including how companies interact with nature, or more specifically natural capital, in decision-making. The Protocol offers a standardized framework to identify, measure, and value impacts and dependencies on natural capital.
- According to the World Bank Group , carbon pricing is an instrument that captures the external costs of greenhouse gas (GHG) emissions, reflecting the economic impact of emissions to the environment and society, such as damage to crops, health care costs from heat waves and droughts, and loss of property from flooding and sea levels. An increasing number of businesses are using internal carbon pricing to guide or support their corporate strategic investment decision-making process and help them shift to lower-carbon business models (Carbon Pricing, n.d.) Various organizations have released studies aimed at assisting businesses in creating effective and economical methods to assign a value to the social and environmental costs of emissions. A notable example is the Executive Guide to Carbon Pricing Leadership, co-published by the UN Global Compact and the World Resources Institute, along with partners from Caring for Climate. This guide clarifies the various approaches to internal carbon pricing and includes case studies from companies demonstrating their practical implementation.

These frameworks permit companies to get a foundational understanding of their current situation and what opportunities they might need to pursue to mitigate their impact and reduce the risk associated with climate change or natural degradation. Leveraging this information to develop new business models or adapt the existing ones will allow the Kentucky bourbon industry to be ahead of the overall spirits industry, strategically approaching its decision-making processes. Some components of this analysis should include:

1. The utilization of scenario analysis to quantify the price of inaction in a business. For the bourbon industry, this should consider productivity declines and

the lack of resilience of the agricultural system and how this may disrupt the supply chain's operations and logistics, creating additional costs or revenue reduction.

2. Estimation of the impact of sustainability on brand value or market capitalization. Work with suppliers and product and innovation teams to explore what capitalizing on these opportunities would require and quantify the potential financial gain.

3. Incorporation of the value of underpriced (or unpriced) and overexploited resources like water and nature. This information is critical to account for the cost of using these resources inefficiently, which will impact productivity and the supply chain in other ways that are harder to recognize later in a balance sheet.

4. Identification of opportunities to improve resource productivity (use efficiency) that will also contribute to sustainability targets. Using efficiency-driven cost savings as the launching pad for an ROI story is a powerful way to gain initial cross-departmental buy-in.

5. Formalization of a governance model to bridge the strategy-execution gap. A robust governance model achieves this by establishing the foundation for implementing climate transition strategy through multiple levels of oversight, well-defined decision rights, and supportive routines and policies.

While recognizing and leveraging the business value of sustainability in the corporate sector, it is important to note that farmers will also prioritize their business viability in their decision-making process. To achieve widespread adoption of conservation practices, farmers need actionable financial information to predict whether a new practice will be profitable, or at the very least not harmful, to their operation. Even though recent reports have projected a positive outlook on the profitability of regenerative agriculture systems, it is generally understood that these benefits are mostly present in an operation's long-term economics, while near-term costs are real and the timeline for recognizable revenue in a bottom line is harder to decipher. A 2023 analysis by the Boston Consulting Group (BCG) and One Planet Business for Biodiversity (OP2B) focused on Kansas wheat farmers suggests that transitioning to regenerative practices could yield a 10-year return on investment (ROI) of 10-25%, with long-term profits potentially reaching 120% above conventional methods. However, an initial 3-5-year transition period might see short-term profit losses of 30-60% due to temporary drops in yields. Similarly, Bain and Company assessed four regenerative agriculture practices, finding that farmers might break even within four years of adoption and eventually achieve a 30% increase in profit margins.

The impact of implementing new regenerative practices in an agricultural system will vary across regions and across the agronomic and technological starting points of the farmers in that area. As a result, locally relevant financial information about conservation practices is required for farmers to make informed management decisions, especially as they consider enrollment in private ecosystem

Bain and Company assessed four regenerative agriculture practices, finding that farmers might break even within four years of adoption and eventually achieve a

30%

increase in profit margins.

services payment programs. The previously mentioned regenerative corn pilot involving Brown-Forman, Diageo North America, Heaven Hill Brands, Suntory Global Spirits, the Kentucky Distillers' Association (KDA), Precision Conservation Management (PCM), and the Kentucky Corn Growers Association (KYCGA) represents a promising step to better understand the economics of local conservation, as management data from participating farming operations will drive a field level economics analysis using PCM's economics tool.

Lastly, as the bourbon industry performs a comprehensive cost/benefit analysis that includes externalities and a long-term perspective, the industry should also consider a key advantage that it possesses in terms of the monetary cost of taking action. The raw material cost of the corn in a typical 750ml bottle of bourbon is only about 25 cents (assuming a typical per bushel cost of $5.50). As a point of comparison, this same $5.50 bushel of corn could be used to produce fuel ethanol, costing about $1.95 per gallon of biofuel (Iowa Renewable Fuels Association, n.d.). In 2025, ethanol sells for approximately $2.25 per gallon, with corn making up 87% of that retail price (E15 and E85 Prices, n.d.). On the other hand, corn represents only 1% of the cost of a $25 bottle of bourbon.

A hypothetical investment of an additional dollar for every bushel of corn used in bourbon would equate to just 4.5 cents per bottle of bourbon. It is reasonable to suspect that this nominal additional cost passed along at the retail point of sale would go unnoticed since it would equate to just 1/500th of the retail cost of a typical $25 bottle of bourbon. To even further mitigate any risk, if the industry acted together to pass along this small cost to support conservation, then no single Kentucky bourbon distillery would be placed at a competitive advantage or disadvantage. The bourbon industry is therefore uniquely situated to invest in conservation in an impactful and scalable fashion.

Foster Cross Industry Collaboration and Advance Policy Initiatives

The opportunities for decarbonization and collective action identified in this white paper were developed for the bourbon industry but have a viable application for other industries looking to decarbonize their corn supply chain and engage in collective action. The other industries sourcing corn in Kentucky include animal feed, ethanol, and food production. The bourbon industry should co-identify shared research questions, policies, and sourcing regions to identify shared challenges and areas of opportunity to work with other industries sourcing Kentucky corn.

