



BIOCHAR'S UNREALIZED POTENTIAL

A ROADMAP FOR ADVANCING THE INDUSTRY



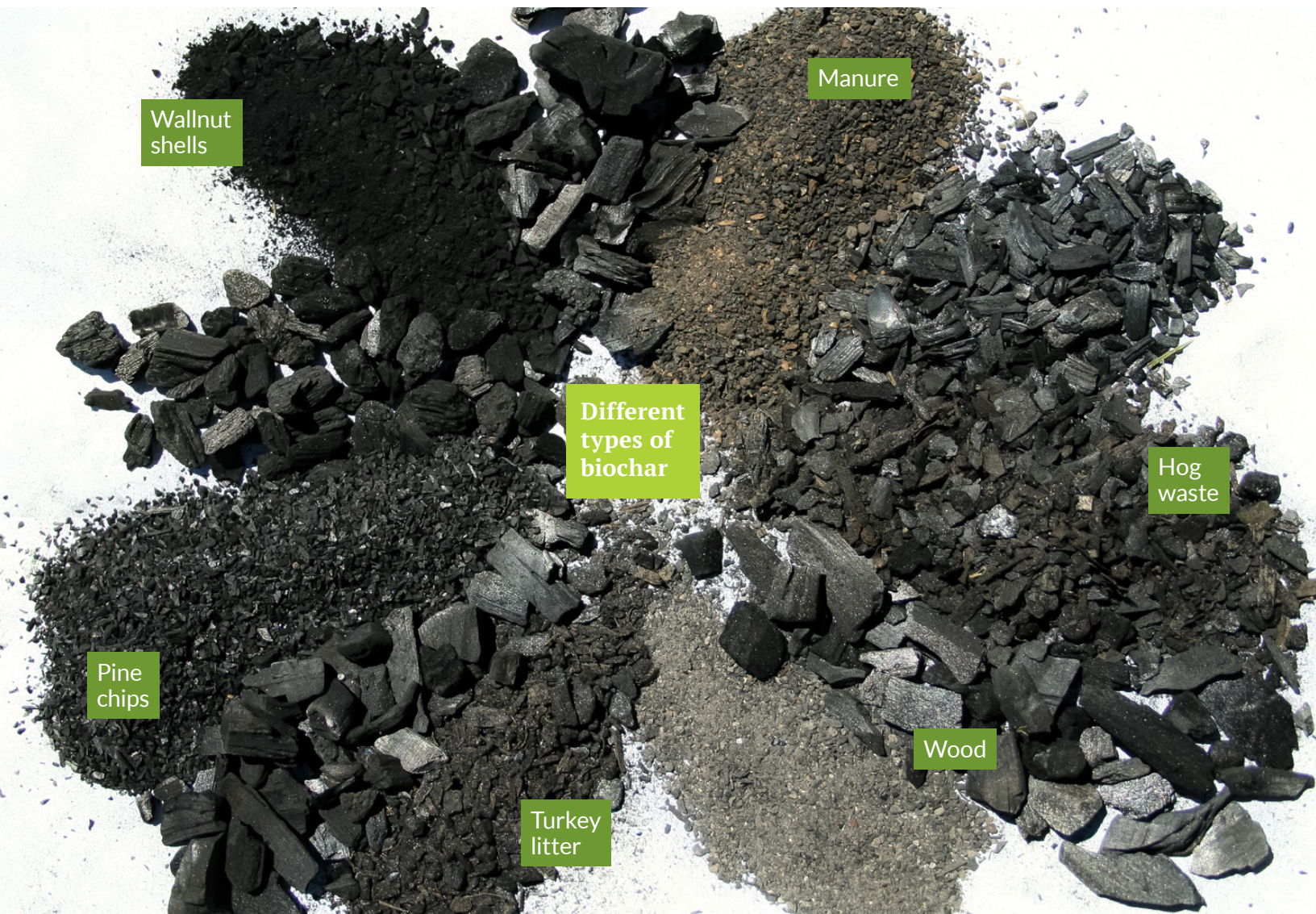
Biochar sequesters carbon

- Improves crop yields
- Reduces risks of forest fires
- Removes pollutants from stormwater runoff

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Photo courtesy of Sanjai Parikh, UC Davis



FROM WASTE TO CARBON SINK

Despite the enormous potential of biochar, efforts to grow an industry in the United States have been slow to develop. Several biochar companies are currently operating in the United States (Restoration Bioproducts LLC, Glanris, Biochar Now, Pacific Biochar et. al.). Given biochar's significant potential and increased demand, more capacity is needed.

Biochar can be produced from almost any organic material such as wood, dead trees, sawdust, nutshells, animal wastes, food waste, municipal waste, and other biogenic sources. Biochar offers the potential to create higher value products from these waste materials, which would otherwise be disposed of in landfills, left to decompose, or be incinerated.

To make biochar, biogenic waste is heated, sometimes burned, in the absence of oxygen through a process called anaerobic pyrolysis, which creates a carbon-rich fine-grained, highly porous material. More importantly, the carbon from the waste material is captured and stored, often called sequestration. One ton of dry biochar (on average) stores about 2.5 tons of carbon dioxide.

