State of the Biochar Industry 2015

A Snapshot of Commercial Activity in the Biochar Sector

The International Biochar Initiative (IBI)



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This document is based on information provided by respondents to an industry survey conducted by IBI in 2015, the *State of the Biochar Industry 2014* report, the *State of the Biochar Industry 2013* report, as well as information compiled from websites of entities operating in the biochar space. IBI does not warrant the accuracy, suitability, or content of the survey responses or the results of that survey as set out herein. Nor does IBI warrant the accuracy, suitability, or content of the information collected from websites as set out herein. It is the sole responsibility and obligation of the reader of this report to satisfy himself/herself as to the accuracy, suitability, and content of the information contained herein. IBI makes no warranties and shall have no liability to the reader for any inaccuracy, representation, or unintentional misrepresentation set out herein. The reader further agrees to hold IBI harmless from and against any claims, loss, or damage in connection with or arising out of any commercial decisions made on the basis of the information contained herein. The reader of this report is strongly advised not to use the content of this report in isolation, but to take the information contained herein together with other market information and to formulate his/her own views, interpretations, and opinions thereon. The reader is strongly advised to seek appropriate legal and professional advice before entering into commercial transactions.

Sources of Information

Information in this report was used to create an IBI company database (see Company Database Appendix) derived primarily from three sources: 1) a public survey conducted by IBI from August – November 2015; 2) data aggregated from the IBI membership database; and 3) internet-based research of biochar-related companies.

Purpose of this Snapshot

IBI published its first *State of the Biochar Industry* report (for year 2013) in March 2014 and the second (for year 2014) in May 2015; this is the third annual report on findings from the industry at large. It presents a brief snapshot of the current biochar industry based on responses to surveys from companies in the industry as well as internet research; for more in-depth information on how policy, certification, regulation, carbon markets, and other drivers may impact the biochar industry, readers should refer to the 2013 and 2014 *State of the Biochar Industry* reports at http://www.biochar-international.org/commercialization.

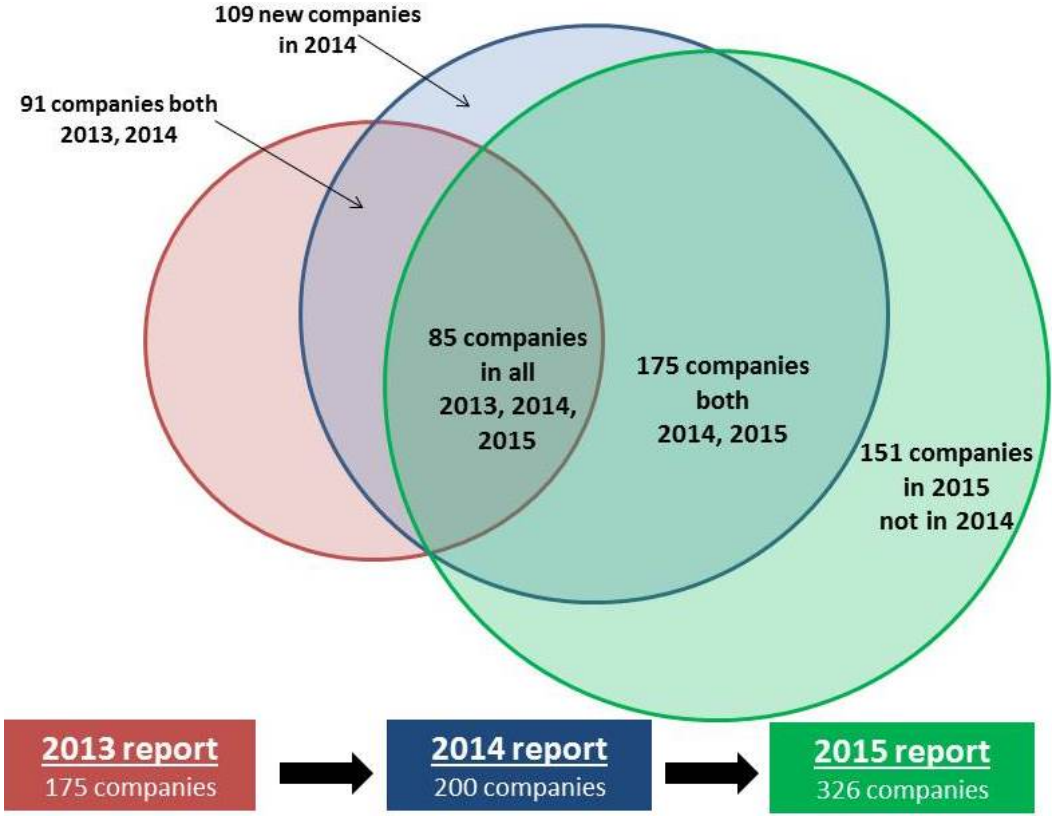
As defined by IBI, biochar is *a solid material obtained from the thermochemical conversion of biomass in an oxygen limited environment. Biochar can be used as a product itself or as an ingredient within a blended product, with a range of applications as an agent for soil improvement, improved resource use efficiency, remediation and/or protection against particular environmental pollution, and as an avenue for greenhouse gas (GHG) mitigation.* Biochar has the potential to increase agricultural productivity, enhance agriculture's resilience to the impacts of climate change, reduce greenhouse gas emissions, and produce sustainable energy. When added to soils, biochar may enhance the resilience of soil ecosystems in the face of intensifying weather events and pressures to improve soil productivity. But not all biochars are created equally. Diversity in feedstocks, production technologies, and biochar end uses creates a complex web of variables whose interactions and synergies are still being investigated. And although purposely adding charcoal to soils is an old practice in some parts of the world, biochar as a product is relatively new—both in terms of research and of a formal biochar industry focused on promoting its adoption as a mainstream soil fertility management practice.