The bourbon industry should take advantage of the opportunity to work with other sectors that are sourcing corn from Kentucky on joint policy initiatives. These industries include poultry feed, livestock feed, consumer goods companies, and ethanol. An example of this approach is the White Oak Resilience Act, which establishes a voluntary and collaborative group of public, State, private, and NGOs to coordinate the restoration of white oaks in the United States. This initiative directly mentions research gaps, outreach to landowners, and the creation of policy options to improve the quality and quantity of white oak nurseries.

DIVERSITY, EQUITY, INCLUSION, AND JUSTICE

The efforts of this white paper do not explicitly focus on human rights, labor, or historically underrepresented communities. However, it's widely recognized that these issues are core to a holistic understanding of sustainability. Specifically, the bourbon industry should continue to address topics related to equity, diversity, and inclusion that are material to the state of Kentucky and other nodes of their value

chain. The industry has already demonstrated the ability to address these important issues through the launch of initiatives like the Black Bourbon Guild. The Black Bourbon Guild works to document and elevate the contributions that African Americans and other historically underrepresented communities have made to bourbon now and throughout history. Diversity, equity and inclusion should underpin sustainability efforts — for example, gender and racial equity and the rights of migrant workers. It is increasingly clear that addressing these challenges is part of a modern company's "social license to operate", especially in Western contexts, and the bourbon industry should consider the incorporation of related principles and interventions as crucial to achieving sustainable and equitable food systems that comprise a regenerative agricultural transformation. Sustainability strategies should align with the United Nations human rights standards, including the UN Declaration on the Rights of Indigenous Peoples and the principle of providing Free, Prior, and Informed Consent (FPIC). Companies and other value chain stakeholders should apply and monitor social and environmental safeguards and appropriately support the governance, knowledge systems, and self-determined sustainable visions of current and future generations of Indigenous Peoples and local communities. Diversity, equity, inclusion, and justice initiatives should be context-specific and created with the people the initiative is designed to impact.

LIMITATIONS

This white paper was produced using publicly available sources, academic papers, and stakeholder interviews. It does not include empirical data collection and aims to provide a qualitative description of the Kentucky bourbon sourcing area and related recommendations. Additionally, public issues regarding the use or disposal of spent stillage, such as environmental impact and farmers' reliance on it for livestock feed, are complex. An in-depth analysis of these issues was beyond the scope of this white paper. Other identified gaps in data and information have been highlighted throughout this document, and we recommend further research and analysis to address them.

CONCLUSION

The Nature Conservancy engaged stakeholders throughout the value chain via interviews and workshops to assess baseline conditions, challenges, and opportunities, which allowed for contextualization and validation of the information gathered through a comprehensive literature review. While focusing on the decarbonization opportunities at the grain production stage, this analysis emphasizes the need for a collaborative effort that prioritizes the participation of stakeholders across the entire value chain.

The bourbon industry stands at a pivotal crossroads where the integration of sustainability practices into its operational framework is essential for ensuring long-term viability and climate impact reduction. Furthermore, a shared goal of decarbonizing the production activities connected to Kentucky's bourbon corn supply chain presents significant opportunities to align value chain actors' strategies and actions and enhance their impact.

Farmers in Kentucky have been at the forefront of regenerative practice adoption, which is clearly evidenced by the high relative rate of no-till farming. However, there remains a substantial opportunity for the industry to better understand challenges to adoption that farmers face with scaling additional practices such as cover crops, buffers and advanced nutrient management methods. Once the challenges to adoption are better understood,

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then responsive solutions can be developed to expand the acres of conservation practices that will contribute to decarbonization and sustainability. Investments focused on improving existing systems and data to monitor progress in scaling these practices, as well as to evaluate and measure their climate impacts and other environmental benefits, are essential for improving the quality of decisions necessary to catalyze this process.

This document's main recommendation is to develop a collective, industry-wide sustainability strategy that mirrors successful models, such as the Scotch Whiskey Association's long-term approach, which has integrated comprehensive emissions inventories and ambitious decarbonization targets. By fostering collaboration across the bourbon value chain, from retailers to farmers, with a critical role of the distilleries at its center, the industry can enhance communication, share data, and set clear pathways to achieve decarbonization goals. Immediate opportunities include educating farmers on emissions reduction tools and improving financial and technical support for regenerative practices. Furthermore, addressing research gaps, such as developing a bourbon-specific life cycle assessment, will elucidate the industry's climate impact and decarbonization potential. The emerging evidence of land use changes in bourbon-producing regions underscores the need for comprehensive research to holistically evaluate the environmental consequences of agricultural practices driven by the market and policy signals. As the industry navigates the complexities of natural resource dependence and market dynamics, it is vital to quantify risks associated with climate change and environmental degradation, guiding decision-making and strategy development. This will also allow the industry to incorporate natural capital into business operations as a strategic necessity that can unlock new opportunities, safeguard supply chains, and enhance overall resilience. All this information should be leveraged to create much-needed incentives to encourage and support farmers as they transition to a regenerative agriculture system that contributes to climate mitigation and adaptation.

In summary, actors of the bourbon industry have established common decarbonization and sustainability goals, as well as a shared, defined corn sourcing geography. By investing in a collaborative approach that supports research efforts and promotes regenerative and innovative practices, the bourbon industry can lead the way toward a more sustainable future, showcasing how dedication to environmental stewardship can coexist with economic prosperity. Going forward, the next step would be for the industry to establish a pre-competitive home for its decarbonization initiative and come to an agreement on funding and personnel needed to create a formalized industry strategy that includes discrete objectives, budgeting, a system of funding, expected milestones, and a feasible timeline. While some of the recommendations in this white paper will necessarily take time to complete, other recommended actions that will lead to material progress can get underway as soon as the collaborative strategy is developed and formalized.

GLOSSARY

BIER

The Beverage Industry Environmental Roundtable (BIER) is a technical coalition of global beverage companies working together to advance environmental sustainability within the beverage sector(Beverage Industry Environmental Roundtable, 2012).[2]

Carbon Credit

A tradeable intangible instrument that is issued by a carbon-crediting program, representing a GHG emission reduction to, or removal from, the atmosphere equivalent to one metric ton of carbon dioxide equivalent. This is calculated as the difference in GHG emissions or removals from a baseline scenario to the emissions or removals occurring under the mitigation activity, and any adjustments for leakage. The carbon credit is uniquely serialized, issued, tracked and retired or administratively cancelled by means of an electronic registry operated by an administrative body, such as a carbon-crediting program(The Integrity Council for the Voluntary Carbon Market, 2024).