In the US alone, there is an estimated 1 billion tons of biomass generated each year (mainly forestry and agricultural residues), which demonstrates the potential for growth of the biochar industry.

In 2015, the International Biochar Initiative (IBI) estimated that 85,000 tons of biochar were produced and sold globally. In 2018, the US Biochar Institute (USBI) estimated that US annual production of biochar was approximately 45,000 tons (Groot 2018). Since these last reports, China has begun to produce a significant amount of material. As of 2019, China was producing 551,156 tons a year (T.R. Miles pers. comm).

While no recent estimates of global production are available, it is estimated that global biochar production remains under 1 million tons per year. That's miniscule compared to the enormous amount of residual biomass generated each year. Waste biomass can also be used to produce energy. Revenue from energy production is important to many biochar enterprises, however the focus of this roadmap is on biochar products.

Over the last decade, biochar has attracted interest as a new product with exciting opportunities to:

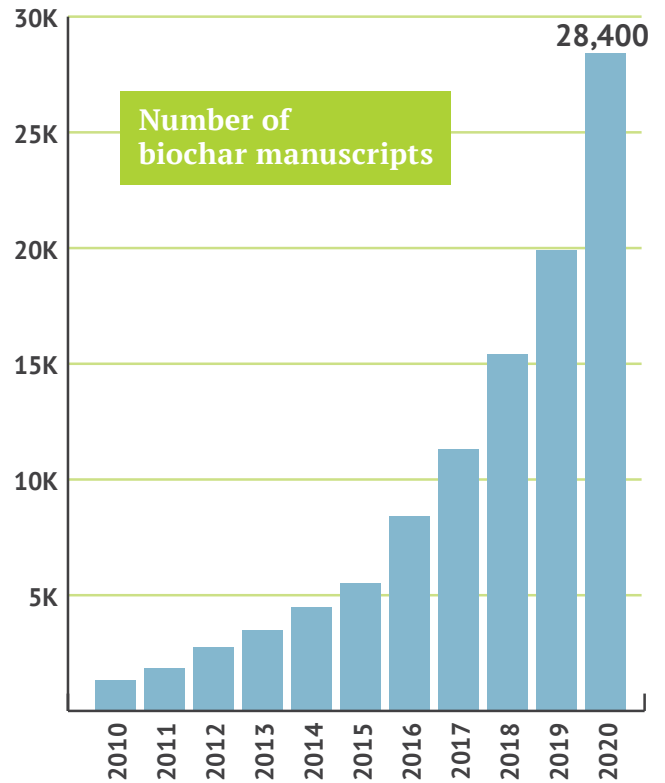
- **Mitigate climate change**
- **Improve forest health and decrease wildfire risk**
- **Improve soil health and crop yields**
- **Bolster ecosystem services**
- **Revitalize rural economies**



Photo by Marcus Kauffman, Oregon Dept. of Forestry



Biochar stormwater filtration media. Photo by Marcus Kaufmann, Oregon Department of Forestry



Exponential growth in number of biochar manuscripts (Google Scholar) from 1,310 in 2010 to 28,400 in 2020.

CONVERTING FOREST WASTE TO BIOCHAR

In the case of the US Forest Service, reducing wildfire risk is urgent. Across the western US, overcrowded forests need to be thinned to enhance forest health and reduce the risk of catastrophic wildfires. The forest biomass produced from thinning has little to no commercial value. Agencies like the US Forest Service and the Nebraska Forest Service are interested in supporting biochar because it removes forest debris from the waste stream while creating a viable carbon sink.

As a result, the US Forest Service and other Federal agencies like the USDA Natural Resource Conservation Service have sponsored grants and initiatives to spur development of biochar products and markets. In addition to agency interest and scientific research into biochar and its potential, organizations – such as the US Biochar Initiative and the International Biochar Initiative – are attempting to support and grow markets for biochar.



Forest thinning pile in the Willamette National Forest Photo by Marcus Kaufmann, Oregon Department of Forestry

CREATING POLICIES TO ENCOURAGE BIOCHAR PRODUCTION

The viability of any emerging industry depends heavily on supportive government policies that allow and encourage it to develop and mature. A lack of awareness about how biomass can capture carbon and reduce CO₂ emissions has hampered policy development. This piece provides information to increase knowledge of the ecological and economic benefits of creating and using biochar.

Infrastructure investment is needed to produce larger quantities of biochar at scale. For instance, larger machines can manufacture consistent, high quality biochar products at a compelling price point.

