Cultivating Capacity for Biobased Materials and Chemicals Through 2017

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Introduction

Investment and growth in biobased material and chemical capacity continues to increase globally. We analyzed 229 sites from 217 companies that were planned, operating, or shuttered between 2005 and 2017. We then categorized their products—133 chemicals and classes like succinic acid and polyols—into seven main product categories (e.g., intermediate chemicals, polymers, and specialty chemicals) and 22 subcategories (e.g., isoprenoids, gases, and starch plastics). We also classified them by feedstocks, country, and geographic region. This report assesses product growth, identifies feedstock trends, determines the fastest growing geographies, and the regional product and feedstock trends. This report also evaluates industry growth trends and commercialization successes, highlighting lessons to be learned and emerging opportunities.

Landscape—The Overall Map of Feedstocks to Products

The basic science of biobased materials and chemicals has advanced to the point that dozens of chemicals can now be produced from multiple feedstocks, at costs that are competitive with petroleum—at least in theory—and at scale. To prove out their processes in industrial quantities and start seeing larger revenues, many BBMC developers have been working towards full-scale production.

For this report, we examined 217 companies’ biobased material and chemical production facilities (229 sites in total), that were planned, operating, or shuttered between 2005 and 2017 all over the world. For each facility, we documented the actual or planned nameplate capacity for the 2005 to 2017 period.

From 2005 to 2013, the count of BBMC facilities worldwide grew from 24 to 193, a compound annual growth rate (CAGR) of 26%. From today through 2017, it will grow to 229 sites, a CAGR of 3%. In terms of capacity, the worldwide tonnage of biobased products produced grew from 1.9 million metric tons (MT) in 2005 to 6.9 million MT in 2013 (a CAGR of 15%). Through 2017, the total capacity will increase to 13.2 million MT, growing 14% annually, though this number does include both chemical intermediates and final products. For example, capacity for both lactic acid and poly(lactic acid) (PLA) are included.

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Executive Summary

Biobased material and chemical (BBMC) technologies have advanced to the point that companies are scaling to commercial production quantities and pursuing revenue. We examined 217 companies’ planned and existing capacity between 2005 and 2017 and found that:

- Production of intermediate chemicals like adipic acid and lactic acid will grow from 2.0 million MT to 4.9 million MT in 2017, while growth in first-generation facilities stalls. Going forward, today’s 1.1 million MT bio-derived polymer capacity grows 18% per year through 2017 as companies like Avantium build new sites, and production of bio-oil and its derivatives is set to grow from 1.0 million MT today to 1.8 million MT in 2017.
- Specialty chemicals (e.g., farnesene) are set to boom, growing with a compound annual growth rate (CAGR) of 46% between now and 2017, while the nascent biobased advanced material space, comprised of products like bee silk, continues to have a negligible capacity through 2017.
- First-generation sugar/starch feedstocks—such as corn and sugarcane—are, and will remain, the dominant biobased source. At the same time, new technologies result in a sharp drop in the share of cellulosic capacity, from 67% to 27%, and bio-oil feedstocks—such as palm and canola—supply 1.1 million MT of BBMC capacity today.
- Processes converting chemical inputs, (e.g., converting suc-cinic acid to butanediol) will see a 19% CAGR through 2017. In addition, explosive growth is planned for gas-fed facilities, with a 117% CAGR from 2013’s 29,000 MT capacity, driven largely by long-shot waste gas consumer CO2 Solutions and algae developers struggling with high production costs.
- North America ranks fourth in global capacity today, but will become first by 2017. In parallel, North Asia rises as a
competing geography, from 2 BBMC sites in 2005 to 37 in 2017. Europe’s share of global capacity drops from 37% in 2005 to 14% in 2017.

- Substitute products like [poly(lactic acid)] PLA found their market share, but growth will slow to a CAGR of only 8%. Drop-in biobased products will continue to hold the lion’s share of total capacity at 68% and bio-products with improved performance will grow to 19% of the total capacity by 2017.
- Specialty chemicals are enabling new biobased markets in the nearer term, as companies like Solazyme and Segetis bring products to market, and, long term, biobased advanced materials is an emerging sector, with products like spider silk and nanocrystalline cellulose.
- First-generation sugars are good feedstock targets and will lead capacity growth, at least until someone solves the cellulosic problem. However, cellulosic waste, such as corn stover, is still gaining and set to increase to 9% of the total feedstock usage and 32% of all cellulosics. A growing focus on non-sugar and non-cellulosic feedstocks, such as waste gas, results in increased feedstock diversity.
- North America’s 3.6 million MT product portfolio is the most diverse, as American start-ups like Gevo build initial plants close to home. North Asia’s capacity is 71% intermediate chemicals, as producers look to build close to plastic demand. Also, [the Association of Southeast Asian Nations] ASEAN has the largest regional share of bio-oils and derivatives, though first-generation dominates with 42% of 2017 capacity, and first-generation biobased materials and chemicals makes up 53% of Europe’s 1.8 million MT capacity in 2017.
- A few unlikely gas consumers plan for North American scale-up, while a handful of developers like Elevance and Butamax, retrofit biofuel facilities. North Asia’s bioproducts are dominated by nonfood feedstocks, while 47% of ASEAN’s BBMC capacity will come from bio-oils and starch. Though cellulosic feedstocks dominate Europe today, sugar will supply 742,000 MT of capacity in 2017.