ACS Sustainable Chemistry & Engineering
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Editorial

Expectations for Manuscripts on Biomass Feedstocks and Processing in *ACS Sustainable Chemistry & Engineering*

Cite This: *ACS Sustainable Chem. Eng.* 2020, 8, 11031−11032
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ACS Sustainable Chemistry & Engineering (*ACS SCE*) reports and promotes innovation and advances in sustainable chemistry and engineering. The disciplines of sustainable chemistry and engineering are rapidly evolving, and consequently, our expectations for manuscripts that will be published in *ACS SCE* are also evolving. To help guide authors in understanding these changes, this editorial focuses on the scope and expectations for manuscripts reporting advances in the use and processing of lignin, cellulose, chitin, lipids, polysaccharides, and other renewable materials broadly characterized as biomass.

The demand for energy and everyday commodities has increased in all regions of the globe. Sales of chemicals, including pharmaceuticals, are projected to exceed US$5 trillion in 2030, double that of 2017.[1] Currently, these items are mostly produced through manufacturing processes utilizing nonrenewable resources, such as crude oil, coal, and natural gas. Global energy supplies are also heavily reliant on nonrenewable resources, and global demand for energy is projected to grow from its current level of approximately 600 quadrillion BTU (quads) per year to 900 quads/yr by 2050.[2] Only a small fraction of this energy use is currently derived from renewable biomass resources.[3]

Multiple analyses have indicated that energy and materials use from biomass could be increased significantly, even using only biomass materials that are currently viewed as wastes. Projections of feedstock availability show that up to a billion tons per year of crop residues, herbaceous energy crops and woody crops and wastes, are available in just the United States.[4] Algae systems could add to this feedstock flow, especially if they could be colocated with concentrated CO_2 sources, such as ethanol plants, coal-fired power plants, and natural gas-fired power plants.[4] However, for these feedstock resources to gain acceptance as reliable feedstocks, methods for improving reliability of their quality while minimizing variability must be developed along with robust supply chains.

Once sourced, feedstock resources must be pretreated, dissolved, or fractionated, prior to conversion into energy products, chemicals, or materials, preferably with unique functional properties. Fractionation and purification of cellulose, hemicellulose, lignin, chitin, lipids, and other biomass resources have most often been developed as unit operations integrated into linear production systems; fractionation and purification methodologies with full usage of the renewable feedstock remain scarce. Green processing through use of renewable energy, regenerable green solvents, and catalysts are also needed.

Overall, biomass-based resources for the production of chemicals, materials, and energy have the advantage of being renewable and may have economic and other environmental advantages: soil, water, and air quality enhancement and new areas of employment that can enhance rural economic development. The overall sustainability of biomass resources must be evaluated carefully, however. Understanding the amount of biomass that can be sustainably sourced, recognizing the land, water, and other resource requirements of biomass production, is an active area of research.

ACS SCE seeks to publish new and high-impact research articles that address the challenges of sustainably using and processing biomass resources. We welcome contributions that report the development of new molecular products; we also welcome contributions describing new bulk material products and nanomaterials. These include but are not limited to contributions describing platform chemicals, specialty chemicals, biodegradable materials, nanomaterials derived from biomass, biomedical materials, catalysts, and sensors. Uses of biomass to create electrochemical energy conversion and storage devices, such as solar cells, fuel cells, photoelectrochemical cells, batteries, capacitors, and supercapacitors, are also welcome.

In all of these areas, manuscripts should emphasize the novelty of the work and contributions that the work makes in addressing key scientific or technological challenges. Reports describing biomass-based catalysts, electrocatalysts, photoelectrocatalysts, photocatalysts, membranes, and other functional materials will be considered if they show outstanding performance relative to benchmark products or processes. Manuscripts reporting unique device functionality that only can be achieved using biomass derivatives are also encouraged. Reports that do not demonstrate advances in performance compared to appropriate benchmarks, however, will not be considered.

Manuscripts describing biomass processing to value-added chemicals or fuels are encouraged, including methods for processing of cellulose, lignin, chitin, polysaccharides, and other biomass resources. Processing should demonstrate high

Received: July 14, 2020
Published: August 3, 2020

conversion efficiencies and high selectivity. Contributions addressing sustainable processing and applications of molecular products and functional materials derived from biomass that are under pilot-scale tests or small trial tests are particularly welcomed. Manuscripts that describe incremental variations of a well-established research protocol, however, are typically considered out of scope. For example, reporting the use of a new biomass feedstock, including algae for energy production, where the process chemistry is already well developed, is unlikely to be considered, unless substantial advances in sustainability and connections to circular economies are examined. Similarly, descriptions of pretreatment, fractionation, and purification processes will only be considered if there is a proven advance in sustainability and economic benefit compared to reported procedures. Biomass processing often requires considerable resources, and advances can be achieved by reducing energy and material consumption, improving performance and efficiency, and by switching to more sustainable solvents.[5] When assessing whether changes in biomass processing have resulted in a more sustainable process, many factors can be considered. These include, but are not limited to, the amount of energy and materials required, carbon footprints, recycling, and disposal.

Reviews and perspectives that report significant advances and opportunities in emerging or rapidly evolving topics on biomass feedstocks, processing, and products are also welcomed. Manuscripts must clearly discuss potential sustainability advantages of the reviewed topic as well as the fundamental and practical challenges that must be addressed for implementation.

Finally, in all manuscripts, authors are encouraged to use quantitative metrics to characterize improvements in sustainability made possible by their research. While we realize that the use of quantitative metrics is not possible or necessary in all cases, we continue to encourage authors to make these assessments to strengthen their manuscripts.[6]

Future editorials will address the evolving scope and expectations for manuscripts in other topical areas covered by *ACS SCE*. Our intention is that the topically specific discussions of scope will help *ACS Sustainable Chemistry & Engineering* authors and reviewers understand the types of research contributions that are most likely to be sent for external review and accepted in the journal.

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Notes

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ACS Sustainable Chem. Eng. 2020, 8, 11031−11032