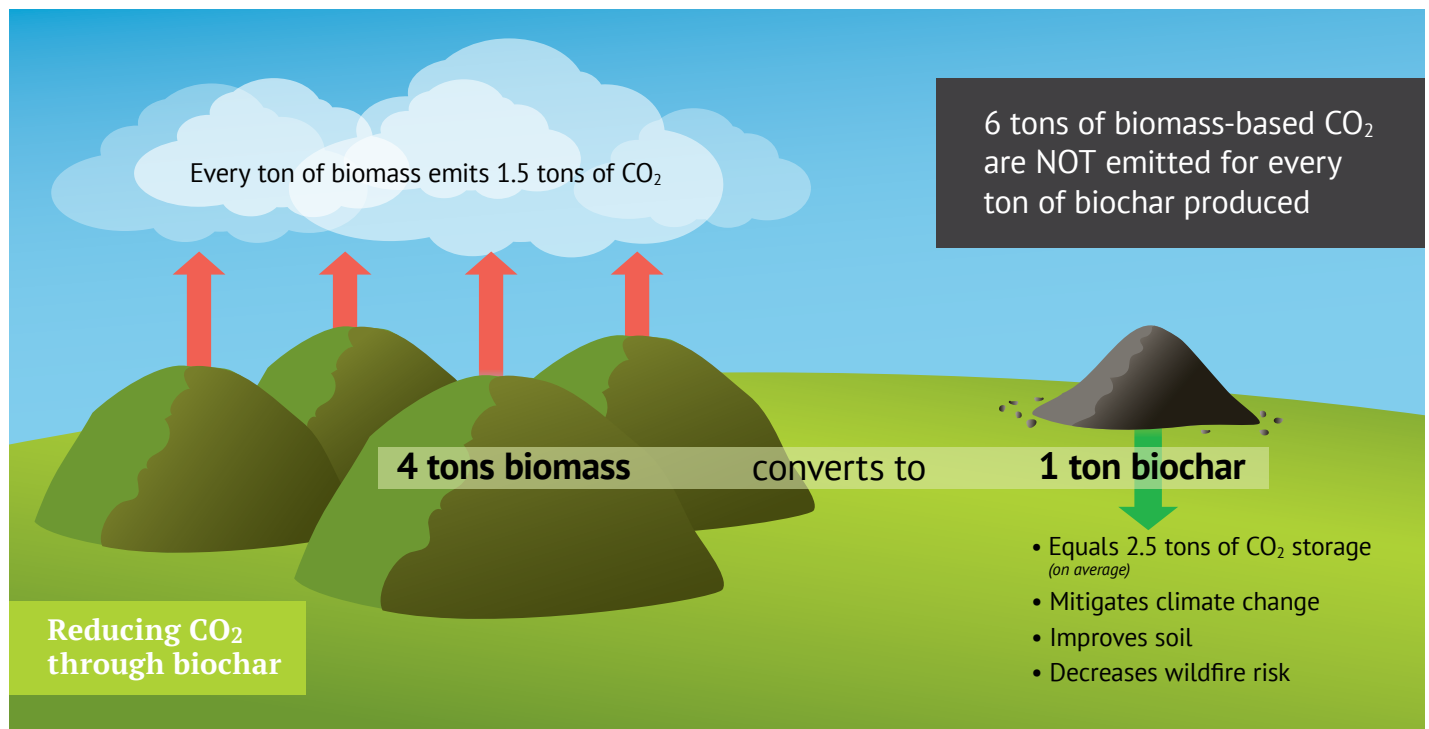
Through policy, governments can encourage growth of biochar using tax credit incentives, USDA loans, BioPreferred Program listings, and other programs. Stimulating growth in this way will encourage both biochar startups and established companies to innovate and expand product development and applications.

Of course, production capacity and market demand are necessary for any industry to succeed. The challenge right

now is that even though some producers have seen market receptivity, they worry that the market may not be big enough to support the investment in biochar production. Given the benefits of biochar to increasing crop yields, reducing forest fire risk, treating stormwater and numerous other uses, markets will develop. Policies can hasten that development, which will also address climate change.

The innovation stage of new sustainable industries is always challenging. The environmental benefits of sequestering carbon in biochar make this industry one that can contribute in multiple ways to society with the following support:

- **Policies that increase access to capital**
- **Tax and incentive programs**
- **Government purchasing specifications that favor biochar products**
- **Further research on biochar to show its climate and agronomic benefits**
- **USDA BioPreferred Program**



Scientific researchers have published thousands of articles on biochar in recent years, highlighting biochar's potential as a soil amendment, pollutant filter media, carbon removal strategy and dozens of other potential applications.

Biochar's many uses

These examples of applications clearly show the viability of biochar and help to understand its use and benefits.



Soil health

Biochar can improve soil health and sequester carbon in agricultural settings. Biochar amended soils boost yields in certain crops and conditions, particularly in sandy soils during hot summers. Increases in yields were shown in studies of blueberries¹ and in lab tests of wheat, barley, and maize².

Biochar can also increase soil organic matter as part of a strategy of improving soil health using a low cost option to sequester carbon. Research shows that biochar's enormous potential to remove CO₂ from the atmosphere as part of an overall climate change mitigation strategy³



Golf courses

The North Shore Country Club in Illinois used quality, pre-conditioned biochar to add value in several areas: water retention, nutrient holding (due to biochar's high CEC), and enhanced soil and plant health from microbial activity.

Golf Course Superintendent Dan Dinelli, CGCS, wanted to replace peat in rootzones on the course's greens. He did a series of tests with biochar and was pleased with the results.

He strongly supports creating biochar standards, because there is no consistency about what a quality char is and how char should be used.



