Preface

The twenty-first century saw rapid expansion into making liquid fuel production more sustainable by producing ethanol from corn starch. Brazil already pioneered ethanol from sugar cane, but a logical step was to use corn from the world’s most prolific agricultural production area, the USA’s Midwest. Ethanol production in the US jumped in a few years from a few billion gallons to fourteen billion gallons, all in less than a decade, to become the world leaders in biofuels production. This is a remarkable achievement of free enterprise, mainly driven by smaller companies and farmer owned consortia. While corn is not the answer to replacing fossil fuel sources due to production limitations, the industry made a brave statement in replacing almost 10% of all liquid fuel needs. What is more, ethanol is a very clean octane enhancer and avoids the pollution of water resources found with the previously and still used MTBE (methyl tertiary butyl ether) from petroleum sources. The production cost of ethanol from corn is not quite competitive with petroleum-based gasoline and the industry has been relying heavily on selling coproducts, particularly distillers dried grains (DDG) and subsidies. With subsidies being withdrawn, the industry will become even more dependent on efficient coproduct utilization.

Biofuels have come under scrutiny and criticism recently. It is claimed that although renewable, these products are not as environmentally friendly as originally conceived, mainly because the energy inputs, often from non-renewable sources, are as large or larger than the energy contained in the fuel product. In addition, corn used in ethanol production reduces the supply of a staple food or animal feed. Lastly, there is a perception that the US ethanol causes an increase in food prices. Careful analysis of all these allegations will show that these are generally exaggerated and the ethanol industry deserves much more praise for their pioneering efforts in ethanol production. What is more, the industry deserves to be supported by research into better utilization of all the organic matter to produce additional coproducts some of which is presented in this book. Nevertheless, there is a clear need to expand biofuel production beyond what can be based on seeds.

Lignocellulosic ethanol production seems to have the key to sustainable biofuel production. Taken as a whole, with billions of tons of primary plant productivity of
lignocellulosic material per year world-wide, it becomes clear that such quantities of raw material could indeed become the main raw material for liquid fuel production. The production capacity of hydrocarbons by the plant kingdom, algae and cyanobacteria using solar energy is huge and the first chapter describes mechanisms of such primary production. However, while the technology exists, current production methods, on the verge of intermediate-scale production, are not yet economical and would indeed be more costly than ethanol production from corn. Various methodologies are being developed to lower costs and some chapters in this book are devoted to this topic, including electrochemical pathways to produce electricity based on simple degradation products from lignocellulosics.

Equally important is the fact that all biofuel production methods generate leftovers. These leftovers do not only present disposal challenges, but also provide opportunities for making further coproducts. These coproducts could play even further important roles in substituting for petroleum products in making bio-polymers and many other valuable substances. Only when all organic material from lignocellulosic material is used gainfully will the biofuel industry truly become sustainable. Various chapters in this book are devoted to further useful applications of the leftovers from various lignocellulosic processing operations under development.

The last three chapters reflect on the overall picture of use and production of biofuels and its infrastructure impacts, assessment of environmental risks and the lifecycle of biofuels.

Researchers and practitioners engaged in the study of bioenergy and bioproducts will find this book very useful. This book will also serve as an excellent state-of-the-art reference material for graduate and postgraduate students in biorenewables.
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