Index

Α

acid esterification pretreatment 26 active carbon, *Jatropha* product 48–49 Aeromexico, biofuel test results 206

- bargasse 170
- biofuels and biomass 169-172
- carbon market projekts 171
- commodity supply of the world 16
- dependence on food imports 103
- fossile fuels dependency 169-170
- Jatropha curcas 59-60
- land grab 59-60
- low-carbon 169
- Moringa tree 171
- potential for biofuels 170-171
- sub-saharan 169-170
- sugarcanes 170

aggressive plants, Napier grass 95 agricultural land

- and biofuels 13-14, 65
- "food-or-fuel" debate 23
- investment opportunities 208
 agricultural prices, increasing 16
 agricultural residues
- as biomass 113
- as second-generation feedstock 25 agriculture, global 24
- agripellets
- as feedstock of biomass 117-118
- from palm tree 113
- sustainability 119-120
- see also woodpellets

agroforestry, woodchips 116

Air China, biofuel test results 205

Air New Zealand, biofuel test results 197

airline industry, biofuel development 183 airline test results

- Aeromexiko 206
- Air China 205
- Air New Zealand 197
- Alaska Airlines 205-206
- British Airways 201
- Cathay Pacific 203-205
- Continental Airlines 199-200
- Japan Airlines 198-199
- KLM 199
- Lufthansa 202-203
- Qatar 198
- TAM 200-201
- see also aviation

airplanes, fuel efficiency 173

Alaska airlines, biofuel test results 205–206 algae

- airline biofuel tests 198
- benefits of 76
- biofuel development in China 150
- Continental Airlines 199-200
- cultivation 74
- definition 235
- investment possibilities 216
- Navy orders 76
- open and closed systems 74
- ${\sf -}$ as second-generation feedstock 22,

24-25, 72-77

Algenol Biofuels, investment

possibilities 215 AltAir Fuels, investment possibilities 218

AltAir Fuels, investment possibilities 218 alternate cropping see double cropping alternative energies

- development by oil companies 19
- see also renewable energies

Second Generation Biofuels and Biomass: Essential Guide for Investors, Scientists and Decision Makers, First Edition. Roland A. Jansen.

© 2013 Wiley-VCH Verlag GmbH & Co. KGaA.

Published 2013 by Wiley-VCH Verlag GmbH & Co. KGaA.

alternative fuels, definition 235 American Society for Testing and Materials (ASTM)

- biokerosene 189-190
- definition 235

Amyris (company), investment possibilities 216

animal feed, Jatropha product 47 arable land

- "food-or-fuel" debate 23
- per person 13-14

Arundo donax, bioethanol 196 Asia, green energy potential 81 assets

- hard 15
- melt down of soft 7 aviation biofuels 196, 235
- benefits 188
- Brazil 160-161, 168
- cap and trade 180
- carbon credits 179-182
- carbon dioxide emissions 175-177
- carbon dioxide lifecycle 174
- carbon reduction 173-174, 180-181
- certification 180, 189
- comparison with bio-SPK 180
- demand 196
- diesel 186
- EU Emission Trading Scheme 179
- Fischer-Tropsch process 187
- fuel standards 189
- green aviation 175-176
- hydrogenation 186
- IATA goals 186
- important facts 173
- from Jatropha 55, 128-129, 181, 185
- kerosene 186
- markets 184
- by nanoemulsions 188
- refining 185
- renewable 160
- standards 189
- from sugarcanes 166
- Sustainable Aviation Fuel Users Group 178
- see also airline test results; biofuels; biokerosene

Aviation Fuel Users Group 178

B100 biodiesel, from Jatropha 188

bacterial enzymes 193

bagasse 159

- Africa 170
- Brazil 162-163

- as feedstock for agripellets 117 basic materials, transformation of raw materials into 2

bees

- role in Jatropha cultivation 38
- socially responsible investing 106

Benz, Karl 29

bio-derived synthetic paraffinic kerosene (Bio-SPK)