Inventory accounting

Also known as attributional accounting, tracks GHG emissions and removals within a defined organizational and operational boundary over time. It is the primary method used by corporations and other organizations to report emissions from their operations and value chains. Its rules and procedures are detailed within several GHG Protocol standards and guidance including the GHG Protocol **Corporate Standard**, the **Scope 2 Guidance**, the **Corporate Value Chain (Scope 3) Standard**, and the upcoming **Land Sector and Removals Guidance**.

Intervention Accounting

Also known as consequential accounting or project-based accounting, estimates the impacts or changes in GHG emissions resulting from specific projects, actions, or interventions relative to a counterfactual baseline scenario. It is the primary method used to evaluate the emission effects of projects by comparing emissions and removals that happen in the project scenario with an estimate of what would have happened without the intervention. The project-based accounting approach evaluates system-wide emissions impacts of the project or intervention in question, without regard to the reporting company's operational or organizational inventory boundary.

Kentucky Corn Growers Association

A grassroots organization representing the interests of more than 6000 corn farmers throughout Kentucky.

Life Cycle Assessment (LCA)	A life-cycle assessment is a tool that can be used to evaluate the potential environmental impacts of a product, material, process, or activity (Environmental Protection Agency, n.d.).
Non-Governmental Organizations (NGOs)	A non-governmental organization (NGO) is defined as a non-profit organization, group or institution that operates independently from a government and has humanitarian or development objectives. If a NGO is designated to implement a UNDP project, the NGO must have the legal status to operate in accordance with the laws governing NGOs in the program country (*United Nations Development Programme: Non-Governmental Organization, n.d.*).
Natural Resources Conservation (NRCS)	formerly known as the Soil Conservation Service, is an agency of the United States Department of Agriculture that provides technical assistance to farmers and other private landowners and managers (*Natural Resource Conservation Service: About NRCS, n.d.*).

APPENDICES

APPENDIX 1. METHODOLOGY

The Nature Conservancy selected a diverse group of stakeholders and interviewed them to identify the 'current state of play' surrounding corn sourced for bourbon. Each stakeholder was identified and interviewed individually or with peers from partner organizations. The 25+ interviews took place from September 2024 to January 2025 over Zoom, Teams or in person. The below table illustrates the different stakeholder groups, and the number of interviewees per stakeholder group.

Stakeholder Group	Number of Interviewees
Farmers	8
Farmer Adjacent Organizations	6
State and Federal Government	2
Distilleries and Brands	8
Conveners of Sustainability Initiatives	4
Academics and Research	6
Total	34

The interviews were conducted in accordance with The Nature Conservancy's internal Standard Operating Procedures (SOPs) to ensure data privacy, Free Prior and Informed Consent, and to uphold the rights of the stakeholders interviewed. With the permission of stakeholders, we recorded select interviews. We also assigned a primary interviewer and primary note taker in each call to ensure accuracy and adapt to the information shared during the interviews. The available transcriptions were reviewed and coded using the NVIVO software and revisited for key themes and insights.

DETAILED INSIGHTS FROM STAKEHOLDER GROUPS

Farmers

Key Takeaways

The farmers we interviewed are deeply committed to providing corn and other grains to the bourbon industry. The farmers recognized the premium obtained and convenience in supplying grain to the bourbon industry. Equal emphasis was given to the particular needs and quality requirements of the industry when compared to corn sold for other uses. Farmers are keen to understand the sustainability goals and commitments of distilleries and their parent companies so they can make more informed decisions and collect the appropriate data. Farmers agree that additional practices should come with additional payments or incentives, but there is no agreement on this system's structure. The farmers we interviewed who farm a large acreage were farming across multiple counties with different soil types, which added additional complexity to their management systems

Insights

Practice Adoption

- High level of agreement that there are logistic and labor barriers to implementing cover crops across all areas. Farmers have experimented with the type of cover crop, type of application, and time of year.
- Farming across multiple counties complicates the ability to plant cover crops; most farmers who were unable to plant cover crops across parts of their acreage emphasized labor.
- No-till is highly adopted across the farms that we interviewed.
- Farmers with smaller acreage were growing other cash crops and also had cattle operations. Larger operations were focused on corn, primarily, wheat, and soy production.
- Farmers cited having access to agronomic support as a key driver for their ability to implement and experiment with new practices.
- Farmers recognize that there is a need for increased conservation to control erosion even where some conservation practices (like no till) are already in place.
- Regenerative certification and sourcing are viewed as opportunities or added value by some farmers, while other farmers were not interested.

Characteristics of Working with Farmers

- Farmers that act as aggregators and then sell to the bourbon industry have heavily invested in infrastructure (drying, cleaning, storing, and transporting grain); their interest and ability to pivot away from this and to an elevator are limited.
- Farmers are skeptical of anaerobic digestors being installed. Their primary concerns are losing access to the free feed source and the feasibility of applying the digestate to their fields.
- Farmers were eager to learn about the sustainability commitments companies had made and how this could drive the value of their products.
- There are varying levels of agreement on whether there has been conversion caused by the increase in corn supply to the bourbon industry. Multiple farmers note that there has been a shift to increased cropland acres and fencing infrastructure has been removed, implying the shift to cropland is permanent.

Carbon Accounting

- Farmers demonstrated interest in carbon markets and carbon opportunities, but none had participated in a carbon market program.
- Some farmers have participated in nitrogen reduction programs.
- There is limited understanding of the types of data needed to be collected and the different accounting systems used by corporates, carbon markets, and other programs.

Identified Areas of Improvements

- Farmers noted that consultants brought in by companies often times lacked an understanding of the specific Kentucky agriculture context, which makes their recommendations difficult to follow and impractical.

- Multiple programs, certifications, and sustainability offerings are being presented to farmers. Farmers are interested in what can drive value for their operation and meet the needs of the companies they supply corn to.

