

Biorenewable Insights

Natural Oil Feedstocks

Table of Contents

A Report by NexantThinking™

Published August 2015

www.nexantthinking.com

Section	Page
1 Executive Summary	1
1.1 INTRODUCTION.....	1
1.1.1 Overview	1
1.1.2 Natural Oil Feedstock Consumption	1
1.1.3 Natural Oil Feedstock Drivers	1
1.2 TECHNOLOGY	1
1.2.1 Oilseed Crops.....	1
1.2.2 Oilseed Crushing.....	3
1.3 ECONOMICS	4
1.4 CAPACITY ANALYSIS.....	5
1.5 PATENT ANALYSIS.....	6
2 Introduction.....	7
2.1 OVERVIEW	7
2.2 NATURAL OIL FEEDSTOCK DRIVERS.....	7
2.2.1 Natural Oil Feedstock Consumption	7
2.2.2 Policy Drivers	8
2.2.3 Sustainability	10
2.2.4 Carbon Footprint/LCA	11
2.2.5 Species Preservation and Land Use	12
2.2.6 Rural Development.....	12
2.2.7 Food and Feed versus Fuel, Chemicals, and Polymers	13
3 Technology.....	14
3.1 OILSEED CROPS AND OTHER OLEAGINOUS FEEDSTOCKS	14
3.1.1 Overview	14
3.1.2 Dominant Oil Feedstocks	14
3.1.3 Other Major Feedstocks.....	22
3.1.4 Other Smaller Volume Oilseeds.....	29

3.1.5	Other Sources of Oleaginous Feedstocks	35
3.2	OIL EXTRACTION	38
3.2.1	Pretreatment.....	39
3.2.2	Batch Pressing	40
3.2.3	Continuous Expeller	40
3.2.4	Solvent Extraction	41
3.2.5	Refining	42
3.2.6	Oil and Grease Extraction from Non-Oilseed Feedstocks	42
4	Economics.....	45
4.1	OVERVIEW AND METHODOLOGY.....	45
4.1.1	Agricultural Cost of Production Models.....	45
4.1.2	Manufacturing Cost of Production Models	46
4.2	GLOBAL ECONOMIC ASSESSMENT	53
4.3	NORTH AMERICA	54
4.3.1	North American Soybean	54
4.3.2	North American Rapeseed.....	58
4.4	SOUTH AND CENTRAL AMERICA.....	62
4.4.1	South American Soybean	62
4.5	EUROPE	66
4.5.1	European Rapeseed	66
4.5.2	European Sunflower Seed	70
4.6	ASIA PACIFIC	74
4.6.1	Asia Pacific Oil Palm	74
4.6.2	Asia Pacific Soybean.....	78
5	Capacity Analysis	82
5.1	OVERVIEW	82
5.2	CAPACITY ANALYSIS.....	82
5.2.1	By Oil Type.....	82
5.2.2	By Location.....	90
6	Patent Analysis.....	109
6.1	OVERVIEW	109
6.1.1	Types of Patents Considered.....	109
6.1.2	Overall Patent Activity by Region.....	109
6.2	GRANTED PATENTS	109
6.2.1	Global	109
6.2.2	North America	111
6.2.3	Asia Pacific.....	118
6.2.4	Europe.....	123
6.2.5	ROW.....	125
6.3	PATENT APPLICATIONS.....	126