- Camelina 85
- defnition 236
- Jatropha 46
- jet fuel demand 55
- see also synthetic paraffinic kerosene

bio-economy, new 135

Bio-Energy Emission Solution (BEES) powder 50

bio jet fuel

- defnition 235
- see also aviation biofuels

Bio-SPK see bio-derived synthetic paraffinic kerosene

biochar, Jatropha product 49

biodiesel

- aviation biofuels 186
- benefits 27-28
- from Camelina 86
- defnition 235
- industry in EU 136
- from Jatropha 43-44, 102, 129, 186
- from Pongamia pinatta 71-72
- production 22, 26
- refinement 26, 155
- tax exemptions 157-158
- see also diesel

biodiversity, by intercropping 97 bioelectricity, Brazil 162-163

bioenergy

- future 227-234
- value chain 207

Bioenergy International, investment possibilities 215

bioethanol production 26

biofuels

- Africa 169-172

- Brazil 159-168

- certification 189-190

- China 141-158, 150, 160

- companies 210-220

- comparison between Brazil and the United States 160

- converted from feedstocks 194-195

- corn based 160

- definition 9, 235

- diversified supply 174-175

- in Europe 133-136

- first ever 29

- and food production 13-14

- future 227-234 - generations 236

- indirect land-use change 136

- inventors 28-29

- market for, in aviation 184

- non-food sources 138

- pact between China and United

States 149-151

- public health 167

- RSB Principles & Criteria for sustainable production 111-112

- standards 133-134

- sugarcanes as source 160-161, 165-166

- United States 137-140

- water footprint of crops 62

- see also aviation biofuels; biokerosene; firstgeneration biofuels; second-generation biofuels

Biofuels 2.0 21

biofuels feedstocks

- algae 72-77

- Camelina 83-88

- castor 93

- Crambe 88-90

- grass 94-96

- halophytes 93-94

- Jatropha curcas (see Jatropha curcas)

- Miscanthus 94

- Moringa 91-93

- Napier grass 94-96

- palm oil 77-83

- pennycress 90-91

- Pongamia pinatta 71-72

- Ricinus communis 93

- sugarcane 94

- Thlaspi arvense 90-91

- whisky 90

biogas, from Moringa 93

biokerosene

- airline test results 197-206

- ASTM 190

- aviation industry 183-192

- catalytic reactions 186-187

- certification 189-190

- Fischer-Tropsch process 187

- investments in 208

- from Jatropha 37, 57-58, 183-189

- jet fuel standards 189

- market 184-185

- nanoemulsions 188

- new generation fuels 196

- refining 185-189

- safety 184

- targets 181

- tests 190-191, 201-202, 206

- usage potential 176

biokerosene index, investment possibilities 220

biolubricants, from Camelina 86

biomass

- Africa 169-172

- basic categories 114

- benefits of 114

- in Brazil 118-119

- challenges 125

- conversion to bioethanol 26

- definition 113

- defnition 236

- demand in United States 137-138

- demand worldwide 121-124

- energy density 120-121

- environmental aspects 138

- EU environmental regulations

124-125

- in Europe 123

- feedstocks of 115-118

- investments 208

- of palm tree 81

- production companies 210

- and second-generation biofuels

24-26 - solid 1

- sustainability of agripellets 119-120

Biomass Crop Assistance Program - Bio-SPK 85 (BCAP) 138 - as biofuel feedstock 83-88 - investment possibilities 219 - cultivars 87 $-\omega$ -3 fatty acids 86 biomass-to-liquids (BTL) process 187 - Qatar 198 - rotation with wheat 84 Biomass Valley 207 - as second-generation feedstock 24-25 BIONAS 50 - sustainabality 84 bioplastics, from sugarcane 166-167 Canada, oil production 18 bioreactors, with algae 74 cap-and-trade systems, EU 122, biorefineries 127-128, 180 - Italy 196 capital, movement from North to South 16 - number of 138 carbon, active 48-49 biotechnology, for biofuel production 14, carbon chains 180 carbon credits 193-196 - aviation 179-182 Boeing - Camelina biofuels 88 - carbon reductions 130 - see also UOP (Honeywell) - and climate change 127-131 BP, alternative energies 19 - and extreme weather patterns 130-131 - Jatropha kerosene 128-129 - agricultural hectares planted in 118 - Lufthansa 203 – bagasse, bioelectricity, and biofuels 162–163 carbon dioxide absorption, Jatropha 50, 210 - biofuels in 159-168 carbon dioxide emissions - biomass potential 118-119 – air transport industries 173 - bioplastics 166-167 - airline comparison 175 - cautionary notes 167-168 - financial pressure 181 - comparison with United States 160 - global 176-177 - Crambe 88-90 - KLM 199 - energy balance 165 - penalties 208 - ethanol production 162 - reduction 173-174 - flex fuel 162-163 carbon dioxide footprint, Jatropha 153 - "food-or-fuel" debate 23 carbon dioxide lifecycle 174-175 - fuel consumption 163-164 carbon footprint - greenhouse gas reductions 164-165 - bioplastics 167 - definition 236 - Jatropha research projects 225 - jet fuel 160-161, 168 carbon market projekts, Africa 171 - oil production 18 carbon neutral, definition 236 - potential for agripellets 117 carbon neutral growth, definition 236 - public health 167 carbon reduction, by Jatropha 130 - research projects 225 carbon society, transformation to - sugar production 161-162 low-carbon society 8-9 - sugarcane for biofuels 160-161, 165-166 carbon storage, sugarcanes 164 Brechnuss see Jatropha curcas carbon tax 144 British Airways, biofuel test results 201 Bunge, research projects 224 - increased use of electricity 14 - sales numbers 146-149, 163 Caspian Sea, energy reserves 17 \mathbf{C} castor, as biofuel feedstock 93 Camelina "castor oil plant" 34 - Agronomy 85-86 Cathay Pacific, biofuel test results 203-205 - airline biofuel tests 198-199