The Biochar Industry – A 2015 Snapshot

As noted in the 2013 *and* 2014 IBI *State of the Industry Reports*, the biochar industry is still quite small; however the data trend over the last three years shows continued growth. The term "biochar" is gaining wider recognition outside of the industry, but the understanding of this term by the general public is limited.

For the purposes of this report, IBI defines the biochar industry as *those enterprises encompassing the commercial production, distribution, and marketing of biochar and biochar-related products and services*. Within this definition, three sectors of biochar business entities can be broadly identified: 1) biochar production and/or product sales; 2) biochar production equipment manufacturers; and 3) other biochar-related enterprises, such as consultants, project developers, and others.

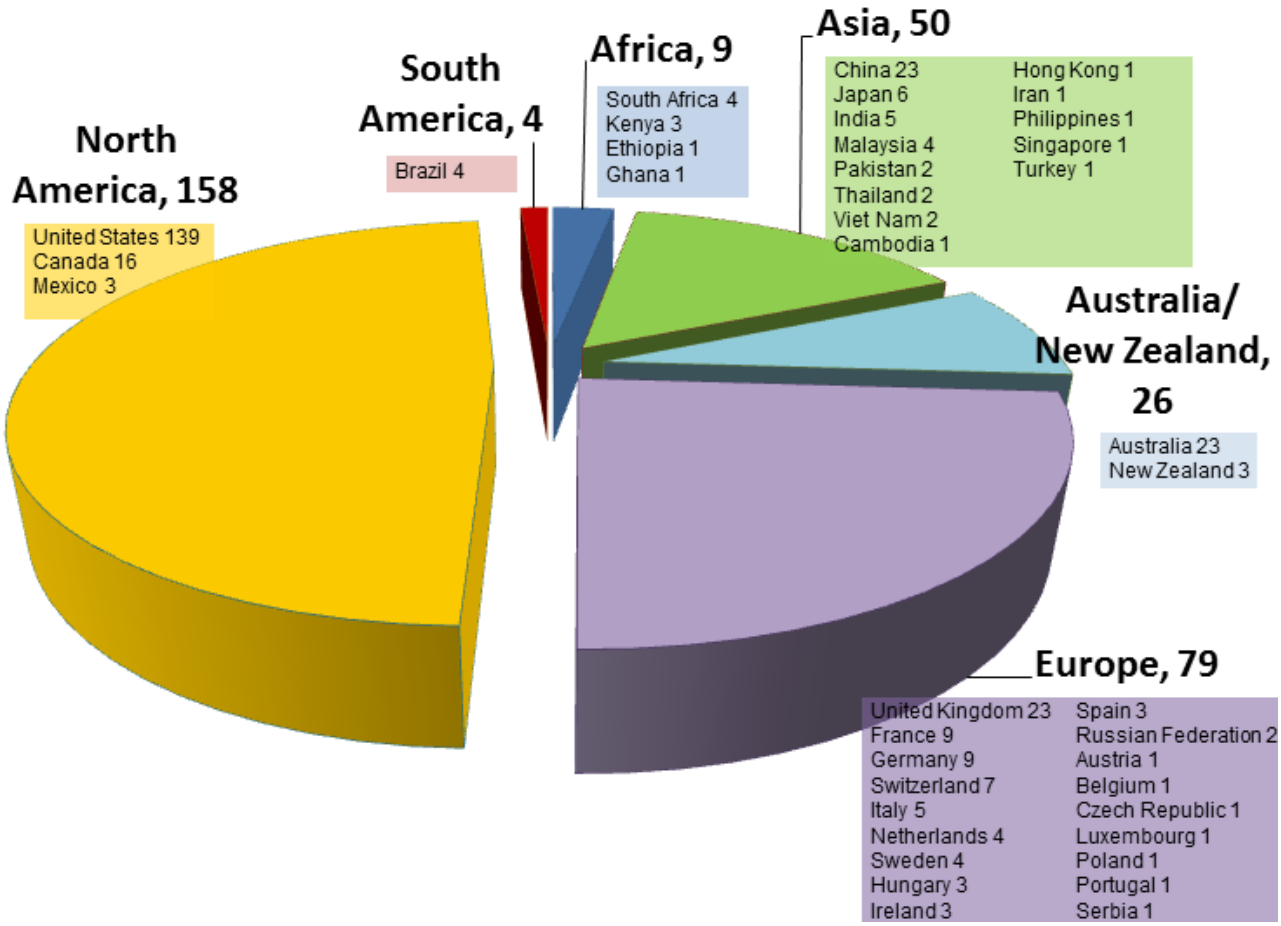
This 2015 snapshot includes data from 326 companies in the accompanying database, 118 of which took the complete IBI survey. As is shown below, the company count has almost doubled from 2013 to 2015—which is most likely indicative of both new companies entering the marketplace as well as more information being readily available regarding biochar-related companies around the world.



Comparison between 2013, 2014, and 2015 companies included in the IBI State of the Industry Reports

Of the 326 companies in the 2015 IBI company database, over half (206) were involved in biochar production and/or sales, 130 were biochar equipment manufacturers, and 87 were involved in related enterprises; 82 companies showed activity in more than one sector and 15 showed activity in all three sectors.

The geographic distribution of biochar enterprises shows a heavy focus in North America, Europe and Asia, with the United States, China, Australia, and the United Kingdom reporting the highest number of active biochar companies.



Geographic location of biochar businesses

The "undocumented" biochar sector

While the figure above indicates that the majority of companies were located and operate in North America, Europe, and Asia (and seeing a large growth in reported companies operating in Asia over the 2013 and 2014 reports), it is likely that the Asian market, especially in China and Southeast Asia, is significantly underrepresented in this data. Obtaining reliable data on this sector is difficult due to the lack of availability of biochar growth and production metrics. Future

research efforts should focus on identifying and quantifying currently undocumented biochar production and use in order to fully report on the global biochar industry.

Results from the 2015 State of the Industry Company Survey

While the previous section reported on all 326 companies in the IBI company database, the following sections focus on survey results from the 118 companies who took the 55-question online survey administered by IBI from August through November 2015. The survey was primarily taken in English, but was also translated into Chinese and Spanish to reach companies outside the English-speaking marketplace.

