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The Biolosed ECONOMY

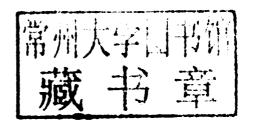
Biofuels, Materials and Chemicals in the Post-oil Era

Edited by Hans Langeveld, Johan Sanders and Marieke Meeusen

The Biobased Economy

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I. van Haveren obtained his Ph.D. degree for a study on metal-ion complexation of carbohydrates, at the Technical University of Delft. He has been with Wageningen University and Research Centre for over 16 years in several positions. He is co-author of more than 15 patent applications and over 30 scientific publications. He is currently Programme Co-ordinator Sustainable Chemistry at WUR/A&F, responsible for setting up both fundamental and applied research programmes, in close interaction with industry, in the field of organic & polymer chemistry with a focus on exploring the possibilities to use renewable building blocks in polymer applications.

John Jaworski received his B.Sc. in Chemistry from McGill University in 1970 and his Ph.D. in Analytical Chemistry from Cornell University in 1974. At the National Research Council of Canada he studied the ecotoxicology of heavy metals and helped make the case for removal of lead from gasoline in Canada. In 1984, he joined the Industrial Research Assistance Program of the National Research Council where he helped launch the first generation of Canada's biotechnology companies. After he joined Industry Canada in 1992, he combined his interests in biotechnology and the environment by helping to promote the development and adoption of industrial biotechnology in Canada for the production of renewable fuels, chemicals and materials. From 1998-2008 he was Chairman of the OECD Task Force on Industrial Biotechnology. He is a founding member of the Canadian Biomass Innovation Network and, after retiring from the federal public service in 2009, now acts as a senior policy advisor on the bioeconomy for the Government of Ontario.

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Mads V. Markussen is a research assistant at Risø National Laboratory for Sustainable Energy, The Technical University of Denmark. He works

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René van Ree became Bachelor of Science in Chemical Engineering at the College of Utrecht in 1989. He became Master of Science in Chemistry at the Department of Chemistry, Technology and Society (Research Group Energy & Environment) of the University of Utrecht in 1992 and Registered Energy Consultant at the General Association of Energy Consultants (AEC) in 1998. From 1993 to 2007 he worked at the Energy Research Centre of the Netherlands (ECN) on clean fossil fuel technology and biomass technology developments. Since 2007 he has worked at Wageningen University and Research Centre as Programme Manager Bioenergy, Biofuels, and Biorefinery. He is co-chair of the European Biofuels TP; co-ordinator of IEA Bioenergy Task 42 on Biorefinery; KBBE-Net representative; initiator of a variety of running European projects (BIOPOL, BIOREF-INTEG, BIOSYNERGY, Green Biorefinery); and a number of national bioefinery initiatives.

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List of Acronyms and Abbreviations

ABE acetone, butanol, ethanol

ACTS Advanced Catalytic Technology for Sustainability

ADM Archer Daniels Midland AEZ Agro-Ecological Zones

AK aspartate kinase
BDBP biodiesel by-products

BIMAT Biomass Inventory Mapping and Analysis Tool
BMELV Federal Ministry of Agriculture (Germany)
Ministry of Environment (Germany)

BTL biomass to liquid

C carbon

CBB Chemical Building Bloc

CBIN Canadian Biomass Innovation Network

CCS carbon capture and storage
CES constant elasticity of substitution
CGE computable general equilibrium

CH4 methane

CHP combined heat and power

CO carbon monoxide

CPL chorismate pyruvate-lyase

DARCOF Danish Research Centre for Organic Farming

DDGS distiller's dried grains with solubles

DH doubled haploids

DHDPS dihydrodipicolinate synthase

DME dimethylether

EEA European Environment Agency EEG Renewable Energy Source Act

EMF ethoxymethylfurfural
EPS expanded polystyrene
ETBE ethyl tertio butyl ether
EU European Union
FAME fatty acid methyl ester

FAO Food and Agriculture Organization of the

United Nations

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FFV flexible-fuel vehicles

FNR Agency for Renewable Resources (Germany)

FT Fischer-Tropsch
GBR Green Biorefineries
GHG greenhouse gas

GHI Global Hunger Index GM genetic modification

 H_2 hydrogen H_2O water

H₂S hydrogen sulphide

ha hectare

HCHL 4-hydroxycinnamoyl-CoA hydratase/lyase

HHV Higher Heating Value

HI harvest index

HMF hydroxymethylfurfural HTU hydrothermal upgrading

IAEA International Atomic Energy Agency

ICI Imperial Chemical Industries
IEA International Energy Agency

IFOAM International Federation of Organic

Agriculture Movements

IFPRI International Food Policy Research Institute IPCC Intergovernmental Panel on Climate Change

ISO International Standards Organization

KFA Key Factor Analysis

LCA life cycle assessment/analysis

LCFBR Lignocellulosic Feedstock Biorefineries

LCP liquid crystal polymers LHV Lower Heating Value

LPCP liquid phase catalytic processing

LPG liquefied petroleum gas
MBR Marine Biorefineries
MEK methylethylketone

MEVM Methane Energy Value Model

MLP multilevel perspective

MNP The Netherlands Environmental Assessment Agency

MSA Mean-Species-Abundance MTBE methyl tertiary butyl ether

N nitrogen N_2O nitrous oxide

NAFTA North American Free Trade Agreement

NGO non-governmental organization

NH₃ ammonia NO_x nitrogen oxide

NREL National Renewable Energy Laboratory

NUE Nutrient Use Efficiency

OCVCI Ontario Chemical Value Chain Initiative
OECD Organisation for Economic Co-operation and

Development

OPEC Organization of the Petroleum Exporting Countries

P phosphorous PDO 1,3-propanediol PE polyethylene

PHA polyhydroxyalkanoate/polyhydroxy fatty acids

pHBA parahydroxybenzoic acid PHB polyhydroxybutyrate

PLA polylactic acid or polylactide

PNPB National Program for Production and Use of Biodiesel

PPP Public-Private Partnership
PPT poly(propylene terephthalate)
PSA Pressure Swing Absorption

PV photovoltaic

RED Renewable Energy Directive RES renewable energy sources RME rapeseed methyl ester

RSB Round Table on Sustainable Biomass
RSPO Round Table on Sustainable Palm Oil
RTFO Renewable Transport Fuels Obligation
RTRS Round Table on Responsible Soy
RUDAD rumen-derived anaerobic digester
SBIR Small Business Innovation Research

SDE Promotion of Sustainable Energy Production

SME soybean methyl ester SNG Substitute Natural Gas SOM soil organic matter

SRES Special Report on Emission Scenarios

SSC small-scale combustion

SSF simultaneous saccharification and fermentation

SVO straight vegetable oil

TS total solid

UDP uridine diphosphate

UNCED United Nations Conference on Environment and

Development

VFA volatile fatty acid

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VOC Volatile Organic Compounds

VROM Ministry of Housing, Spatial Planning and the

Environment

VS volatile solids

WCBR Whole Crop Biorefinery
WPC wood plastic composites
WTO World Trade Organization
WUE Water Use Efficiency

WWF World Wildlife Fund
WWI World Watch Institute

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