CDM see Clean Development Mechanism cellulosic biomass 25-26

- bargasse 162
- as feedstock of gasoline production 22, 81
- Napier grass 95

cellulosic ethanol 194-196

Certified Emission Reductions (CERs) 128-129

certified palm oil 79

chimneys, smog reduction 50

- 5-Year Plan 143-144
- airline biofuel tests 206
- barren land for Jatropha plantation 154
- biodiesel refineries 155
- biofuel pact with United States 150-151
- biofuels in 141-158
- car sales 146-149
- clean energy 141-142
- commodity consumption 148
- commodity prices 12
- demographics 12, 55
- diesel pricing mechanism 149
- economy growth 145
- energy consumption 3, 145-147
- environmental protection 144
- "food-or-fuel" debate 23
- geographical considerations 152-153
- greenhouse gases 145
- Hainan 154-155
- inclusive growth 143-144
- income growth 55
- investment in commodity production beyond its borders 61
- oil consumption 147
- as oil importer 147
- per capita oil consumption 11-12
- political and technical aspects 141-158
- poverty and Jatropha 156-157
- subsidies for farmers 157-158
- tax exemptions for biodiesel 158

China National Offshore Oil

Corporation (CNOOC), Jatropha activities 226

China Sustainable Development Strategy Report 2009 146

Clean Development Mechanism (CDM) 127-128, 171

clean energy

- China 141-142
- see also renewable energies

climate change 15, 231

- and carbon credits 127-131
- effect on developing countries 103
- extreme weather patterns 131
- and socially responsible investing 104
- versus agripellets 120
- for electricity generation 122

coal-to-liquid process, biokerosene 187

coconut, world consumption 82

Codexis, investment possibilities 216

commodities

- comparison of oil, first- and secondgeneration biofuels 13-14
- costs 9-10
- definition 2
- economies based on 16
- export deals 61
- geopolitical shift in oil production 18
- global consumption 148
- and low-carbon society 8-9
- in the media 6
- megaforces 14-17
- nonrenewable 3
- and nuclear energy 13-14
- per capita factor 10-12
- prices 5-8, 12, 15
- resource wars 17
- role of Federal Reserve Board 7-8
- supply constraints 2

commodity cycles 1-3

Company-Community Committees, socially

responsible investing 106

Confederation of European Paper

Industries (CEPI), biomass

deficit 123

Consumer Price Index (CPI) 5

contamination clean-up, by Napier

grass 95

Continental Airlines, biofuel test

results 199-200

corn based biofuel industry 160

corporate governance, socially responsible

investing 105-109 Cosan, Jatropha research projects 225

cottonseed, world consumption 82

Crambe 177 double cropping - abyssinica 89 - Camelina 84 - as biofuel feedstock 88-90 - Crambe 89 - Jatropha 99 cropping methods 97-99 - overview 97-99 crude oil - african import needs 169 - Pennycress 90 - airline costs 174 drilling, horizontal 18 - chinese consumption 145 drop-in fuels - costs 210 - aircraft 183 - dependency 169-170 - bacterial enzymes 193 - fuel standards 189 - biokerosene 196 - hydrocarbons 193 - Cathay Pacific 204 - import reduction 139 - definition 21, 236 - fermented fuels 194 - Jatropha 150, 224 - prices 157, 231-232 - sugarcane ethanol 165 - see also oil drumstick tree see Moringa cultivars, Camelina 87 DSM, investment possibilities 217 cultivation DuPont, investment possibilities 214 - algae 74 "Dutch castor oil" 34 - Jatropha 37-38 Dynamic Fuels, investment - see also domestication possibilities 217 curcin 34 E earth see Mother Earth Daimler, Gottlieb 29 eco communities 143 Daimler (company), Jatropha activities 226 Ecole Polytechnique Federale de Danisco, investment possibilities 214 Lausanne (EPFL), sustainability deflation, coexistance with inflation 15 initiative 111 deforestation economy - Indonesia 78, 81-82 - commodity-based, resource-rich 16 - international activities against 80 - low-carbon 232 demographics - zero-waste 232 electricity - China and India 55 - and commodity prices 12 - aircraft 183 DESERTEC 170 - from coal 122 developing countries, and global energy - generation in United States 4-5 policies 103 - increased use 14 diesel - from Jatropha 49 - consumption in China 145 - from sugarcane straw 166 - growing demand 149 Elephant grass see Napier grass - Jatropha curcas 53-55 EMBRAPA (Brazilian research - pricing mechanism in China 149 organization) 33, 89-90 - Napier grass 94 - from sugarcanes 165 emissions see carbon dioxide emissions Diesel, Rudolf 28-29 diesel fuel substitutes, from plants 33 Emissions Trading Scheme (ETS), distillation, biodiesel production 26 EU 121-122, 127-128, 179 domestication employment opportunities, socially