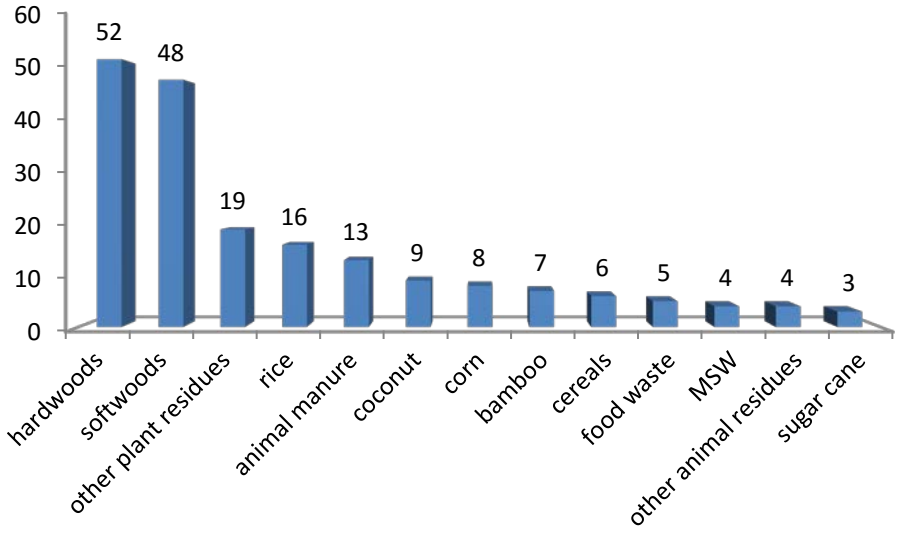
Biochar Producers

Of the 118 survey respondents, 84 (or 71%) identified as biochar producers. Of those 84 producers, 36 sell both pure and blended biochar, 32 sell only pure biochar, and 9 sell only a biochar blend (biochar mixed with compost, fungi, etc.). Note that the 2015 company database which includes both survey respondents as well as companies from other sources (internet research, IBI databases), includes 206 companies that are biochar producers/have biochar product(s) for sale.

Biochar Feedstocks

Biochar can theoretically be made from any source material or feedstock with organic carbon content. The organic carbon-containing compounds in the feedstock are converted into persistent and easily mineralizable ('labile') fractions in the final biochar product. Biomass is, by definition, the only acceptable feedstock source of biochar and can be divided into unprocessed feedstocks (for example, wood chips or corn stover) and processed feedstocks. The latter are those feedstocks that have undergone chemical (e.g., paper pulp sludge) or biological (e.g., manures digested through an animal's gut or sludge from waste effluent treatment) processing.

Of the 84 survey respondents who identified as biochar producers, 78 (or nearly 93%) provided information on feedstocks. The graphic below shows that the forest products industry was by far the primary source of biochar feedstocks. Note that survey did not correlate tonnage-feedstock information so this data is limited to % of respondents, not % of biochar produced by those respondents.



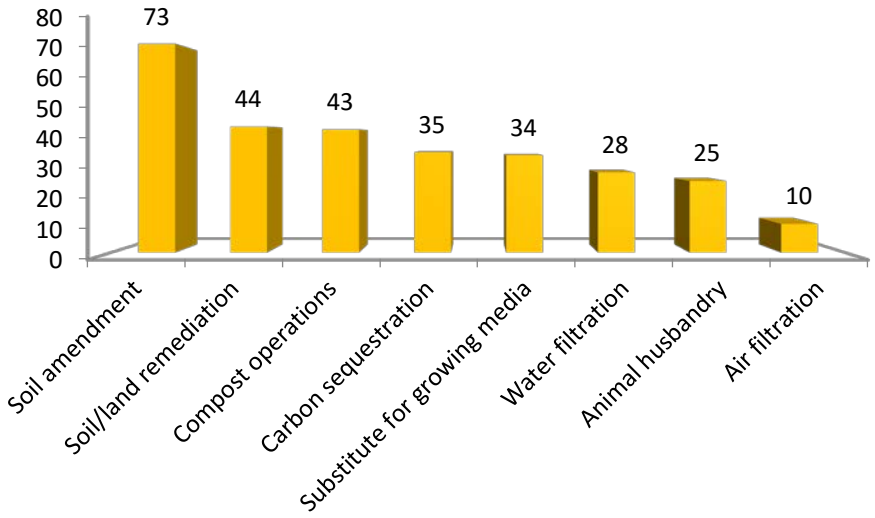
Feedstocks reported by companies producing biochar (n=194)

Wood-based residues—softwoods and hardwoods, or a combination of both—were listed as feedstocks in just over half of the biochar products (51%) which is a lower percentage compared to 2014, where 87% of respondents reported using softwoods, hardwoods, or a combination for their product. As noted earlier, the likely underreporting of biochar production in East and Southeast Asia shows up in the feedstock results as well. Many producers in Asia use straw and/or rice husk as a feedstock, based on agricultural availability.