Peat replacement

Harvesting peat for use as a component of horticultural mixes emits methane and carbon dioxide. To avoid the release of greenhouse gases, researchers in Europe tested biochar as an alternative product in horticultural medias.⁴

All three biochar trials showed equal performance as the horticultural media amended with peat.

Concerns about the high cost of growing media, recent supply chain issues, and unease about the environmental impacts of peat are spurring interest in alternative media for the horticulture and turf industries.



(opposite page)
Biochar amended compost.
Photo courtesy of Pacific Biochar

(left)
Biochar in greenhouse plants.
Photo courtesy of Victory Gardens



Compost

Since starting to use biochar in their compost process, Rexus, a family-owned compost and soil producer in Oregon, has continued to record higher nutrient values in their biochar compost than compost without biochar. They also report higher beneficial plant bacteria and microbes compared to compost without biochar. With higher nutrients and more beneficial microbes, a higher value soil product commands a better price for their home gardening potting and garden soils product lines.



Stormwater

Biochar serves as a low-cost option to remove various pollutants for runoff, including heavy metals, microbial pollutants (like E. coli bacteria), and trace organics.⁵ It's also economical compared to activated carbon products that are typically used. Bulk biochar costs 20–100% less than activated carbon, which costs between \$1,000 and \$5,000 per ton. By comparison, bulk biochar costs can range from about \$800 to \$2,500 per ton.⁶

It can also be beneficial to soils with poor water infiltration. A biochar amended buffer could save \$215,000 over standard treatments. That's because a biochar amended buffer needs only 0.12 acres compared to 3.7 acres required for standard treatments. Green roofs also effectively reduce stormwater runoff in cities.



Non-soil applications

Biochar has a variety of non-soil uses, including biochar amended concrete⁷, asphalt⁸, as a green additive to bioplastics⁹, and as a material that can be used in batteries¹⁰, among many other applications.

These non-soil products tend to command higher prices compared to biochar used in soils or compost. In many cases, the biochar has to be treated before being used in higher end product applications. For example, bioplastics requires finely ground biochar (100 microns or less). Other products may require a large surface area and require that biochar be steam-activated. The extra processing capacity and resulting capital costs should be considered for non-soil product opportunities. Yet, the demand for carbon neutral and sustainably-sourced products creates exciting possibilities for biochar.

Photo by carbonauten GmbH

Quality of biochar varies

How biochar is created gives it different properties. Additionally, biochar combined with other substances impacts how it performs. Any user should take care to ensure that they are purchasing the correct biochar for their application.

Application	Some of the benefits	General size guideline*	Important qualities
Veggies and seedlings	Enhancing soil biology, replacing peat which is environmentally damaging, boosting yields	¼" minus (3 mesh).	Inoculate first (mix with some nutrient rich material before application, e.g., compost, manure, or liquid fertilizer) so it doesn't tie up nutrients in the first year of application
Golf greens and turf	Enhancing soil biology, reduce H ₂ O use	Powder size for spraying as a slurry on golf greens and tees	
Tree seedlings	Holding onto H ₂ O, preventing plantings from drying out in summer heat	½" minus, some fines ok (and desirable)	
Bioretention	Capturing pollutants in runoff, increasing plant survival during summer	Mixed sizes. Around 10% fines OK	Want moderate and steady infiltration rate when mixed with soil
Green roof media	Exporting nutrients in runoff, increasing plant survival during summer	½" preferred. Some fines acceptable	Light aggregate, holds water, provides biology and structure for the plants
Stormwater media filtration	Capturing pollutants in runoff	Avoid fines to prevent clogging of media (nothing under 75 microns).	Raw biochar screened and sized to avoid fines

* Size guidelines are general based on published data and practitioner experience. However, more specific biochar qualities per application will need to be tested and assessed according to the application.

THE CARBON OPPORTUNITY

Key Players in Carbon Markets

Carbon markets are complex with many players who work to move credits through the system and offer payment to producers. This is an evolving marketplace as new companies, organizations and regulating bodies continue to emerge.

Producers

Biochar companies
Farmers who make biochar

Producers sell the credits, while also selling the biochar they produce.

Carbon financiers

(optional)

Standards and Verifiers

Puro.earth
Carbon Futures
Verified Carbon Standard

Brokers

(optional)

Buyers

Microsoft
Barclays
New Belgium
Shopify

Photo by Marcus Kauffman, Oregon Dept. of Forestry

Research shows that biochar, a nature-based strategy, has enormous potential to remove CO₂ from the atmosphere as part of an overall climate change mitigation strategy (Lehmann et al. 2006). Companies are also purchasing biochar carbon credits as part of their strategies to become carbon neutral. This relatively new interest in biochar carbon credits is driving new investments in biochar companies. Currently, biochar producers have three options to sell into the voluntary market: Puro.Earth¹¹, Carbon Future¹² and Verra¹³. Other voluntary carbon programs are under development, for example by the Climate Action Reserve.

The biochar producer can still sell their product into the market (for example to a farmer as a soil amendment), while also receiving carbon credits. This provides an economic incentive to move forward with investments. The biochar carbon credit market has fixed costs (opening a project account, third-party verification, and in many cases a Life Cycle Assessment of the biochar production facility). These costs are challenging for individual small producers.