Incentive Mechanisms

- There was no consistent agreement among the farmers we interviewed about the types of incentive mechanisms that they preferred.
- There was some skepticism relating to existing cost share because of inflexible agronomic guidelines.

Other Insights

- The last bourbon boom in the 20th century sourced corn almost exclusively from the Midwest. Sourcing in the 21st century has increasingly come from Kentucky.
- Over time local emphasis on livestock and pasture has decreased, likely a combined result of livestock market and bourbon.
- The perception from farmers we spoke to is that the vast majority of corn grown within 40-50 mile radius of the different distilleries goes to bourbon.

Farmer Adjacent Groups

Key Takeaways

Among stakeholders considered adjacent or actively supporting farmers, there was a resounding agreement that collective action by the distilleries and brands was essential to overcoming barriers to the adoption of new practices, while also creating a durable financial support. Farmer adjacent groups identified barriers to practice adoption: the need for clearer communication from companies, and the imperative to be specific about what type of carbon program the companies are interested in. Finally, it was emphasized that practice changes must make operational sense, and farmers should be rewarded for the work that has already been accomplished.

INSIGHTS

Practice Adoption

- Some stakeholders mentioned the importance of recognizing the practices that have been implemented, in tandem with striving for more, and new practice adoption.
- Farmer networks were emphasized as an underutilized tool to increasing practice adoption. The peer learning may only be useful if from a localized Kentucky standpoint that addresses real life challenges with conservation.
- Farmer adjacent organizations are highly aware of the interdependencies between grain suppliers, distilleries and farming communities.
- This stakeholder group mentioned that farmers do not take advantage of cost share programs due to seeding rate, timing of planting, etc.
- Also mentioned by this stakeholder group was the need for tailored and context specific agronomic support.
- Some of this stakeholder group observed that larger operations seemed more equipped to make the needed practice changes and corresponding data collection needs.
- Stakeholders in this called out that the

opportunity to work together with farmers, not dictate their practices. KY farmers value the bourbon market but also have other markets as alternatives if necessary.

Carbon Markets and Corporate Decarbonization

- Within this stakeholder group there was a confounding of carbon markets and corporate decarbonization. However, what was clear was that producers need better communication and clear financial values associated with the cost of implementing practices and the financial incentives available to them.

Other

- This stakeholder group had mixed reactions about there being land use change and thought that potentially the increase in corn crop was from tobacco to corn production, not due to converted pasture.
- This stakeholder group identified the additional drying from 15.5% to 14% as an additional requirement for farmers that supply to bourbon, which presents a challenge, and an additional cost for some.

State and Federal Government

Key Takeaways

- At the federal level, bourbon production is an agreed upon bi-partisan issue, as demonstrated through the White Oak Resilience Act. At the state level, there is limited interaction between the distilleries and the Kentucky Department of Agriculture because bourbon only represents a subset of agricultural production. There is a high level of agreement that there needs to be an identified practice specific to Kentucky to improve agricultural management through policy and funding.

Insights

Practice Adoption

- This stakeholder group emphasized the need to identify a suite of practices that have a large impact and appropriately communicate this.
- High level of agreement that there are logistical and labor barriers to implementing cover crops across all areas. Farmers have experimented with the type of cover crop, type of application, and time of year.
- There is a need for both federal and state programs to incentivize the importance of practice adoption.

Messaging

- Bourbon is an opportunity for bi-partisan collaboration, and with the appropriate messaging can create legislative action and funding for focused initiatives.
- There must be a clear value proposition made to various stakeholders/constituents to ensure their participation in an industry-wide effort.
- The White Oak Resilience Act should be looked at as an example by the industry, emphasizing the importance of collective action to address conservation needs.
- There should be a clear connection and communication plan to involve other industries and apply lessons learned in other geographic contexts as support for this work grows.

Distilleries and Brands

Key Takeaways

- Among this stakeholder group there was a need to address scope 3 emissions, meet sustainability goals, and incentivize practice changes through shared and durable financing mechanisms. The bourbon distilleries and parent companies both identified that having procurement and sustainability teams' function separately created challenges for creating and meeting sustainability goals. This group of stakeholders was quick to highlight instances of success like the Kentucky Rye Initiative and the White Oak Initiative, while pointing out remaining gaps like accurate emissions factors and more robust data collection.

Insights

Sustainability Insights

- Of the stakeholders we talked to, most had sustainability goals focused on climate, agriculture, water, packaging, and energy.
- There was an interest in bringing along smaller distillers, even if it wasn't possible for them to have sustainability goals of their own.

Remaining Challenges

- Scope 3 was highlighted as the principal concern for these companies. No one we spoke with has been able to successfully incorporate project level data into their inventory to report progress on their targets.

Sourcing and Supplier Relationships

- It was clear from this stakeholder group that brands and distilleries will never source 100% of their corn locally.
- Separation of procurement and sustainability teams in different functions of the business creates challenges. Multiple stakeholders emphasized that procurement teams are responding to price and quality only, without a way to account for sustainability or use it as a decision-making factor when purchasing.
- It varies by distillery on their decision to procure GMO vs non-GMO corn. The information from the interviews highlights that most of the corn is sourced GMO.

Funding Opportunities

- There was a high level of interest in exploring public funding opportunities
- A durable system to support industry-wide sustainability must go beyond just the distilleries; changing market conditions can negatively impact sustainability efforts if the only support comes from bourbon companies.
- There is a need to look to other industries and learn from any similar successes or failures around sustainable grain sourcing.

Sustainability Initiatives and Conveners

Key Takeaways

- There are few examples of established, long term, and successful initiatives that have been able to bring competitors together to address a material natural resource concern. The White Oak Initiative, the Kentucky Rye Initiative, and the newly public PCM project are the three examples we heard talked about most from all stakeholder groups. The stakeholders interviewed also found immense value in open forums and spaces created by the

Kentucky Distillers Association to discuss sustainability. There is expressed need to create additional pre-competitive opportunities to focus on scope 3 emissions and agriculture. Identifying high level industry targets, and creating a corresponding strategy is essential. Making the case for collective action with cost savings and innovation is useful. Smaller distillers are often able to act with more agility, and drive towards sustainability goals in comparison to large distilleries.