Use of Biochar

While biochars are a spectrum of materials, they do share some distinctive physical and chemical properties, such as a stable carbon fraction and high surface area. In addition to use as a soil amendment, the material is sold for diverse applications including animal agriculture, water filtration, and soil rehabilitation. Although some companies produce biochar for purposes in addition to soil amendment uses, many companies that produce biochar for sale focus on its end use as a soil amendment. At this time, the most widely marketed application for biochar is as an agricultural soil amendment. For more information on specific soil and crop impacts, a bibliography is available at http://www.biochar-international.org/biblio.

Of the 84 biochar producers included in the survey, 74 (or 88%) provided information regarding how their customers are using biochar. As noted in the figure below, all producers except one answered that their biochar is used as a soil amendment (note that respondents could choose more than one use), and at least half included soil/land remediation, compost operations, carbon sequestration, and as a substitute for growing media.



Customer use of biochar (n=292)

Volumes transacted

While there was a modest increase from 2013 to 2014 in the number of companies providing data on sales volumes (16 in 2013 and 24 in 2014), the data still represent less than 25% of all companies reportedly producing or selling biochar. In 2015, the authors looked to a different method of data gathering through an anonymous survey which resulted in 23 companies providing data on biochar sales volumes. While the number of companies did not increase, the sales volumes reported increased significantly from 7,457 metric tons (tonnes) in 2014 to 85,000 metric tons in 2015. Without a larger number of companies providing data on volumes transacted, it remains difficult to determine an accurate estimate of transaction volumes in the marketplace.

Biochar Production Equipment

Biomass feedstock can be converted into various products including solids, liquids, gases, and heat through a range of thermochemical decomposition processes, beginning with the slight charring of biomass—browned and brittle but not fully charred—and ending with complete combustion—the burning of biomass resulting in the production of heat, gases, and ash. Biochar is produced through pyrolysis or gasification. Pyrolysis occurs at temperatures ranging from 300 – 600C and under low or zero oxygen conditions. Gasification, occurring at slightly higher temperatures and with limited oxygen flow, maximizes the production of gas (impure synthesis gas) for energy production but can also produce a solid biochar by-product.

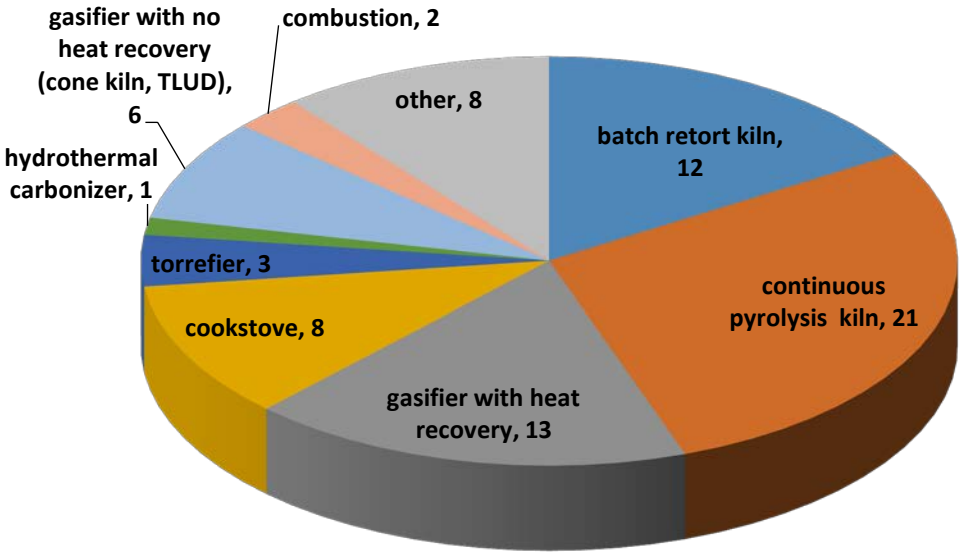
Scales of biochar producing technologies

Pyrolysis and gasification technologies capable of generating biochar are highly diverse. On one end of the spectrum are simple, low-cost cookstoves while on the other end are multi-million dollar industrial facilities engineered to process many tonnes of feedstock per day. Within this spectrum lie a wide range of technologies—spanning various sizes, designs, and engineering complexities.

