

E²Energy Special Issue and Conference Note

Fourth Environment-Enhancing Energy (E²-Energy) Conference in Beijing, China, July 8-10, 2016

Liu Zhidan¹, Yuanhui Zhang², B. Brian He³, Liao Qiang⁴

(1. *Laboratory of Environment-Enhancing Energy (E2E), Key Laboratory of Agricultural Engineering in Structure and Environment, Ministry of Agriculture, College of Water Resources and Civil Engineering, China Agricultural University, Beijing, 100083, China;*

2. *Department of Agricultural and Biological Engineering, University of Illinois at Urbana-Champaign, Urbana, IL 61801, USA;*

3. *Department of Biological Engineering, University of Idaho, Moscow, Idaho 83844, USA;*

4. *Key Laboratory of Low-grade Energy Utilization Technologies and Systems, Chongqing University, Ministry of Education, Chongqing 400030, China)*

The paradigm of Environment-Enhancing Energy (E²-Energy) is to produce renewable energy and chemicals from biowastes and biomass, and simultaneously improve the environment by reusing nutrients, capturing carbon and cleaning wastewater. The 1st E²-Energy Forum was initiated in 2010, Beijing, by Professor Yuanhui Zhang, University of Illinois at Urbana-Champaign (UIUC), China Agricultural University (CAU) and Zhejiang University (ZJU). The forum has grown to a biannual international conference in 2012 in Shanghai, and 2014 in Beijing. The 4th E²-Energy Conference was jointly organized by CAU, UIUC and Chongqing University, and convened at CAU International Conference Center, Beijing, China on July 6-8, 2016. The conference was financially supported by the National Natural Science Foundation of China (5151101167, U1562107 and 51576206), the Bill & Melinda Gates Foundation (RTTC-C-R2-01-001) and Beijing Science and Technology Program (Z161100001316009). Prof. Yuanhui Zhang in UIUC and CAU, and Prof. Qiang Liao of Chongqing University co-chaired the E²-Energy 2016 conference. Prof. B. Brian He of University of Idaho served as the proceeding Chair and Prof. Liu Zhidan of CAU was the program chair.

The E²-Energy Conference explores the resources and production technologies for next generation hydrocarbon fuels and biomaterials with environment-enhancing capabilities, with specific respects to carbon capture,

nutrients reuse, wastewater treatment and reuse. Feedstocks are focused on biowastes and biomass including those from agricultural, industrial and municipal sources. Environmental protection and energy production are among the greatest challenges facing mankind in the 21st century. Mitigation on climate change is in eminent demand. China and the United States are the top two energy users, and at the same time the top two CO₂ emitters. The shared responsibilities on these two great countries to meet these grand challenges are unprecedented. In the context of our modern society, the relationship of environment and energy is more often opponents rather than friendly co-existents. To sustain our economy and environment, our energy sources must be environmentally enhanced and economically sustainable. We envision that E²-Energy technologies should be explored to aim at meeting our future liquid fuel needs at the same time achieving net-zero carbon emission and complete water reuse, and cycling nutrients in the feedstocks.

E²-Energy 2016 aimed to 1) Report the emerging and future E² Energy technologies for next generation hydrocarbon liquid fuels with a total net-zero, or negative carbon emission during their life-cycles; 2) Promote collaborations among, and invest in the academia, industry and government agencies jointly or independently, in the R&D of E² Energy area. Over 100 international participants including universities, institutes and industry

from four countries joined together to exchange the latest findings, current state and future development on E²-Energy. The main topics included:

- Issues of energy, environment, national security and economic development
- State-of-the-art technologies for next generation of hydrocarbon fuels and new chemicals
- Bioscience and engineering of biomass production
- Thermochemical processes of biowastes/biomass for liquid/gaseous fuels or chemicals
- Biochemical processes of biowastes/biomass for liquid/gaseous fuels or chemicals
- Biomass (Algae and lignocellulose) for liquid/gaseous fuels or chemicals
- Waste water cleaning and water resources in bioenergy and chemicals production
- Carbon sequestration and nutrient reuse
- Catalysis of biomass conversion
- Socio-Economic issues related to bioenergy