RESEARCH ABOUT BARRIERS TO BIOCHAR ADOPTION

Given the potential of biochar and the excessive biomass resources available (currently these feedstocks are sent to the landfill or burned on site), various groups have studied barriers to growth of the industry:

Standardization: Standards are important for any product or service because they create expectations and guidelines for production and use. Standards specific to biochar market segments can establish basic information such as the carbon content of the biochar, level of contaminants, or pH.

Biochar production standards can also assure buyers that biochar is made in accordance with clean air requirements or local regulations on air quality as well as sustainable feedstock sources. Standards can establish criteria for a consistent product.

Education: Initially education should focus on those who can influence the growth of the biochar industries: policymakers, consultants/resources (extension services), producers in market segments and their customers. More research could also help prove and enhance product claims.

Pricing and value proposition: With few producers and low demand, the price for biochar is high, especially compared to less environmentally friendly products, like perlite, vermiculite, and peat. Pricing is based on the entire process of getting products to market which includes these items:

- **Production technology**
- **Infrastructure: capital investment**
- **Market development**

Policy development: Government policies can affect all the other barriers.

USBI exists as an education organization to advance sustainable food security, improved soil fertility, environment and climate resilience. There is no organization that serves as a trade association for those involved in the industry to address its economic vitality and how to move that forward. focus on would promote trade laws, provide networking opportunities among competitors, serve as a voice for the industry, when it comes to regulations and new legislation, and develop tools like best practices.

Feedstocks	Organization	Problem biochar can solve
Wood pallets	Packaging and wood products industry	Prevent pallets from being sent to the landfill
Excess forest biomass	US Forest Service, Bureau of Land Management, Tribal lands, state forestry agencies	Provides a new market for low-value biomass created during forest thinning designed to reduce catastrophic wildfire risk
Confined livestock manure	Farmers, livestock industry	Nutrient runoff from manure sources. Avoid degradation of water quality.

CURRENT STATE OF BIOCHAR

Building on previous efforts to support the biochar industry, the USBI and the Nebraska Forest Service received a grant from the US Forest Service in 2020 to develop collateral to help the biochar industry identify and overcome barriers. This roadmap is part of that effort and summarizes key barriers facing the industry and some of its product sectors, while discussing opportunities to overcome them. These are the main obstacles:

- 1. Price and the value proposition (material is too expensive for many sectors)**
- 2. Lack of education about biochar's benefits**
- 3. Consistency in biochar product quality and the need for standards on biochar materials used in select applications**

Additional barriers identified were a lack of policy incentives for the use of biochar and the need for more research to prove the material's performance and effectiveness in different industries.

Some of the themes identified in the recent survey overlap. For example, price potentially reflects lack of business development support and capital investment to make larger biochar machines that can produce the material on a greater

scale and likely at a lower price. Likewise, the biochar industry may need more research on production technologies to create more efficient production techniques, that would lower the overall price.

On the other hand, it is difficult to make a capital investment case if there is not enough demand for the material in certain industries (such as large-scale agriculture or water filtration markets). One of the reasons for lack of demand could be that biochar producers do not understand the standards and specifications for a specific application. In some instances, more research is needed to prove that biochar can perform at a competitive price for a specific application.

Essentially, organic waste becomes a means to create a viable product with multiple benefits. For problematic waste streams with no good disposal options, converting the waste to biochar makes sense when it is financially viable.

The bottom line is that the challenge is multi-faceted and a comprehensive roadmap strategy is needed. In the remaining sections of this report, barriers will be detailed and potential solutions for overcoming them proposed.