Of the 118 survey respondents, 56 identified as companies selling or planning to sell biochar production equipment in 2015. Note that the 2015 company database, which includes both survey respondents as well as companies from other sources (internet research, IBI databases), includes 130 companies that are equipment sellers.

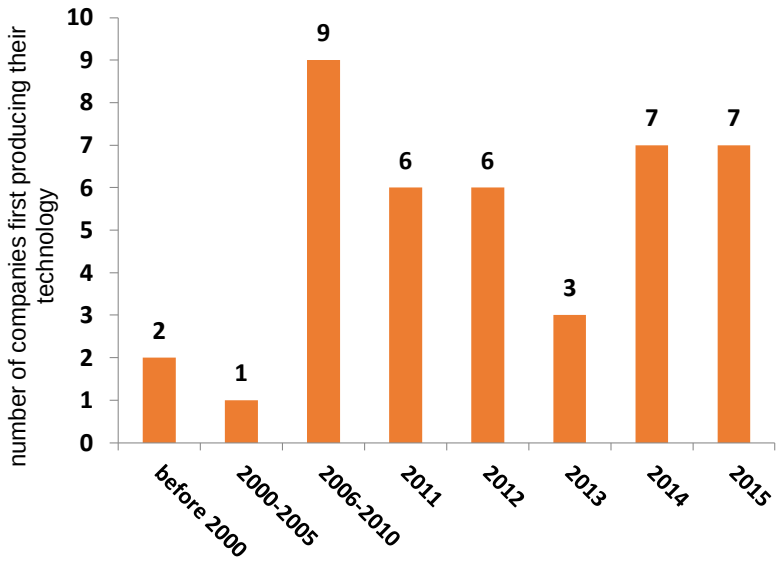
Types of biochar production equipment

There exist many technological configurations for pyrolysis and gasification equipment. Of the 56 respondents identifying as technology producers/sellers, 46 (or 82%) provided more information on the equipment they offer for sale, as is shown in the chart below.



Type of equipment manufactured (n=74)

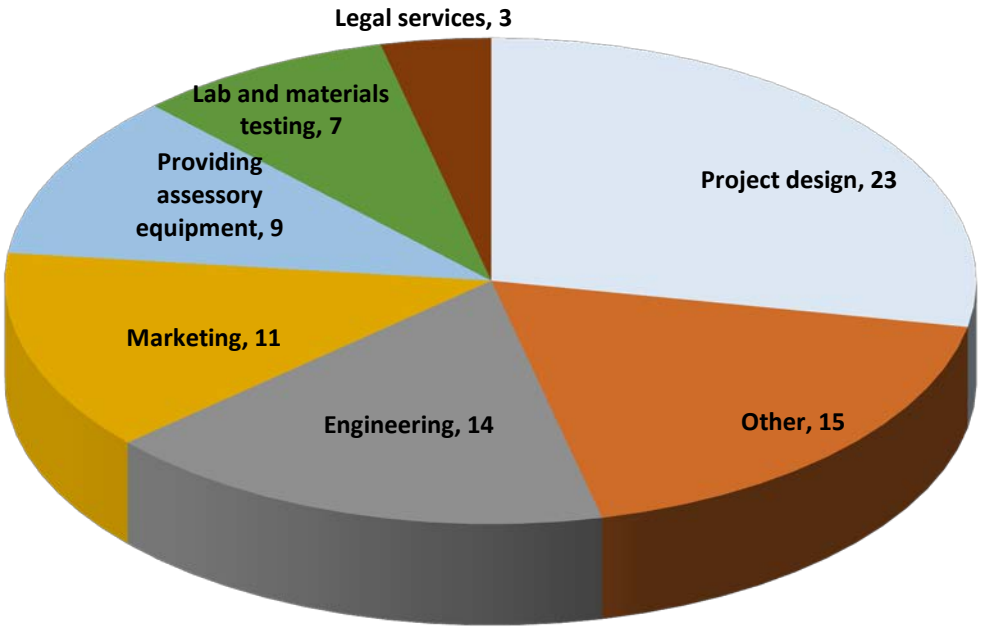
Of the 46 respondents noted above, 13 produce a batch process technology, 24 produce a continuous process technology and 9 produce both batch and continuous process technologies. Most of the companies only started manufacturing biochar production technologies in the last five years, as is shown in the figure below.