responsible investing 107

emulsions, biokerosene 188

- Jatropha curcas 51-52, 66-68, 75

- see also cultivation

energy

- alternative 19
- as most precious commodity 3-5
- see also renewable energies

energy balance

- Brazil 165
- Ethopia 171

Energy Commission, EU 133-134 energy consumption

- China 145-146
- primary 148

energy crops

- as biomass 113
- high oil yields 226
- as second-generation feedstock 25 energy density, of biomass 120-121 energy ellipse, Islamic World 17 **Energy Information Administration** (EIA) 57

energy mix, biomass content 137 energy policies, global 103 energy poverty, Africa 169-170 energy security, Jatropha curcas 58 energy stocks, investment possibilities 212 energy supplies, future 227-234 energy use, transportation sector 4 engine efficency, green aviation 175 engine modifications, Japan Airlines 198 environmental protection, China 144 environmental regulations, EU 124-125 enzymes

- to change biomass molecules 113
- fermenting fuels 193-194 equator, nature around 32-33 esterification, biodiesel production 194 ethanol
- cellulosic 194-196
- defnition 236
- incentives 139
- from Napier grass 94-96
- production 22, 139, 159, 162
- from sugarcane straw 166 Ethiopia
- dependence on oil imports 103
- potential for biofuels 171 Europe

- biofuels in 133-136
- biomass production 123
- Camelina 85

European Biomass Association 123 European Emission Allowances (EUAs) 128 European Union

- biodiesel industry 136
- carbon regulation 16
- Energy Commission 133-134
- environmental regulations 124-125
- "food-or-fuel" debate 23
- palm oil use 80
- policies on biofuels 133-136

exchange-traded fund (ETF) 1

Extractive Industry Transparency Initiative (EITI) 65

Exxon, alternative energies 19

F

Facebook, pressure on companies using palm oil 81

farmers

- and biofuels 13-14
- Guatemala 105
- and Jatropha curcas 58
- quality of life 156

farmland

- increasing prices 16
- socially responsible investing 107

farnesene 165

fatty acid alkyl esters, biodiesel

production 26

Federal Aviation Administration (FAA), partnership with USDA 140

Federal Reserve Board, monetary policies 7-8

feedstocks

- for biofuel production 25
- of biomass 115-118
- conversion into fuels 194-195
- neccessary amounts 190
- yield content 57
- see also biofuels feedstocks