Insights

Success Criteria

- After speaking with the conveners of and participants in existing bourbon sustainability initiatives, it was clear that there are a few criteria for success which include: 1) a leader or champion to move the work forward 2) a co-funded approach 3) appropriate governance so all voices and opinions are considered
- KDA is looked to as a convener and trusted advisor to distilleries and brands, but not all Kentucky bourbon distilleries are part of this initiative.
- While there has been implementation associated with the White Oak Initiative and the Kentucky Rye project, the PCM project is in its initial phases. It will be crucial to apply lessons learned from the existing work to these initiatives.
- Creating an industrywide goal and supporting strategy has allowed other industries to drive towards collective goals more quickly.
- Collective action is essential for supply chain transformation.
- There needs to be more opportunities for distilleries to interact, understand, and work with their farmers directly. Creating a shared understanding takes time and trust but is a low cost financially.

Academics and Research Institutions

Key Takeaways

- The academics and research institutions we interviewed had close relationships and familiarity with the bourbon industry. There was a high level of recognition that research was an avenue for convening multiple stakeholders in the industry. There was also attention placed on research and innovation outside of the agriculture space, but the imminent need to focus more on agriculture as companies start to address their emissions. These stakeholders also pointed to the need to bring craft distillers along and prioritize the creation of actionable and accessible resources.

Insights

- There needs to be an accessible and well-communicated deliverable that comes out of all collaborative work to ensure smaller distilleries and the entire industry as a whole benefit from the work.
- When creating new initiatives, there should be a 'champion' who is responsible for coordinating and moving the work forward.
- Financial resources towards research and agreement upon research questions was a challenge identified by this stakeholder group.
- No-till is highly adopted across the farms we interviewed, which was supported by general information from this stakeholder group.
- The industry should work closely with academics and research institutions to maintain and build relationships going forward, while informing them of the state of corporate decarbonization. Keeping these partners informed on the state of corporate decarbonization is essential.

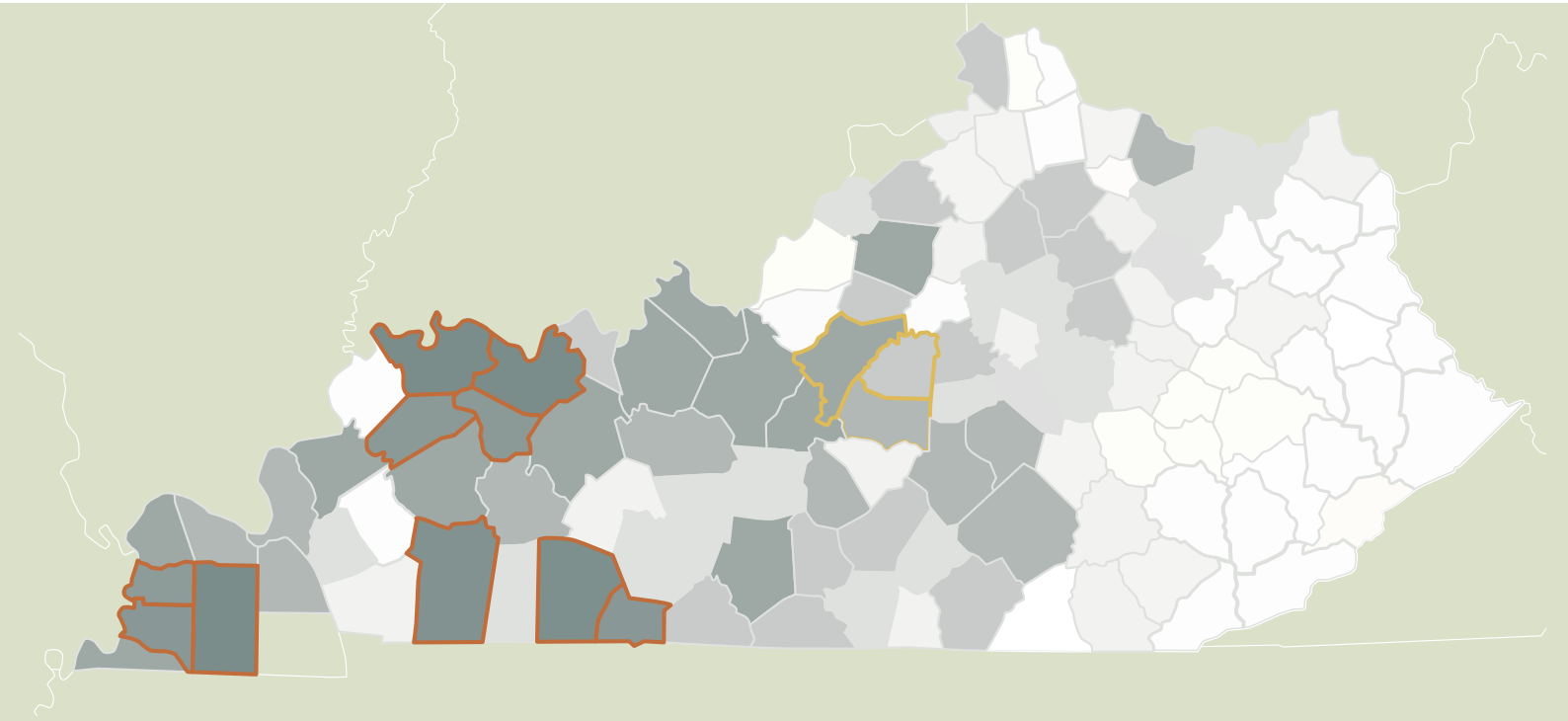
APPENDIX 2. PERCENTAGE OF CORN LOCALLY SOURCED BY THE BOURBON INDUSTRY ACCORDING TO THE KENTUCKY DISTILLERS REPORTS

KDA Report Year	Bushels Purchased from Kentucky (millions)	Bushels Purchased Overall (millions)	% Corn Sourced Locally
2014	6	12	50%
2017	5.5	11	50%
2019	9	16	56%
2021	12.5	16.9	74%
2023	19.1	28.3	67%
***no mention of grains in reports prior to 2014**			

APPENDIX 3. TABLE WITH INFORMATION RELEVANT FOR FIGURE 6.