Year when manufacturers started producing technologies (n=39)

Purveyors of Biochar-Related Goods and Services

In addition to the two main categories of enterprises discussed in the previous sections—those producing and selling biochar and those manufacturing and distributing biochar production equipment—there exists a third category of enterprises in the biochar space. Activities here span a broad range and include: consulting on project design, consulting on engineering, marketing services, selling and designing accessory equipment, materials testing, and "other" related services. Those "other" services include education, consulting on soil science, policy advice, etc. Of the 118 companies who answered the survey, 39 identified some or all of their biochar-related activities in this category. Of the 326 companies in the company database, 87 identified as (or were identified as) companies specializing in biochar-related goods and services.



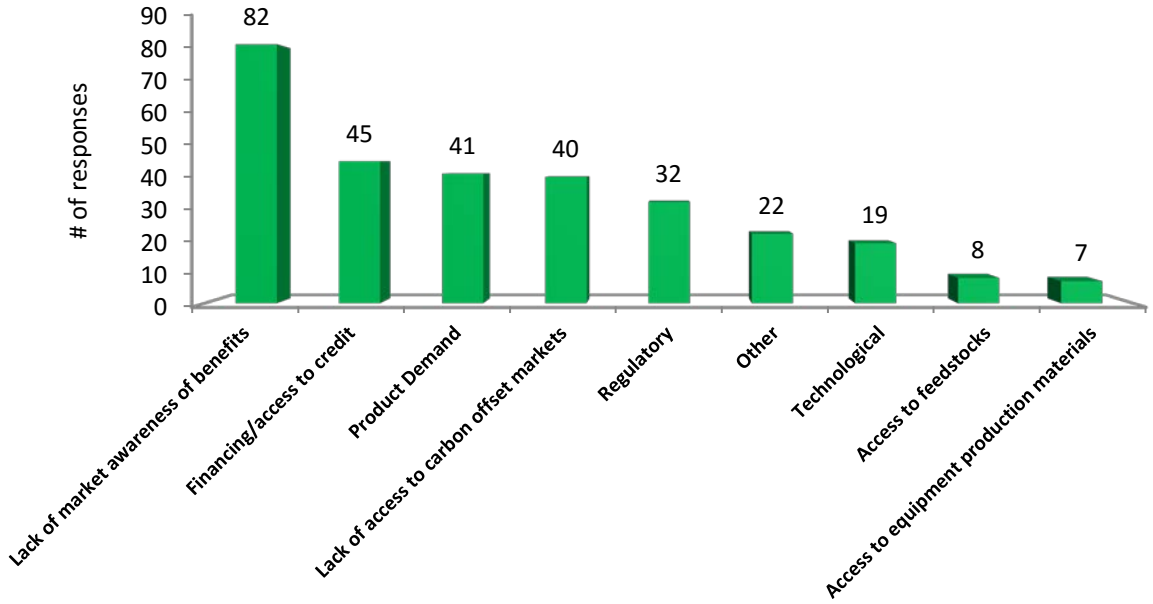
Companies focusing on specific biochar-related goods and services (n=82)

Market Trends and Outlook

As reported in the two prior *State of the Biochar Industry* reports, current biochar commercial activity is indicative of the early evolutionary stage of the industry. This applies not only to the market share of biochar sales—which is nominal compared to related industries such as compost and fertilizer—and its potential for growth, but also to other important indicators of success for an industry, such as consumer awareness, market development, technological maturity, and investor confidence.