fermentation, bioethanol production 26

fermenting fuels 193-196

fertilizers, greenhouse gas reduction 164

financial crisis, global 104

financial pressure, carbon dioxide

emissions 181

Finland, Camelina 85

fire control and prevention, socially responsible investing 107-108

first-generation biofuels Genetic Resource Center (GRC) 69 - applications 22 genetically engineered hydrocarbons 194 - definition 236 Germany, airline biofuel tests 202 - EU policies 133 germplasm banks, Jatropha 32 - feedstock 22-24 Gevo, investment possibilities 216 - and food production 13-14 GEXSI, reports on Jatropha curcas 53, 56 - general overview 21-29 Ghana - renewable energy from 13 - Jatropha curcas 58-59 Fischer-Tropsch process - potential for biofuels 171 - aviation biofuels 187 global agriculture 24 - British Airways 201 global economy, transformation to low-carbon 8-9 - defnition 236 Fischer-Tropsch SPK, definition 236 global financial crisis, 2007 104 Five-year plan, clean energy in China 143 global population explosion 15 flex-fuel cars 159 global warming 15 - Brazil 162-163 - and carbon credits 127-131 Food and Agricultural Organization (FAO) - from carbon dioxide emissions 177 - Forest Resources Assessment report 81 - effect on developing countries 103 - on Jatropha curcas 53, 64 - and socially responsible investing 104 food crisis 16 glycerin "food first" principle 98, 103-104 - biodiesel production 26 "food-or-fuel" debate 22-23 - *Jatropha* product 46 - Brazil 161 grasses, as feedstock of gasoline - Europe 181 production 22 - KLM 199 green aviation 175-176 - see also "fuel-or-food" debate green energy food production, and biofuels 13-14 - China 142-143 food sources, Jatropha biokerosene 201 - potential of palm tree 81 food waste, as biomass 113 - see also renewable energies "Green Hornet," Camelina biofuels 87–99 Ford, Henry 29 Forest Resources Assessment report, FAO greenhouse gases opinion 81 - and aviation 127-128, 176-180 forestry waste, as second-generation - and biofuel sustainability 111 - and biomass demand 121 feedstock 25 forests, original 153 - biomass-to-liquid 219 - Brazil 164-165 fossil fuels, African dependency on 169-170 - China 145 free fatty acids, definition 236 fronds, as biomass 113 - defnition 237 "fuel-or-food" debate 52, 98-99 - EU cap and trade systems 128-129 - see also "food-or-fuel" debate - EU policies 133-135 fuel production, from oil 13-14 - EU regulations 124 fuel standards, turbine jet engines 189 - and extreme weather patterns 131 - Kyoto protocol 127 - reduction with Jatropha 197 garbage see waste Greenpeace, report on palm oil 79 growing conditions, marginal 31-32 gas reserves, Islamic World 17 Guatemala, socially responsible gas-to-liquid (GTL), Qatar 198 investing 104-105 gasoline production, from biofuels 22 guidance prices, diesel 149 genetic research, on Jatropha 68-69

Gulf of Mexico, 2010 oil spill 18-19, 114 industrialized global economy, Gulf States, investment in commodity transformation to low-carbon 8-9 production beyond its borders 61 inflation, coexistance with deflation 15 insecticides, Jatropha product 47 intercropping 97–99 Η International Air Transport Association halophytes, as biofuel feedstock 93-94 (IATA) 55 harvesting commodities, costs 9 - greenhouse gases 179 healthcare, socially responsible - Lufthansa 202 investing 108 International Energy Agency (IEA), outlook Hohenheim University, Jatropha research 41 for American electricity generation 4 honey harvesting, socially responsible International Fund for Agricultural investing 106 Development (IFAD), report on Honeywell/UOP see UOP Jatropha curcas 53 Hong Kong airport, biokerosene investment opportunities facilities 204 - agricultural land 208 horizontal drilling, oil production 18 - biofuel companies 210-220 horseradish tree see Moringa - biokerosene index 220 household waste amounts 229 - eight ways 208 hydrocarbons - overview 207-208 - fermented fuels 193 - plantation start 209-210 - genetically engineered 194 - private equity funds 211 hydrocracking, biokerosene 186 production start 210–211 hydrogen - socially responsible 101-109 - as energy source 14 - trees 209 - production process 215 - see also specific companies hydrogenation, biofuel production 186 Islamic World, energy ellipse 17 hydrolysis, bioethanol production 26 hydropower infrastructure, chinese investments 143 Japan Airlines hydroprocessing, defnition 237 - biofuel test results 198-199 - Camelina biofuels 87 I Iatropha curcas inclusive growth, new chinese - acceptance by farmers 53 concept 143-144 - active carbon from 48-49 income growth forecasts, China and India 55 - advantages and risks 51-58 - agronomoy 39-40 - commodity prices 12 - airline biofuel tests 198 - demographics 12, 55 - animal feed from 47 - income growth forecasts 55 - biochar from 49 India Oil Corporation, Jatropha activities 226 - biodiesel 43-44 indirect land-use change (ILUC), - for biofuel production 22 biofuels 135-136 - biokerosene (see biokerosene) Indonesia - biomass sources 138 - deforestation 78, 81-82 - breeding 37-38