County	1997	2002	2007	2012	2017	2022
ANDERSON	36,940	24,750	24,750	109,516	38,960	25,271
BOYLE	149,488	54,869	54,869	178,190	381,963	1,438,184
FAYETTE	327,503	126,666	126,666	182,577	332,307	282,890
FRANKLIN	62,021	17,982	17,982	188,204	121,060	40,520
MERCER	188,881	112,866	112,866	174,997	765,064	1,370,781
SHELBY	685,817	708,028	708,028	2,376,594	3,290,423	4,114,522
SPENCER	307,822	197,177	197,177	338,881	672,772	541,408
WASHINGTON	143,933	204,258	204,258	345,515	595,484	1,073,350
WOODFORD	177,356	55,551	55,551	218,194	375,487	488,012
BULLITT	152,012	140,368	140,368	193,252	330,688	98,596
CUMBERLAND	64,656	91,348	91,348	128,987	398,157	228,035
JEFFERSON	132,331	80,811	80,811	126,848	59,508	41,437
MARION	534,461	589,312	589,312	809,143	1,725,737	2,734,767
NELSON	622,109	1,217,504	1,217,504	1,533,586	3,905,961	3,790,507
CHRISTIAN	8,034,035	7,856,923	7,856,923	6,294,779	15,556,918	11,223,756
DAVIESS	7,693,883	7,034,003	7,034,003	7,887,559	13,234,890	15,635,674
OHIO	1,733,138	2,014,548	2,014,548	2,947,317	4,573,315	4,327,425
CARROLL	44,878	81,411	81,411	96,431	0	59,075
HENRY	290,158	149,812	149,812	434,737	749,749	943,483
OLDHAM	466,513	373,746	373,746	275,550	357,515	349,643
Subtotal	21,847,935	21,131,933	21,131,933	24,840,857	47,465,958	48,807,336
State of Kentucky Total	115,775,864	108,721,040	166,687,678	104,894,595	220,077,862	223,707,862

APPENDIX 4. HIGHLY ERODIBLE LANDS IN KENTUCKY

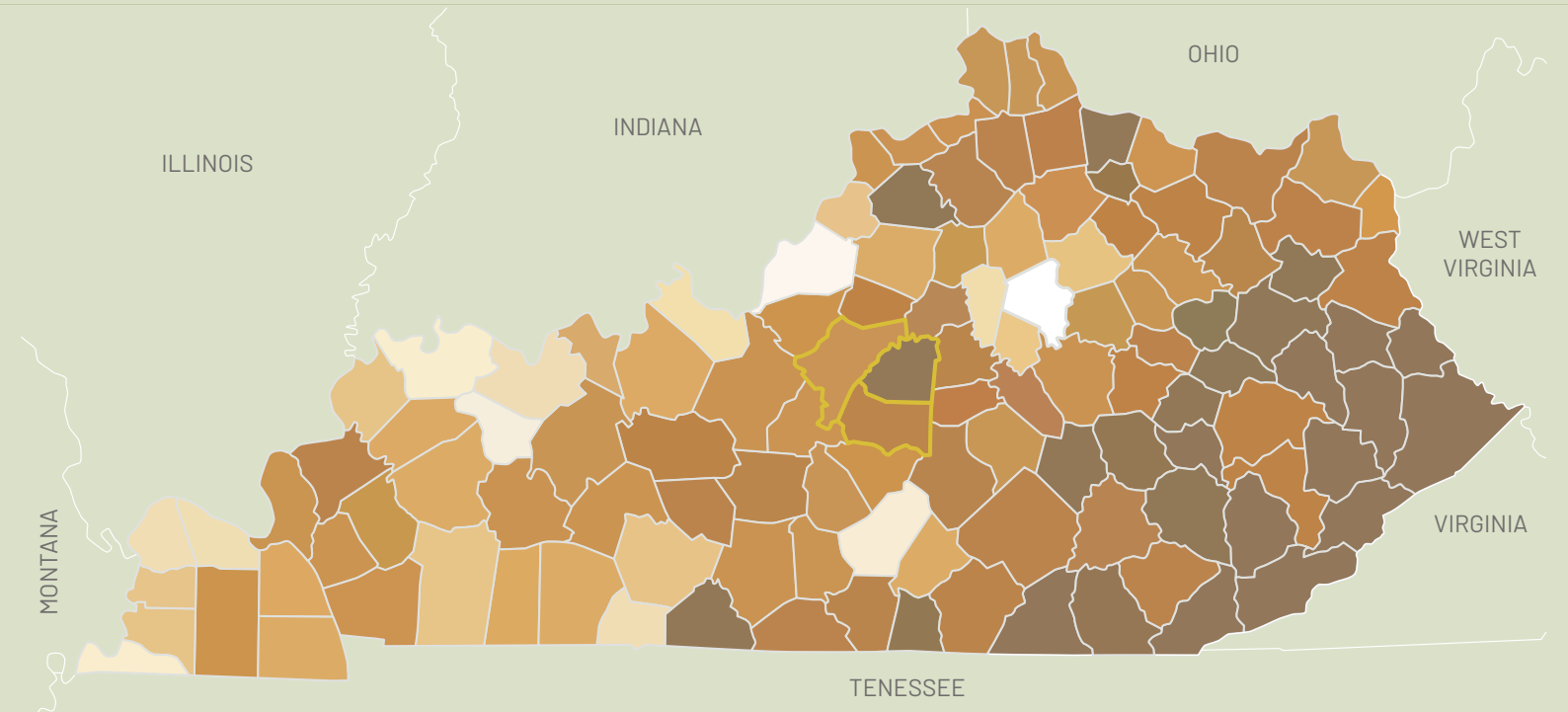


Corn Production (Acres)

- 0-361
- 362-1,432
- 1,433-2,968
- 2,969-5,696
- 5,697-13,293
- 13,294-27,700
- 27,701-42,708
- 42,709-83,534
- Marion, Washington Counties
- Top 10 Corn Producing Counties

HEL% of Top 10 Corn Producing Counties

County	HEL%	County	HEL%
Christian County	59	Webster County	61
Daviess County	46	Hickman County	56
Garves County	69	Mclean County	39
Henderson County	38	Simpson County	45
Logan County	63	Carlisle County	57



% Highly Erodible Land

- 20%-30%
- 31%-40%
- 41%-49%
- 50%-59%
- 60%-69%
- 70%-79%
- 80%-88%
- 89%-98%
- Marion, Washington, Nelson Counties

SOURCE: DEVELOPED BY THE NATURE CONSERVANCY USING 2019 DATA PROVIDED DIRECTLY BY THE KENTUCKY USDA-NRCS.