Keynote presenters in the plenary session include leaders from USA, China and Brazil, including Prof. Robert Easter, President Emeritus of UIUC, USA; Prof. Phillip E. Savage, College of Engineering, Penn State University, USA; Prof. Jawkai Wang, Academician of U.S. Academy of Engineering, Jawkai Biotechnology, China; Prof. Marcio Aredes Martins, Universidade Federal de Vicosa, Brazil; Prof. Roger Ruan, University of Minnesota, USA. Prof. Easter commented that energy is fundamental to the sustainability and human society. Prof. Savage introduced the concept of fast hydrothermal liquefaction of microalgae, demonstrated that it results in higher yield of biocrude oil than traditional hydrothermal liquefaction. In addition, he detailed the properties of biocrude oil and aqueous phase from the perspective of molecular structure and elemental components. Prof. Wang shared his long-term experiences on diatom cultivation in open systems and its valorization for the production of biomaterial and bioenergy. Prof. Martins shared the research advances of algae technologies both in upstream cultivation and downstream processing in Brazil. Prof. Ruan presented a case study on biofuel production from

biomass through sequential two-step fast microwave-assisted pyrolysis and packed-bed catalytic upgrading.

The conferences consisted of four sessions in parallel, including thermochemical conversion, bioconversion, algae culture and wastewater process, and feedstock and system analysis. There were total eleven invited speeches. In the session of thermochemical conversion, Prof. Brian He presented the recent work on in situ SCF processing of microalgae to biodiesel; Prof. Hong Yang of UIUC shared in situ TEM techniques used for understanding the design and processing of catalysts; Dr. Peng Hui, Qingdao Institute of Bioenergy and Bioprocess Technology (QIBEBT), CAS, introduced the research on renewable biofuels and chemicals: from thermochemical conversion to novel approaches; Prof. Li Zifu of University of Science and Technology Beijing, reviewed the opportunities and challenges of manure treatment by pyrolysis process in China. In the session of bioconversion, Prof. Xing Xinhui of Tsinghua University presented the research on bioprocess integration for production of biofuels and biochemicals via C0/C1 biorefinery of low-grade biomass; Prof. Feng Yujie of Harbin Institute of Technology, presented her work on electricity generation and in-situ use in wastewater treatment using microbial electrochemical technologies. In the session of algae and wastewater process, Prof. Cheng Jun of Zhejiang University introduced the research advances on CO₂ fixation by microalgae from coal-fired flue gas to produce biodiesel; Prof. Fu Qian of Chongqing University, presented the enhanced performance of microalgae photobioreactor through the principle of process intensification; Prof. Qin Song of Yantai Institute of Coastal Zone Research, CAS reviewed the algae technology in China, and the development of China Microalgae Industrial Alliance (CMIA). In the session of feedstock and system analysis, Prof. Zhang Huiyan of Southeast University, presented the work on depolymerization of lignin to fine phenolic monomers; Prof. Zhou Wenguang of Nanchang University shared the waste-to-algae technologies for sustainable and environment-enhancing biofuel and biobased byproduct production.

There were 37 oral presentations. The contents

covered a diverse area related to E^2 energy and technology, including feedstock characterization, thermochemical/biological conversion of biomass, catalytic conversion, treatment of wastewater, algae cultivation, nutrient reuse and management, production of biofuels and value-added chemicals, and system analysis.

The conference created a flexible communication platform for academia and industries related to biofuels

and waste/wastewater treatment. We appreciate the opportunity to publish this special issue entitled “Environment-Enhancing Energy” in the *International Journal of Agricultural and Biological Engineering*. We would like to acknowledge Prof. Wang Yingkuan, Editor-in-Chief, and Dr. Ji Fang, the editorial team, and all the reviewers and contributing authors for their efforts that have made this special issue possible.



The 4th international conference on E^2 -Energy 2016



Prof. Li Zhaohu, Vice President of CAU welcomed the conference audience as the hosting institution



Prof. Yuanhui Zhang, UIUC and CAU, chaired the E^2 -Energy conference



Prof. Robert Easter, President Emeritus, UIUC, gave an opening keynote speech