- business 105-106

- byproducts from 48-50

- characteristics 31-45

- carbon dioxide absorption 39, 50, 130

- palm oil production 78

- as second-generation feedstock 25

industrial waste

- as biomass 113

- in China 152-153, 155

- code of conduct 65-66

- commercialization 104-109

- corporate governance 105-109

- cracking the nut 45-46

- cultivation 37-38

- cutting 41

- defnition 237

- description 33-34

- and developing countries 103

- diesel demands 53-55

- direct seeding 41

- domestication 51-52, 66-68, 75

- ecological aspects 39

- electricity from 49

- energy security 58

- FAO reports 53, 64

- farming 40-41

- feedstock future 230-231

- feedstock yield content 57

- as fence 35

- genetic improvement of 68-69

- in Ghana 58-59

- global demand 56-57

- glycerin from 46

- greenhouse gas emissions 197

- growth 67-68

- Guatemala 104-105

- harvesting 40

- hedges 35

- hydrocracking of oil 186

- insecticides from 47

- intercropping 99

- invasiveness 63-64

- jet biofuel potential 185

- jet fuel demand 55

- joint ventures 223-226

- land grab 59-61

- limitations of crop 44

- main products from 46-47

- marginal growing conditions 31-32

- medical applications 36, 46

- nanoemulsions 188

- nature around equator 32-33

- negative effects and risks 58-61

- oil burned in lamps 35-36

- oil yield 41-42, 53, 56-57, 66, 75

- organic fertilizers from 47

- origin 34

- paint from 49

- pesticides from 47

- pests and diseases 44

- polyol from 49

- positive effects 52

- pressing the oil 36

- pricing 43

- propagation methods 42-43

- properties 34-35

- prospects 45

- research projects 41-42, 45, 54, 223-226

- RSB Principles & Criteria for sustainable production 111-112

- as second-generation feedstock 24-25

- seed yield factors 37

- seedcake 44

- significant events 56

- socially responsible investing 101-102

- storage 41

- as succulent plant 39

- survival in harsh conditions 38

– sustainability 52

- TAM 200

- toxicology 34-35

- transplanting 41

- trees 105-106

- water use 62-63

- as wild species 67-68

- woodpellets from 49

- World Bank opinion 64-65

Jatropha Genetic Resource Center (GRC) 69

jatrophin 36

Jet A, defnition 236

jet fuel see aviation biofuels; biokerosene

JOil, Jatropha research 41, 225

K

kerosene, defnition 237

kerosene consumption

- Brazil 164

- Lufthansa 202

key industries, ecological, in China 144

KLM, biofuel test results 199

KUOSOL, Jatropha research projects 224

Kyoto Protocol 127

"La Nina," extreme weather patterns 131

lamp light, by Jatropha oil 36

land acquisition, increasing demand

for 65-66

bindex

land grab, Jatropha curcas 58-61 land rights, deal with 65 land use - indirect change 135-136 - plans in China 152 - sugarcane ethanol 161 light, by Jatropha oil 36 lignin, as part of biomass 26 lignite, versus agripellets 120 Linde, investment possibilities 215 liquid fuels, transportation sector 4 liquid renewable energies 1 loan guarantees, biomass programs 139

- Africa 169
- future 232
- plans in China 143

low-carbon economies

low-carbon society 1, 207

- transformation to 8-9

Lufthansa, biofuel test results 202-203

"locals," plantation crops and 58

Madagascar, land grab 60-61 Malaysia

- Napier grass 95
- palm oil production 78 Mali, Jatrophy plantations 171 marginal land, biofuel production 151 "market fundamentalism" 104 Mauritius, energy investments 171 media, and commodities 6 Mexico, as origin of Jatropha 34 microalgae, as biofuel feedstock 72-77 Millennium Development Goal 61 Millettia pinnata see Pongamia pinatta mineral content, Moringa 92-93
- cellulosic ethanol 194

mining commodities, costs 9

- pellets 94, 116-117

Miscanthus

- as second-generation feedstock 25 mixed intercropping 98 mobile devices, increased use of electricity 14 monetary policies, and commodity prices 7-8

money, devaluation 15

Moringa oleifera

- as biofuel feedstock 91-93

- medicinal applications 92-93
- seeds and cuttings 92

mortgage crisis, assets melt-down 6, 15

Mother Earth, megaforces 14-17

Mother Earth Biokerosene Index 208,

220-221

Mother Earth Investments AG 208,

211, 221

Mozambique, Jatrophy plantations 171

Munich Re (reinsurer), extreme weather

patterns 131

municipal solid waste, as second-generation

feedstock 25

N

nanoemulsions, biofuels production 188 Napier grass

- as biofuel feedstock 94-96
- cellulosic ethanol 194
- productivity 96

national policies, biofuels 134-135

natural commodity cycles 2

natural gas reserves, Islamic World 17 Nestlé.