Compost-biochar. Photo by Pacific Biochar

Commercialization roadmap for biochar

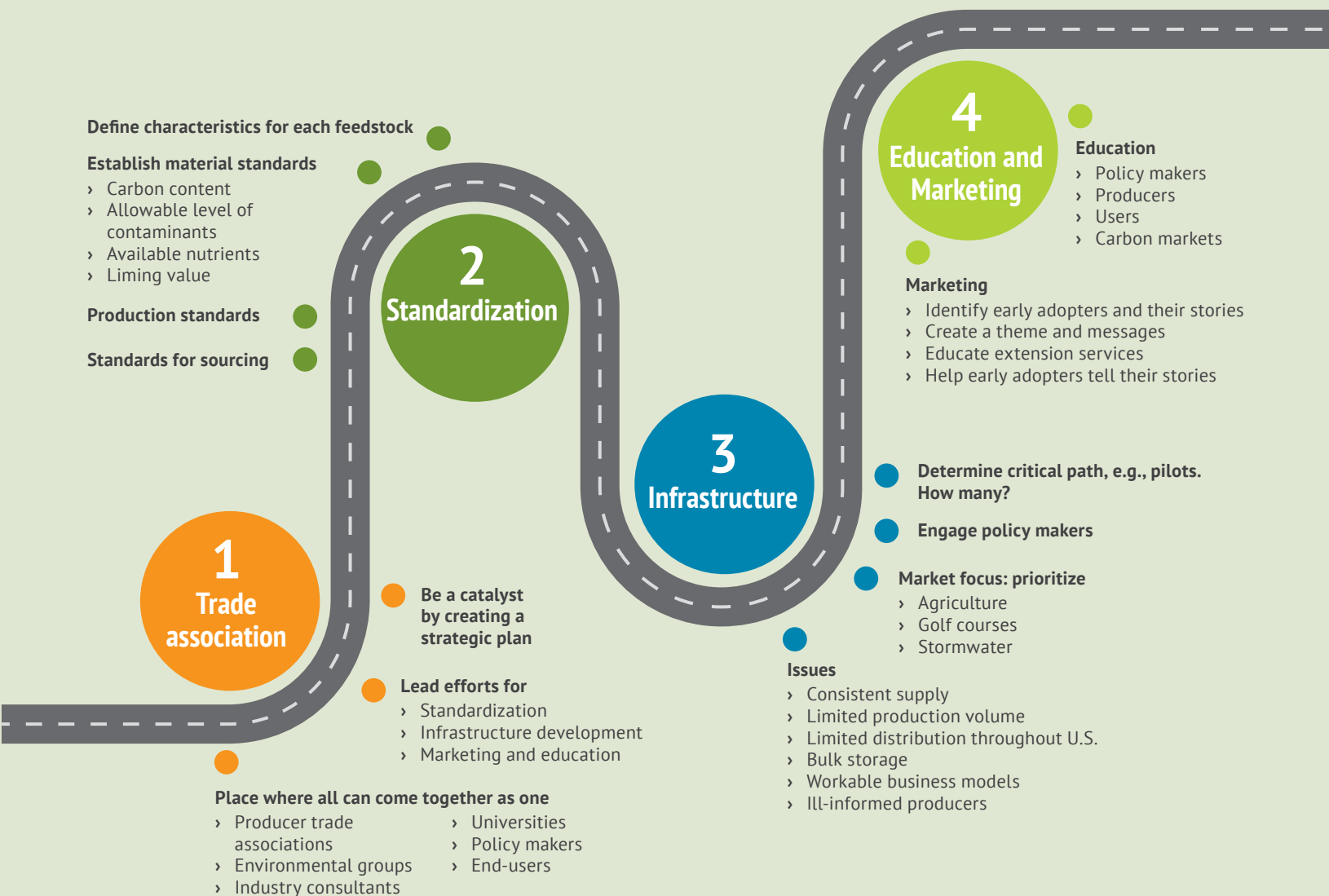
As an emerging industry, biochar has numerous options for moving forward and some may happen simultaneously. Having a roadmap in place can help to ensure the industry develops in a way that maximizes its potential. Ultimately, users will determine the industry's success, so it's important to communicate with them. Fortunately, there are early adopters that can serve as resources who can talk to trade associations, do media interviews, participate in podcasts and share information through digital channels.

Success will be hastened by government policies that support infrastructure and use biochar's carbon sequestration ability to address environmental issues, including climate change. As policy makers and government officials learn more

about biochar, they will seek ways to provide incentives for necessary infrastructure. They will also be hearing more about the economic benefits of biochar from producers and users who recognize the materials benefits and seek government assistance to move the industry forward.

Four things are critical to prioritize. One, forming a trade association is foundational and can take the lead in addressing the other three. Each will be briefly discussed.

1. **Formation of a trade association**
2. **Standardization**
3. **Infrastructure support**
4. **Marketing**





1 Forming a trade association

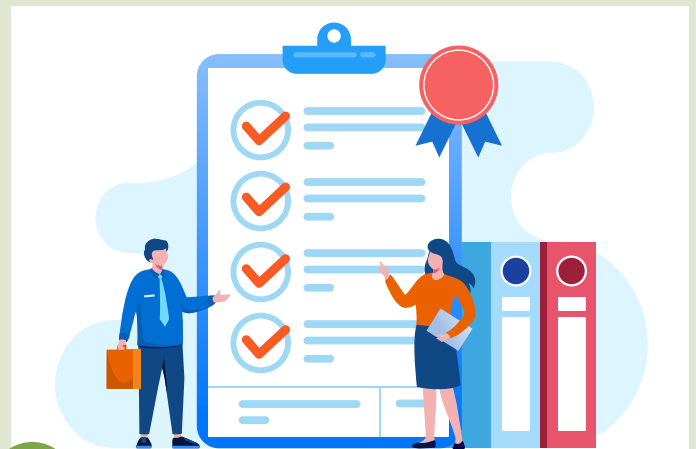
The biochar industry is not cohesive, so market education and research have been slow. To move forward a catalyst is needed to develop standards, increase production and encourage adoption. To create a strategic plan, a strong well-funded trade organization could identify and manage how to deal with issues identified in this roadmap, including:

- **Setting standards for biochar, including**
 - › Whether or not it can only be created by pyrolysis
 - › Characteristics for specific uses to avoid end-user confusion
 - › Standard testing methods and packages
 - › Ongoing and uniform testing
- **Establishing communication with trade associations that represent producers and end-users to gain their support and advocacy**
- **Reaching out to environmental groups who can help to advocate for biochar as a product that stores carbon dioxide**
- **Leading efforts to educate policy makers about the benefits of using biochar and how they can help the industry grow and develop**
- **Creating a single focus for action among all elements of the biochar industry to create a strong voice with consistent messaging**
- **Creating educational materials and distribute them to policy makers, producers, and end-users**
- **Implementing a marketing plan**

There are many voices and groups in the biochar space, but there is little coordination between them. All are well-intended, but the lack of a recognized leader hinders the

industry's ability to set a direction to grow and develop. Right now there is a wide array of information that is confusing to those who may be interested in producing or using biochar in various applications.