6.3.1	Global	126
6.3.2	North America	128
6.3.3	Asia Pacific	138
6.3.4	Europe	150
6.3.5	ROW	152
7	References	155

Figure		Page
1.1	Oilseed Extraction Process	3
1.2	Oilseed Crop Production Regional Competitiveness	4
1.3	Natural Oil Production Regional Competitiveness	5
1.4	Global Oil Production by Type.....	5
1.5	Overall Patent Activity by Region	6
2.1	Global Natural Oil Consumption by End-Use.....	7
2.2	Global Natural Oil Consumption by End-Use.....	8
3.1	Trends in Oil Palm Production and Deforestation	16
3.2	World Soybean Crush	19
3.3	World Soybean Meal Trade.....	20
3.4	Fertilizer Applied to Soybeans.....	21
3.5	Animal Fats Value Chain	25
3.6	<i>Jatropha Curcas</i> Plant.....	33
3.7	Oilseed Extraction Process	39
4.1	Oilseed Crop Production Regional Competitiveness	53
4.2	Natural Oil Production Regional Competitiveness	54
4.3	Sensitivity of North American Soybean Production Costs to Yield	54
4.4	North American Soybean Oil Extraction Sensitivity Assessment.....	56
4.5	Sensitivity of North American Rapeseed Production Costs to Yield	58
4.6	North American Rapeseed Oil Extraction Sensitivity Assessment	60
4.7	Sensitivity of South American Soybean Production Costs to Yield.....	62
4.8	South American Soybean Oil Extraction Sensitivity Assessment	64
4.9	Sensitivity of European Rapeseed Production Costs to Yield	66
4.10	European Rapeseed Oil Extraction Sensitivity Assessment.....	68
4.11	Sensitivity of European Sunflower Seed Production Costs to Yield	70
4.12	European Sunflower Oil Extraction Sensitivity Assessment	72
4.13	Sensitivity of Asia Pacific Oil Palm Full Fruit Bunch Production Costs to Yield.....	74

4.14	Asia Pacific Palm Oil Extraction Sensitivity Assessment	76
4.15	Sensitivity of Asia Pacific Soybean Production Costs to Yield.....	78
4.16	Asia Pacific Soybean Oil Extraction Sensitivity Assessment	80
5.1	Global Oil Production by Type.....	82
5.2	Palm Oil Production by Region	83
5.3	Soybean Oil Production by Region	84
5.4	Rapeseed Oil Production by Region	84
5.5	Sunflower Oil Production by Region	85
5.6	Palm Kernel Oil Production by Region.....	86
5.7	Tallow Production by Region.....	86
5.8	Lard Production by Region	87
5.9	Cottonseed Oil Production by Region	88
5.10	Coconut Oil Production by Region	88
5.11	Corn Oil Production by Region.....	89
5.12	Safflower Oil Production by Region	90
5.13	Global Oil Production by Region	90
5.14	North American Oil Production by Type.....	91
5.15	North American Oil Production by Country	92
5.16	United States Oil Production by Type	92
5.17	Canadian Oil Production by Type	93
5.18	Mexican Oil Production by Type.....	94
5.19	South and Central American Oil Production by Type	94
5.20	South and Central American Oil Production by Country.....	95
5.21	Brazilian Oil Production by Type	96
5.22	Argentinian Oil Production by Type.....	96
5.23	Columbian Oil Production by Type.....	97
5.24	Other South and Central American Oil Production by Type	98
5.25	European Oil Production by Type	99
5.26	European Oil Production by Country.....	99
5.27	German Oil Production by Type.....	100
5.28	French Oil Production by Type.....	101
5.29	Other European Union Oil Production by Type.....	101
5.30	Russian Oil Production by Type.....	102
5.31	Ukrainian Oil Production by Type.....	103
5.32	Other European Oil Production by Type	103

5.33	Asia Pacific Oil Production by Type	104
5.34	Asia Pacific Oil Production by Country.....	105
5.35	Indonesian Oil Production by Type	105
5.36	Chinese Oil Production by Type.....	106
5.37	Malaysian Oil Production by Type.....	107
5.38	Other Asia Pacific Oil Production	107
5.39	ROW Oil Production by Type	108
6.1	Overall Patent Activity by Region	109
6.2	Granted Patents by Region	110
6.3	Granted Patents by Assignee.....	110
6.4	North American Granted Patents by Assignee	112
6.5	Asia Pacific Granted Patents by Assignee	118
6.6	European Granted Patents by Assignee.....	124
6.7	ROW Granted Patents by Assignee.....	125
6.8	Global Patent Applications by Region	126
6.9	Global Patent Applications by Assignee	127
6.10	North American Patent Applications by Assignee.....	128
6.11	Asia Pacific Patent Applications by Assignee	138
6.12	European Patent Applications by Assignee	150
6.13	ROW Patent Applications by Assignee	152