- cropping methods 99
- palm oil supply chains 79-80

Netherlands

- airline biofuel tests 199
- sustainable palm oil 83

new-generation fuels 193

New Zealand, airline biofuel test

results 197-198

NExBTL hydrogenization, Lufthansa 203

Nigeria, potential for biofuels 172

non-porous dense rock formations, oil

production from 18

nonrenewable commodities 3

Novozymes, investment possibilities 215

nuclear energy

- and commodities 13-14
- transition to renewable energies 227-228

0

Oettinger, Günther, Energy Commissioner 133-134

oil

- fuel production from 13-14
- gap between oil consumption and production 147

- import costs 139	pellets
– see also crude oil	from Napier grass 95
oil companies, supply side of oil	 see also agripellets; woodpellets
market 18–19	pennycress, as biofuel feedstock 90-91
oil consumption, by country 11	per capita factor, commodities 10–12
oil importers, top ten 147	per capita income, China 156
oil market	Persian Gulf States, energy reserves 17
– supply constraints 2	pesticides, <i>Jatropha</i> product 47
– supply side of 18–19	petroleum
oil price 3	biodiesel production 27
– linkage with ethanol 168	– import costs 139
– long-term 6	photobioreactors 74
oil production	photosynthesis, as fundamental process 25
– geopolitical shift in 18	photovoltaics, costs 9–10
– growing shortage in the US	physic nut see Jatropha curcas
139–140	plant population, definition 38
oil reserves	plant species, processed into diesel fuel
– estimations 3	substitutes 33
– Islamic World 17	PlantBottle 167
oil spill, 2010 18–19, 114	plants, as basis for biomass 25
oily nuts	plastics, from sugarcane 166
– China 150	pods, Moringa 91
– see also Jatropha	POET, non-food biomass production 139
olive, world consumption 82	Poland
ω-3 fatty acids, Camelina 86	– coal consumption 123–124
organic fertilizers, Jatropha product 47	– EU environmental regulations
organic waste, as biomass 25	124–125
outgrower program, socially responsible	polyethylene, bioplastics 167
investing 108–109	polyhydroxybutyrate, bioplastics 167
<u> </u>	polyol, <i>Jatropha</i> product 49
P	polysaccharide see sugar
paint, from Jatropha 49	Pongamia pinatta, as second-generation
palm kernel	feedstock 22, 24-25, 71-72
– as feedstock of biomass 116	poorest countries 102–103
– world consumption 82	population explosion 15
palm oil	population growth
– as biofuel feedstock 77–83	– China and India 55
– Facebook pressure 81	 see also demographics
– and rainforests 81–82	post-oil era 135
- supply chains 79-80	potable water sources, Jatropha
– sustainability 79, 83	biokerosene 201
palm tree, as biomass 81, 113	poverty
paper money, devaluation 15	– China 155
passenger flight, with biofuels 206	- factors of 157
"Peak Oil" theory 13, 230	– rural 157
peanut oil	 socially responsible investing 102–103
– as first biofuel 29	presscake, pennycress 91
– world consumption 82	primary energy consumption 148

private equity funds, investment row cropping 98 opportunities 211 Russia, extreme weather patterns 130 "protein play" 16 RWE, woodpellet production 125, 137 public health, biofuels 167 Purgiernuss, purging nut see Jatropha curcas S Sahara, as future solar center 16 Q Salicornia Qatar Advanced Biofuel Platform - as biofuel feedstock 94 (QABP) 198 - biokerosene 206 Qatar Airways, biofuel test results 198 sanitation, socially responsible investing 109 SCA, investment possibilities 215 second-generation biofuels - definition 1, 237 Raizen, Jatropha projects 225 - future 227-234 rapeseed, world consumption 82 - general overview 21-29 raw materials - see also biofuels - definition 1-2 seed yield factors, Jatropha 37 - investment possibilities 210 seedcake, as feedstock for agripellets 117 refining SG Biofuels (company) - fundamentals 26-28 - Guatemala 104-105 - of Jatropha to aviation biofuels 185-188 Reliance Life Sciences (RLS) - Jatropha Genetic Resource Center 32, 69 - cropping methods 99 Jatropha research 41, 224 shale gas techniques, oil production 18 - Jatropha research 41 Shell, Jatropha research projects 225 renewable energies - chinese law 146 Sichuan University, Jatropha research 41 - development by oil companies 19 Silicon Valley 207 silver price, long-term 6 - liquid 1 - outlook for 4 SkyNRG, biokerosene for KLM 199 - transition from nuclear energy 227-228 smog reduction, Jatropha application 50 social media, pressure on companies using - see also green energy Renewable Energy Directive, EU 181 palm oil 81 socially responsible investing 101-109 renewable fuel consumption 138 - Company-Community Committees 106 Renewable Fuel Standard (RFS) 196 renewable plastics 167 - corporate governance 105-109 - cycle of poverty 102-103 Rentech, investment possibilities 218 - employment opportunities 107 Repsol, research projects 224 research projects, Jatropha 41-42, 45, 54, - "food first" principle 103-104 - global context 104 223-226 - Guatemala 104–105 resource-rich economies 16 - healthcare 108 resource wars, commodities 17 - Jatropha curcas 101-102 resources, demand for 15 Ricinus communis see castor - kind of business 105-106 rock formations, oil production from 18 - outgrower program 108-109 Roundtable on Sustainable Biofuels - role of education 106-107