The industry needs to create standards, develop infrastructure, coordinate educational efforts and have a marketing program. That work can best be done through a trade association. Forming a trade association will take some time. In the interim, an existing organization, like USBI, could serve as a convener to bring the biochar industry together to move forward.



2 Creating standards

There is a need for an organization to establish clear guidance on the essential qualities of biochar made by major US feedstock types, e.g., wood, straw, agricultural residues and manure) according to specific production temperatures. Dr. Amonette (2021) suggests that an organization compile a minimum of nine feedstock types and process these feedstocks along different production temperatures and methods (or activation methods) and then summarize their characteristics and uses in different market sectors.

This is important because of the diverse uses for biochar. When used as a filtration medium for stormwater, the greater the surface area the better the performance at removing dissolved metals. Activated carbon has different surface area grades for different types of applications and are often graded (in part) according to surface area. One test of surface area (albeit imperfect) is the iodine number. Activated carbon can have 600 cubic centimeters per gram of surface area. Biochar typically averages about 200 cubic

centimeters per gram. If biochar is steam activated, the surface area can reach the 600 cubic centimeter threshold and perhaps be used as a replacement for activated carbon, which has a high value market, and can often command sale prices over \$1.00 per pound.

When it comes to other market segments, such as biochar in compost, the most important element is that the biochar is somewhat bulky (>¾" in diameter). Bulkier biochar aids with compost pile aeration as well as helps provide nooks and crannies for beneficial microbes that help retain nutrients. Biochar "fines" can be part of the addition to the compost pile, but the fine fraction should be a minority (less than 20% by volume).

These two examples illustrate how "standards" specific to biochar market segments can help the biochar industry expand and grow in the US, North America and other regions. A variety of standards are needed:

- **Material standards would include basic information such as the carbon content of the biochar, allowable level of contaminants, or pH.**
- **Production standards would assure buyers that the biochar is being made in accordance with clean air requirements or local regulations on air quality.**
- **Standards for sourcing biomass feedstocks would ensure that material is both sustainable and reliable**

Other organizations and processes will handle additional sustainability certifications or production related air permits to comply with local and national air regulations.

Both the European Biochar Certification (EBC) program and International Biochar Initiative (IBI) have respected programs and standards for biochar production and application. Biochar producers can currently use either EBC or IBI standards. Not all US-based biochar producers have the ability or desire to meet EBC certification for various reasons. There is a need for a US-based standards organization that reflects local feedstocks, federal standards, and state regulations.

For standards associated with sourcing biomass, the EBC program has developed a list of different biomass feedstocks used to produce biochar, classifying each biomass feedstock as carbon neutral, negative, or positive depending on type. Both the EBC and the IBI have a biochar material standard, setting thresholds for acceptable levels of metals and other

contaminants for all types of biochar. In the case of EBC, they make further standard distinctions based on how the biochar is used. For example, there are some standards that apply if the biochar is to be used in a soil application and a different threshold in the case of biochar being used as an animal feed.

EBC also has a certification program that involves on-site visits at biochar production facilities to certify biochar production meets their requirements for air emissions, qualifying feedstocks, utilization of heat energy, and compliance with other EBC production requirements.

Every major industry has organizations and/or trade groups that set standards or advocate for standards for the benefit of their industry. An organization like USBI is well-suited to fill that type of role for the US biochar community. If not, some other type of "biochar industry association" should be formed.



3 Supporting infrastructure

Infrastructure has been slow, so production volumes are limited. Though there are consultants in this space, faster progress can be made with government support and incentives. This would also encourage adoption by larger organizations that would increase visibility and use of biochar. Currently, smaller producers serve niche markets, but they are not able to provide enough impetus to grow this industry.

Business assistance from organizations with a strong interest like the US Forest Service and USBI, can address climate change and be instrumental in moving biochar adoption forward. Industrial scale production would increase the acceptance of biochar and be a market motivator.

Initially, the focus could be on a few markets to build the case for the benefits – both in results and for the environment.

- **Agriculture: increase crop yields**
- **Golf courses: building turf**
- **Stormwater: creating clean water at a lower cost**

Major issue	Potential solution
Consistent supply	Expand infrastructure with carbon-based waste management.
Limited production volume	Need industrial sized facilities
Limited distribution: product not uniformly available across U.S.	Develop facilities in major geographic regions of the country to reduce delivery costs
Bulk storage	Need warehouses and covered storage
Identify current, workable biochar business models	Showcase to policy makers to encourage incentives to do more. Share case histories
Producers aren't well-informed	Educate producers using case histories to underscore how-tos and successes Provide technical/business assistance
Access to capital	Modify terms and conditions of federal loan programs

Society benefits from converting waste material into an economically useful product that stores carbon dioxide long-term. This industry is worthy of public investment. Pilot projects to build biochar facilities in regions that have an ample supply of organic waste is a pragmatic approach to learn more about how to collect, produce, sell and encourage adoption. This approach also offers a real-life opportunity to do valuable research.

