

# **BIOENERGY AND AGROFUELS**

## *Relevance beyond polemics*

Albert SASSON



Publication supported by the Hassan II Academy of Science and Technology  
Rabat, Morocco

## CONTENTS

FOREWORD .....	9
GLOBAL ENERGY CONSUMPTION AND GROWTH.....	11
The energy equation and mitigating climate change .....	11
<b>BIO MASS AND BIOENERGY.....</b>	<b>15</b>
Prospects for the transition from non-renewable carbon and energy resources to renewable bioresources .....	17
Acting on lignin and cellulose biosynthesis .....	19
The concept of modern biorefinery .....	20
<b>Agrofuels .....</b>	<b>21</b>
<i>Agrofuels versus renewable sources of energy: what could be expected? .....</i>	21
<b>UNITED STATES' AND EUROPEAN UNION'S AGROFUEL POLICIES .....</b>	<b>25</b>
Transportation fuel consumption .....	25
The appeal of agrofuels .....	25
Legislation and forecasts .....	28
Tax incentives and tariffs .....	33
Need for global standards .....	34
Conclusions .....	38
<b>BIOETHANOL PRODUCTION AND INDUSTRY IN THE UNITED STATES .....</b>	<b>39</b>
Present situation and forecasts .....	39
Sugar-cane cultivation in Hawaii for bioethanol production .....	41
Ethanol imports: tariffs and drawback provisions .....	42
New maize hybrid varieties with high ethanol yield potential .....	44
Boom and bust of the US bioethanol industry .....	47
<b>PRODUCTION OF AGROFUELS FROM GENETICALLY ENGINEERED CROPS : AN OPPORTUNITY FOR EUROPE? .....</b>	<b>51</b>
<b>Oilseed-rape .....</b>	<b>51</b>
<b>Sugar-beet .....</b>	<b>52</b>
<b>Other possible approaches .....</b>	<b>53</b>
<b>BRAZIL'S SUGAR INDUSTRY AND BIOETHANOL PRODUCTION.....</b>	<b>55</b>
World sugar production .....	55
Brazil's bioethanol industry .....	56
Mastering the whole chain of bioethanol production .....	58
Brazilian cars burning gasoline, natural gas and ethanol .....	60

<i>Investments in the sugar industry: consolidation and mergers .....</i>	62
<i>Foreign Investments .....</i>	65
<b>Environmental impact of the expansion of bioethanol production .....</b>	68
<i>Recycling of wastes of sugar-cane cultivation and alcohol production .....</i>	69
<i>Reduction of greenhouse-effect gas emissions and air pollution.....</i>	70
<i>Conclusions .....</i>	72
<b>Energetic efficiency of bioethanol production .....</b>	73
<b>Prospects.....</b>	74
 BRAZIL'S BIODIESEL PRODUCTION : OUTPUT, RESEARCH AND PROSPECTS .....	
<b>Biodiesel blends and financial support .....</b>	77
<b>Biodiesel output .....</b>	78
<i>North region .....</i>	79
<i>Northeast region .....</i>	80
<i>Centre-South .....</i>	81
<b>Conclusions .....</b>	82
 AGROFUEL PRODUCTION IN LATIN AMERICA AND THE CARIBBEAN .....	
<b>Guatemala .....</b>	83
<b>El Salvador .....</b>	84
<b>Nicaragua .....</b>	85
<b>Costa Rica .....</b>	85
<b>Dominican Republic .....</b>	85
<b>Jamaica .....</b>	85
<b>Colombia .....</b>	85
<b>Guyana .....</b>	86
<b>Mexico .....</b>	86
<b>Peru .....</b>	89
<b>Linkages between European financial institutions and Latin American businesses and agrofuel companies .....</b>	90
 AGROFUEL PRODUCTION IN SUB-SAHARAN AFRICA .....	
<b>Investments .....</b>	99
<b><i>Jatropha curcas, a source of biodiesel .....</i></b>	100
<b>Other agrofuel ventures .....</b>	102
<b>Conclusions .....</b>	104
 AGROFUEL PRODUCTION AND INDUSTRY IN ASIA .....	
<b>India .....</b>	107
<i>Government policy and cooperation with companies .....</i>	108
<i>Government support for the companies .....</i>	109
<i>Bioethanol production .....</i>	111
<i>Jatropha cultivation and biodiesel production .....</i>	112
<i>Future research and development plans .....</i>	116
<b>China .....</b>	117

<b>China</b>	117
<b>Thailand</b>	118
<b>Philippines</b>	118
<b>South Korea</b>	119
<b>Japan</b>	120
<b>Malaysia</b>	121
<b>Indonesia</b>	122
<i>Environmental impact</i>	123
<b>Transnational biodiesel webs in Malaysia, Indonesia and Singapore</b>	125
<b>BUSINESS AND CORPORATE ALLIANCES IN AGROFUEL PRODUCTION AND DISTRIBUTION</b>	131
<b>"CELLULOOSIC" ETHANOL</b>	135
<b>Enzymatic depolymerization</b>	135
<b>Genetically engineered crops</b>	136
<b>Polyculture</b>	136
<b>Boosting biomass</b>	137
<b>Fermentation process</b>	138
<b>Market and investments</b>	138
<b>Advanced research</b>	139
<b>OTHER POTENTIAL (BIO) FUELS</b>	143
<b>Blokerosene from babassu-palm oil (Brazil)</b>	143
<b>New fuels for aircrafts</b>	143
<b>Biofuels from microalgae</b>	145
<b>Hydrogen produced from cellulose degradation by termites</b>	148
<b>Other biofuel alternatives</b>	148
<b>Biofuel production through "synthetic biology"</b>	150
<b>THE AGROFUEL CONTROVERSY AND POLEMICS</b>	153
<b>Maize, sugar and oilseeds for food or for fuel?</b>	153
<b>Soybeans</b>	156
<b>Impact of bioethanol production on grain output</b>	160
<b>Increase in food prices</b>	162
<b>Is it realistic to reconsider agrofuel production targets?</b>	167
<b>Agrofuels and deforestation in tropical regions</b>	170
<i>Environmental and social impact of oil-palm expansion for biodiesel production</i>	171
<i>Example of Riau (Indonesia)</i>	172
<b>Agrofuels and climate change</b>	173
<b>Do agrofuels increase the incomes of the rural poor in developing countries?</b>	174
<b>CONCLUSIONS : MEETING DEMANDS OF FOOD, FEED AND FUEL</b>	177
<b>REFERENCES</b>	183