Table	Page
2.1 Biodiesel Blending Mandates	10
3.1 Global Vegetable Oil Production by Type, 2013	14
3.2 Top Five Producers of Palm Fruit, Palm Oil, and Palm Kernel Oil, 2013/2014	15
3.3 Fatty Acid Composition of Palm Oil.....	18
3.4 Top Five Producers of Soybean and Soybean Oil, 2013/2014.....	19
3.5 Top Five Producers of Rapeseed and Rapeseed Oil, 2013	22
3.6 Top Producers of Coconuts and Copra Oil, 2013/2014	23
3.7 Top Producers of Beef and Tallow, 2013/2014.....	26
3.8 Top Producers of Pork and Lard, 2013/2014	26
3.9 Top Producers of Sunflower Seed and Sunflower Seed Oil, 2013/2014	27
3.10 Top Five Producers of Cottonseed Oil, 2013/2014.....	28
3.11 Top Five Producers of Corn Oil, 2013/2014.....	29
3.12 Top Five Producers of Safflower and Safflower Oil, 2013/2014	30
3.13 Top Five Producers of Peanuts and Peanut Oil 2013/2014.....	30
3.14 Top Five Producers of Olive Oil, 2013/2014	31
3.15 Top Five Producers of Linseed Oil, 2013/2014.....	32
3.16 Diesel and Biodiesel Specifications	34
3.17 Top Five Producers of Castor Beans	35
4.1 Cost of Production Estimate, North American Soybean	55
4.2 Cost of Production Estimate, North American Soybean Oil.....	57
4.3 Cost of Production Estimate, North American Rapeseed	59
4.4 Cost of Production Estimate, North American Rapeseed Oil.....	61
4.5 Cost of Production Estimate, South American Soybean.....	63
4.6 Cost of Production Estimate, South American Soybean Oil	65
4.7 Cost of Production Estimate, European Rapeseed	67
4.8 Cost of Production Estimate, European Rapeseed Oil	69
4.9 Cost of Production Estimate, European Sunflower Seed	71
4.10 Cost of Production Estimate, European Sunflower Oil	73
4.11 Cost of Production Estimate, Asia Pacific Oil Palm Full Fruit Bunch	75
4.12 Cost of Production Estimate, Asia Pacific Palm Oil	77
4.13 Cost of Production Estimate, Asia Pacific Soybean.....	79
4.14 Cost of Production Estimate, Asia Pacific Soybean Oil	81
6.1 Key Global Granted Patents.....	111
6.2 Key North American Granted Patents.....	112

6.3	Canadian Granted Patents	113
6.4	United States Granted Patents.....	117
6.5	Other North America Granted Patents	118
6.6	Key Asia Pacific Granted Patents	119
6.7	Chinese Granted Patents	120
6.8	Other Asia Pacific Granted Patents	123
6.9	Key European Granted Patents	124
6.10	All European Granted Patents.....	125
6.11	All ROW Granted Patents	126
6.12	Key Global Patent Applications	127
6.13	Key North American Patent Applications	129
6.14	Canadian Patent Applications	130
6.15	United States Patent Applications	135
6.16	Other North America Patent Applications	138
6.17	Key Asia Pacific Patent Applications.....	139
6.18	Chinese Patent Applications	139
6.19	Japanese Patent Applications	148
6.20	Republic of Korea Patent Applications	148
6.21	Australian Patent Applications.....	149
6.22	Other Asia Pacific Patent Applications	149
6.23	Key European Patent Applications.....	150
6.24	European Patent Applications	151
6.25	All ROW Patent Applications.....	153

NexantThinking™

Biorenewable Insights



Nexant, Inc. (www.nexant.com) is a leading management consultancy to the global energy, chemical, and related industries. For over 38 years, Nexant has helped clients increase business value through assistance in all aspects of business strategy, including business intelligence, project feasibility and implementation, operational improvement, portfolio planning, and growth through M&A activities. Nexant has its main offices in San Francisco (California), White Plains (New York), and London (UK), and satellite offices worldwide .

Contact Details:

New York: Steven Slome

Phone: + 1-914-609-0379, e-mail: sslome@nexant.com

New York: Heidi Junker Coleman, Global Programs Support Manager

Phone: + 1-914-609-0381, e-mail: hcoleman@nexant.com

Nexant, Inc. (www.nexant.com) is a leading management consultancy to the global energy, chemical, and related industries. For over 38 years, Nexant has helped clients increase business value through assistance in all aspects of business strategy, including business intelligence, project feasibility and implementation, operational improvement, portfolio planning, and growth through M&A activities. Nexant has its main offices in San Francisco (California), White Plains (New York), and London (UK), and satellite offices worldwide.

Copyright © by Nexant Inc. 2015. All Rights Reserved.