There are small producers who could lend their expertise to a larger venture. Success will depend upon a product that is created in a way that its specs are consistent, and users can trust that it will perform in predictable ways. This underscores the need for standardization. There are also users who have achieved outstanding results but aren't sure they can be replicated because of the lack of standardization in biochar characteristics and production.



4 Developing a marketing plan

Educating policy makers, producers and users lays the foundation for marketing. The USBI website provides significant information about biochar, its uses and benefits. There are other sources of biochar information, such as Nebraska Forest Service and state and/or regional initiatives devoted to adoption of biochar. A trade association could use USBI's website to provide reliable information that would help others understand and adopt the use of biochar.

Initially, the marketing focus would be on tapping early adopters as spokespeople for the industry. There are examples of uses that provide demonstrable benefits, as well as users who see the value of additional research to encourage broader adoption. Fact sheets that have been developed provide case histories, and highlights research that underscores biochar's benefits.

Identify early adopters: Many are featured in the fact sheets. The Biochar Grant Team could provide others. Create an Excel sheet with names, contact information, and their expertise to use to communicate with this group. Estimated size 20–30 initially.

- **Reach out and ask each of them if they are willing to talk about their experiences with others**
- **Vet them as spokespeople**
- **Ask them to share successes, as well as others who are adopting biochar**
- **Develop a bi-monthly e-newsletter to communicate with them, sharing new research, new uses, and a profile of one of them in each issue**
- **Contact each person by phone to maintain contact on a quarterly basis**
- **Encourage them to talk with elected officials to move policy and incentives forward**

Determine the best ways to tell their stories: This requires focusing on who should hear the stories. There are two main groups:

1. Producer trade associations that represent markets: Agriculture, landscaping, golf courses, stormwater

2. Policy makers: Federal and State

Depending on the available resources, it may make sense to select a market segment and focus on it. In any case, policy makers will be a key audience. Reaching them will be enhanced by forming coalitions with environmental groups who will value the climate benefits of using biochar. Care should be taken to inform those groups that there is a billion tons of biochar, which is going to waste now. This does not involve creating waste to make biochar, which some use to discourage its use.

By defining what policy makers can do, the industry can advance faster. The more specific advocates can be in their requests, the more receptive policy makers will be. These are suggestions:

- **Support the development of standards, which is critical to more broad-based adoption of biochar**
- **Create incentives, especially around infrastructure funding and research, that will cause more companies to produce and/or use biochar**

Here are specific tactics that can be used:

Create and consistently use a theme and key messages.

Educate state extension services about biochar's benefits:

They serve as conduits to users and will be approached for their advice on how to use biochar. By giving them the information they need, they can help move the industry forward. Agents can also provide information from the field to help the industry grow and develop.

Help early adopters tell their stories: Many of them are already interacting with their trade association, participating in podcasts, posting information online and encouraging others to use biochar. As more is learned about them, information about how they want to share their stories can also be captured. Here are some communication channels to consider:

- **Case histories that can be posted in a variety of ways: on websites, social media and in print. These should be archived.**
- **Presentations at trade association meetings and before state legislatures.**

- **News releases can be developed to share with media that have an interest in agriculture, landscaping, stormwater, and golf courses. Trade associations can help identify those media.**
- **Spokespeople can use their communication channels, as well as like and share relevant information from others.**
- **White papers can be used with policy makers and perhaps with environmentalists who do not realize that biochar is created from waste that would otherwise generate carbon dioxide. Forming alliances with some of these groups will build support among policy makers.**

Conclusion

Organic waste material, which would otherwise become landfill, left to decompose, or be incinerated, can be converted to biochar. One ton of biochar stores about 2.4 tons of carbon dioxide.

With an estimated 1 billion tons of organic waste generated in the US each year, the opportunity for growth of the biochar industry is significant. The amount of biochar produced in the US is less than 100,000 tons, which requires 400,000 tons of waste material.

Standardization and infrastructure are two ways that government policies and infrastructure can support the ability of biochar to sequester carbon to address environmental issues, including climate change. The US composting industry faced similar challenges and overcame them with standards and government support.

Government policy incentives can help create more demand for biochar, spurring capital investment to make the product at larger scales. For example, Climate Smart Agriculture incentives could help farmers use biochar to achieve carbon reduction targets and mitigate the effects of climate change.

Small producers currently serve niche markets, yet are not able to provide the impetus to grow the industry. Larger scale infrastructure investments are needed. Support for biochar market development will create new jobs that make high value products from low-value waste streams.

The environmental benefits are significant: reduce impacts of catastrophic wildfires, lower CO₂ emissions from forest slash burning and filter damaging pollutants from water and the list continues!

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