APPENDIX 5. CLIMATE AND REPORTING STANDARDS

Greenhouse Gas Protocol (GHGP)

The GHGP was convened in 1998 by the World Resources Institute (WRI) and by the World Business Council for Sustainable Development (WBCSD). From its conception, the GHGP has provided standards, guidance, tools, and training for businesses and governments to measure and manage their greenhouse gas emissions. The standards and guidance directly relevant to this project focus on the corn supply chain for Kentucky bourbon and the companies that produce it, **the Corporate Accounting and Reporting Standard**, **the Corporate Value Chain (Scope 3) Standard**, and the draft **Land Sector and Removals Guidance** (GHGP LSRG). The final land sector and removals guidance is expected by the end of 2025. The Corporate Standard, and Scope 3 Standard create the foundation for companies and other organizations to conduct and prepare a greenhouse gas inventories for their direct and indirect operations (inclusive of Scope 1, 2 and 3). The GHGP Land Sector and Removals Guidance builds upon the Corporate Standard and the Scope 3 Standard by creating accounting categories for land management, land use change, biogenic products, and carbon dioxide removal strategies, so that companies have guidance on accurately and completely reporting their emissions and removals from land-based activities.

The Science Based Targets Initiative (SBTi)

The SBTi, founded in 2015, enables companies and organizations to set science-based targets in line with keeping warming under 1.5 degrees Celsius. Incorporated as a non-profit, the SBTi has partners that include the Climate Disclosure Project (CDP), the UN Global Compact, World Resources Institute (WRI), the We Mean Business Coalition, and the World Wildlife Foundation (WWF). The SBTi works to define the best practices for setting emissions reductions and net-zero targets and developing sector guidance and decarbonization pathways in line with the latest climate science. Additionally, the SBTi has a validation services unit that assesses and validates companies' climate targets. The SBTi guidance most relevant to this project is the **Net-Zero Standard**, and **the Forest Land and Agriculture (FLAG) Guidance**. The **SBTi's Corporate Net-Zero Standard** provides the guidance and tools companies need to set science-based net-zero targets which includes short term targets, long term targets, neutralization of residual emissions, and beyond value chain mitigation (BVCM). The SBTi FLAG Guidance creates a robust and science-based understanding for companies with land related emissions, detailing the amount of emissions and how quickly a company needs to reduce them to align with 1.5 degrees Celsius. Although these targets are robust, there is significant concern over the achievability of these targets once set. Companies are required to set FLAG targets if 20% or more of their emissions are in FLAG or if they have emissions in timber, pulp, paper, rubber, animal protein, food and beverage processing or tobacco. To view the public commitments of companies setting SBTi targets, visit the **SBTi Target Dashboard**.

Value Change Initiative (VCI)

The **Value Change Initiative (VCI)** is a peer-to-peer learning network for companies focused on

identifying and addressing scope 3 emissions in the agriculture and apparel sectors. The VCI was launched in 2017 and currently has over 105 members, including companies, consultancies, and NGOs involved in various nodes of the agricultural and apparel supply chain. The VCI is responsible for publishing Value Chain Interventions Guidance which is primarily written for companies that seek to quantify, account, and report value chain interventions. Since the publication of this guidance the VCI has published a technical addendum titled **Achieving Net Zero Through Value Chain Mitigation Interventions: Exploring Accounting, Monitoring & Assurance in Food and Agriculture.** The 2022 VCI Systems Lab resulted in the guidance **Making value chain decarbonization a scalable reality: Role of Scope 3 systems in enabling collective action and co-investment**, which creates a "system of systems" approach by interlinking an impact verification system, tracking system, and trading system. Currently on the fourth iteration of the Food and Agriculture working group, the VCI is working to identify a credible and actionable supply shed that would be copacetic with the final GHGP-LSRG.

Sustainable Accounting Standards Board (SASB)

SASB standards provide industry-specific guidance for organizations to disclose sustainability-related risks and opportunities that could impact cash flows, access to finance, or cost of capital over various timeframes. Covering 77 industries, these standards focus on issues critical to investor decision-making. Developed through research, stakeholder input, and oversight by the independent Standards Board, they are recognized globally for enabling consistent and comparable sustainability disclosures. In August 2022, the International Sustainability Standards Board (ISSB) of the IFRS Foundation assumed responsibility for the SASB Standards, committing to their maintenance and evolution while encouraging continued use by companies and investors. The most relevant SASB standards for the bourbon industry are the **Alcoholic Beverages Sustainability Accounting Standard** and the Standard. These standards cover topics such as energy management, water management, responsible drinking, packaging lifecycle management, and environmental and social impacts of the ingredient supply chain. Each of the topics has a corresponding metric for companies to report on to their investors and in their sustainability disclosures.