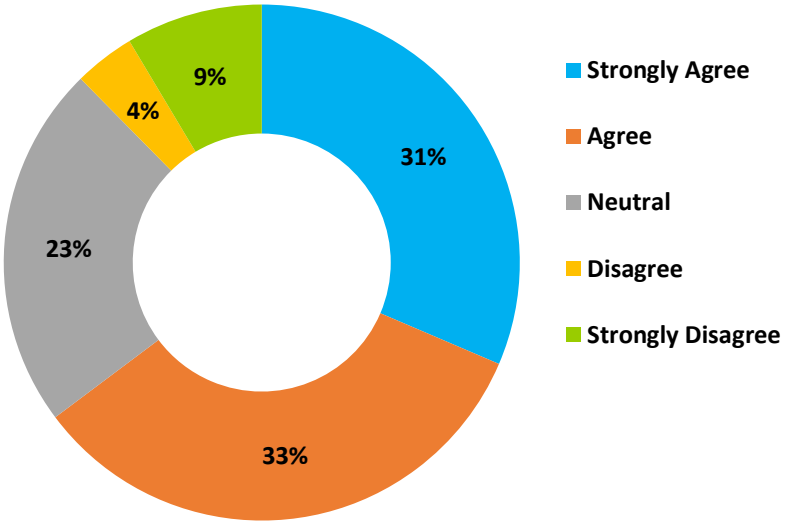
Barriers to Market Growth

Even with the growth in biochar companies over the past few years as highlighted earlier in this snapshot, the biochar industry is still small, with room for expansion. But that expansion will not come without certain obstacles being addressed; which the following graphic highlights. Of the 118 survey respondents, 104 provided feedback on barriers to market growth. Note the extremely high number of responses reported for "lack of market awareness of the benefits of biochar", which highlights that the biochar community can have a large role to play in educating the market (to include both retailers and customers) on the best uses for biochar in a number of applications. "Other" answers most commonly included in survey responses included: high transportation/shipping costs and difficulties; biochar companies overselling the benefits of their product/selling underperforming products; low sales prices compared to high production costs; and lack of vetted cost/benefit data for consumers.



Perceived barriers to market development for all respondents (n=300)

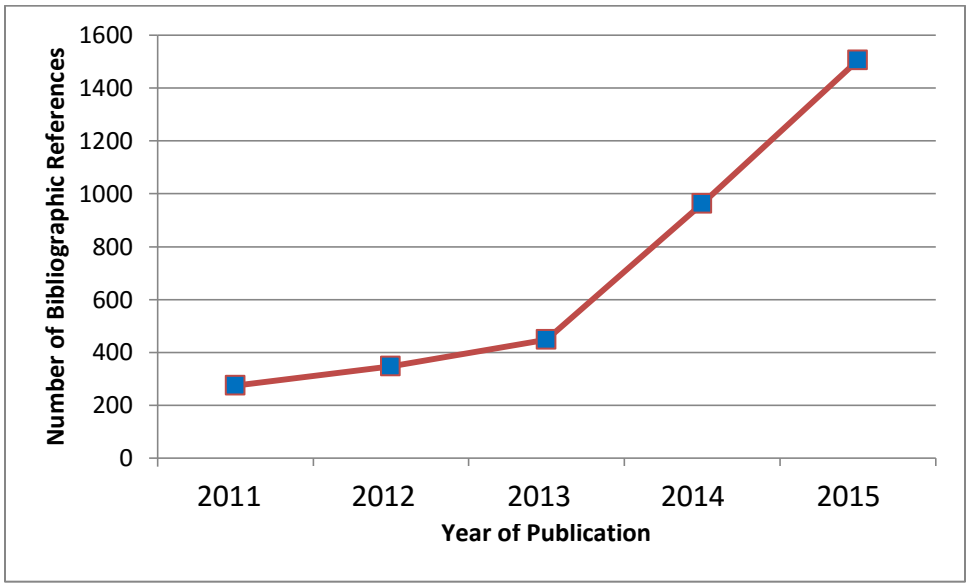
Although the pace of market growth is uncertain overall, it potentially can be influenced by factors such as consumer education/outreach and market development, technological advances, and investments in business development; and other factors that are more difficult to influence such as the current low price of fossil fuels, especially in the energy sector (which makes biomass energy production less profitable at this time). Of the 105 respondents who answered the question of whether they see sales increasing in the coming 12 months or not, 65% of respondents agreed or strongly agreed that sales would increase. This percentage is the same portion of responses that agreed or strongly agreed in 2014.



Biochar sales will increase over the next 12 months (n=105)

State of Biochar Research

Innovative and peer-reviewed research on all aspects of biochar better supports the growth of a successful biochar industry. Without continued strong research on biochar and its potential effects on crop growth, water retention, carbon stability, cost-benefit analysis etc., industry growth is constrained as biochar producers must be able to provide a compelling value proposition to attract new and returning customers. Fortunately the dramatic increase in biochar-related publications in the peer-reviewed scientific literature over the last five years supports this opportunity for the industry to access this expanding knowledge bank.



Growth in peer-reviewed biochar-related publications from 2011 – 15 (source: IBI website bibliography)