- sanitation 109

- by intercropping 97

- socially responsible investing 109

soil fertility

(RSB) 111-112, 178

Roundtable on Sustainable Palm Oil

- Guatemala 104-105

(RSPO) 77

solar energy

- palm oil 79, 83

- Africa 170 (SAFUG) 87, 178 - China 142 Sustainable Development Strategy - costs 9-10 Report 2009 146 sustainable livelihood 103 - from Sahara 16 switchgrass Solazyme Inc. - biomass sources 138 - biofuel from algae 76 - investment possibilities 216 - cellulosic ethanol 194 Solena, investment possibilities 219 synthesis gas, biokerosene 187 solid biomass 1 synthetic paraffinic kerosene (SPK) SORESIN (SOcially RESponsible Investing), - cap and trade system 180 virtual company 105-109 - defnition 237 South Africa, energy investments 171 - jet fuel standards 189 soybeans - see also bio-derived synthetic paraffinic - as biofuel feedstock 89 kerosene (Bio-SPK) - world consumption 82 Syntroleum, investment possibilities 218 starches, in biomass 25 T sub-Saharan Africa - dependency on food imports 103 "takeoff" point 10-11 - dependency on fossil fuels 169-170 tallow, biokerosene source for succulent plants 39 Lufthansa 202 sugar, in biomass 25 TAM, biofuel test results 200-201 sugarcane tank filling costs 19 - Africa 170 Tanzania, energy investments 171 - as biofuel feedstock 94 tar sands, oil production from 18 - Brazil 160-162 tea plants, as feedstock for - energy balance ratio 165 agripellets 117 - as feedstock for agripellets 117-118 test results see airline test results - future of 231 Thlaspi arvense see pennycress - resouces for energy and food 163 three biofuel combination, Japan - resource for biofuels 165-166 Airlines 198 - straw 166 TNT, Jatropha activities 226 - yields 162 Toyota, Jatropha activities 226 sunflower, world consumption 82 transatlantic biofuel flight, test results 206 super-cycles, commodities 2 transesterification supply chains - biodiesel production 186 - palm oil 79-80 - bioethanol production 26 - and sustainability 111 transportation sector, energy use 4 supply constraints - commodity cycles 2 - as feedstock of biomass 115 - oil market 2 - investment opportunities 209 sustainability triglyceride oils, biodiesel production 26 - biofuels 21 turbine jet engines, fuel standards 189 - Camelina 84 - challenges for the planet 104 - definition and standards 111-112 - defnition 237 Unilever, palm oil supply chains 79 - oils 218 United Nations Environment Programme

Sustainable Aviation Fuel Users Group

(UNEP) 78

United States

- biofuel pact with China 150-151
- biofuels 137-140
- Camelina 85
- electricity generation 4-5
- extreme weather patterns 130
- oil production 18

United States Army, biofuel usage 138 United States Department of Agriculture (USDA), fuel use 140

United States Navy, biofuel from algae 76 UOP (Honeywell), biokerosene production 87-88, 150

vapor power turbines, sugarcane ethanol 162 vegetable oils, world consumption 82 vitamin content, Moringa 92-93

Wageningen University, Jatropha research 41

waste

- biokerosene source for British Airways 201
- biokerosene source for Cathay Pacific 204
- biomass 113-114
- biomass-to-liquid 219
- cellulosic ethanol 194
- future of 228-229
- household amounts 229
- recycable 16-17
- as second-generation feedstock 25
- zero-waste 232-233

water footprint, biofuel crops 62

water sources, potable and Jatropha 201

Waterland, Jatropha projects 223

weather patterns, extreme 130-131

West Timor, *Pongamia* pinatta forests 71–72

Western hemisphere, oil production 18

Weyerhaeuser, investment possibilities 214

wheat, rotation with Camelina 84

whisky, as biofuel feedstock 90

wild flax see Camelina

wind technology, power output 141

women, role in farming 108 wood, as biomass 113

woodchips

- cellulosic ethanol 194
- as feedstock of biomass 115-116 woodpellets
- as feedstock of biomass 115
- investment possibilities 211
- Jatropha product 49
- produced by RWE 125, 137
- see also agripellets

working-age population, China and

India 55

world, future of 233

World Bank, and Jatropha curcas 64-65

world consumption, vegetable oils 82

World Growth (company) 81-82

WWF (World Wide Fund for Nature) 80

Y

Yunnan University, Jatropha research 41

\mathbf{Z}

zero-waste economy 232-233