APPENDIX 6. COMPANY EMISSIONS PROFILES

Company	% of emissions from Scope 3
Bacardi	88%
Beam Suntory	81%
Brown Forman	79%
Campari	92%
Diageo	90%
Kirin Holdings	85%
MGP	N/A (Only accounts for scope 1 and 2)
Sazerac	N/A
Average	87%

Company	Total Emissions (Mt)	Scope 1 (Mt)	Scope 2 (Mt)	Scope 3 (Mt)	% Scope 3
Brown Forman	1,006,693	150,435	59,420	796,838	79%
Beam Suntory	1,115,357	207,232	0	908,125	81%
Pernord Ricard	3948178	232381	104190	3611607	91%
Kirin Holdings (Four Roses)	3613643.39	358664.55	192323.16	3062655.68	85%
Diageo	6,169,171	599,000		5570171	90%
Campari	944,819	73,323	20098	871496	92%
Bacardi	1,171,950	115,658	21919	1034373	88%
MGP		187378	51539	Not measuring scope 3	
Sazerac	N/A	N/A	N/A	N/A	N/A
Totals	17,969,811	1,924,072	449,489	15,855,266	87%

APPENDIX 7. A SUMMARY OF SCOPE 3 VERSUS CARBON CREDIT PROJECT ACTIVITIES

	Scope 3	Credits
Accounting approach	Inventory, e.g., GHGP LSRG	Crediting Protocols or methodologies, e.g., Verra VM0042.
Deliverable	Updated Emissions Factor (EF) (tCO_2e/unit product)	Credits in metric tons CO_2 equivalent (mt CO_2e)
Additionality Requirement	No, just a departure from baseline EF.	A real, measurable reduction in GHGs compared with business as usual, as result of the project interventions i.e., departure from counterfactual.
Estimation approach	Update the EF based on new project information and appropriate modeling. For net removals, must also include empirical data collection for certain parameters as specified in LSRG.	Causal GHG reduction attributable to the intervention/project. Use of empirical data and modeling.
Discounting approach	No, but EF estimates must be statistically significant, i.e., must meet a minimum statistical uncertainty threshold.	Credits are discounted based on model uncertainty and sampling error.
Disclaimer conveyed to a partner company	Updating the EF using better data may result in a higher or lower EF independent of the project practices.	There may not be credits available if model requirements are not met.
Finance Mechanism	Scope 3 projects are typically funded by a company in the value chain.	Credits can be financed by within or outside the value chain entities and can be purchased on a marketplace.

Emission factor changes may include reductions that result from a company's actions as well as other factors (e.g., improved data).

APPENDIX 8. SPIRIT COMPANY AND BOURBON DISTILLERY SUSTAINABILITY COMMITMENTS.

Company	Climate Commitment	Water Commitment	Other
Bacardi	Net zero across our direct operations by 2040; net zero across our entire value chain by 2040.	By 2030: water positive across all our operations.	Plastic free by 2030.
Beam Suntory	Aim for net zero greenhouse gas emissions across the entire value chain by 2050.	Reduce water usage rate by 50% per unit produced by 2030; Replenish more water than we use in our direct operations in water-stressed watersheds by 2040; Protect and improve watershed sustainability through natural water sanctuary initiatives by 2040.	Plant more trees than harvested to make our new barrels by 2030; 50% of key ingredients sourced from regenerative agriculture practices by 2030; 100% of key ingredients sourced from regenerative agriculture practices by 2040
Brown-Forman	We are committed to reducing greenhouse gas (GHG) emissions across our owned operations and supply chain. Our goal is to halve our emissions by 2030 and become net-zero GHG emissions by 2045.	We are committed to protecting the health of key watersheds in our communities. Our goal is to ensure that 100% of our high-risk and business critical watersheds achieve water balance by 2030.	We are committed to creating a resilient and agile agricultural supply chain by implementing regenerative practices on the agricultural lands we grow and source from by collaborating with our growers and other industry partners.
Campari Group	The group is committed to achieving net zero emissions by 2050 or sooner. -70% from direct operations (scope 1 and 2) by 2030. -30% from the total value chain (scope 1, 2 and 3) by 2030.	For all our production sites, we continue to ensure the safe return to the environment of our wastewater from operations.	

Diageo	Become net zero carbon in our direct operations (Scopes 1 and 2); Reduce our value chain (Scope 3) carbon emissions by 50% and reach net zero by 2050 or sooner	Reduce water use in our operations with a 40% improvement in water use efficiency in water-stressed areas. Replenish more water than we use for operations in water-stressed areas Engage in collective action in all priority water basins to improve water accessibility, availability and quality and contribute to net positive water impact.	Develop regenerative agriculture programmes in five key sourcing landscapes.
Four Roses (Kirin Holdings)	Realize Net-Zero GHG emissions from the entire value chain by 2050. Achieve RE100 at an early stage and source the company's energy from 100% renewable energy.	Continue to reduce the volume of water use in group operational bases. Minimize risk during water-related disasters by reinforcing resilience and efficiency for supply chains. Implement water source preservation activities and education programs to preserve water in raw material production areas, thereby solving water issues in the value chain.	Procure agricultural raw materials that comply with certification schemes, such as FSC, RSPO and the Rainforest Alliance.
MGP	Measuring, but no commitment.	Measuring, but no commitment.	Achieving a 35% absolute reduction in energy usage over 2022 baseline levels by 2027.
Pernod Ricard	Reducing its absolute scope 1 & 2 emissions and its scope 3 non-FLAG emissions by 90% by FY50 from a FY22 baseline. Pernod Ricard also commits to reducing absolute scope 3 FLAG emissions by 72% within the same timeframe.	Reduce overall water consumption intensity (per unit of distilled alcohol) by 20% vs FY18, by 2030.	

APPENDIX 9. BIER LCA VALUES

Process	CO2e in grams
Column Distillation	992.3
Glass Bottle (750 mL)	559.4
Maturation	138.8
Warehousing	283.5
Corn	240.4
Transportation	185.5
Barley	95.3
Bottling	74.4
Electricity	62.1
Corrugated Cardboard	57.4
Other Processes	60.9
Total	2750

APPENDIX 10 LAND USE AND LAND COVER CHANGE CATEGORIZATION AND AREA ESTIMATES

LULC Category	Description	CDL Classes
1	Forest, shrubland, wetland, grassland	141-195
2	Fallow, pasture, barren	61-65
3	Annual crops, double cropping, perennial crops, specialty crops	1-60, 66-80, 204-255

2017	2018	2019	2020	2021	2022	2023	2024	Acres
1	3	3	3	3	3	3	3	**5751**
1	1	3	3	3	3	3	3	**4385**
1	1	2	3	3	3	3	3	**14**
1	1	1	3	3	3	3	3	**2000**
1	1	1	2	3	3	3	3	**51**
1	1	1	1	3	3	3	3	**793**
1	1	1	1	1	3	3	3	**785**
1	1	1	1	1	1	3	3	**761**
1	1	1	1	1	1	1	3	**1646**

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