

TECHNOLOGY AND COSTS

TECHNOECONOMICS - ENERGY & CHEMICALS

Linear Alpha Olefins - 2024

July 2024



This Report was prepared by NexantECA, the Energy and Chemicals Advisory company ("NexantECA"). Except where specifically stated in this Report, the information contained herein is prepared on the basis of information that is publicly available, and contains no confidential third party technical information to the best knowledge and belief of NexantECA. The information has not been independently verified or otherwise examined to determine its accuracy, completeness or financial feasibility. Neither NexantECA, Subscriber nor any person acting on behalf of either shall have any liabilities for any loss or damage arising from or connected to the use of any information contained in this Report. NexantECA does not represent or warrant that any assumed conditions will come to pass.

The Report is for Subscriber's internal use only and shall be kept strictly confidential. The Report should not be otherwise reproduced, distributed or used without first obtaining prior written consent by NexantECA. Each Subscriber agrees to use reasonable effort to protect the confidential nature of the Report.

Copyright © by NexantECA (BV) Ltd. 2024. All rights reserved.



Contents

1	Executive Summary	1
1.1	Introduction and Overview.....	1
1.2	Technology Overview.....	2
1.3	Process Economics.....	4
1.4	Carbon Intensity	8
1.4.1	Full Range Technologies	8
1.4.2	On-Purpose Butene-1	9
1.4.3	On-Purpose Hexene-1	10
1.4.4	On-Purpose Octene-1	11
1.5	Commercial Overview	12
2	Introduction.....	14
2.1	Overview.....	14
2.1.1	Market Overview	14
2.1.2	Historical Technology Overview and Industry Developments.....	16
2.1.2.1	Wax Cracking	16
2.1.2.2	Dehydrogenation of n-Paraffins	17
2.1.2.3	Mixed C ₄ Extraction.....	18
2.1.2.4	Oligomerization	19
2.2	Technology Overview.....	22
2.2.1	Full-Range Process Technology	22
2.2.2	On Purpose Process Technology	23
2.2.3	Developing Technologies.....	23
2.3	Technology Holders and Licensing Status.....	24
2.4	Strategic and Business Considerations	25
2.5	Physical and Thermodynamic Properties.....	27
2.6	Specifications	28
2.7	Health and Safety Factors or Health Hazards.....	31
2.8	Storage and Transportation.....	31
3	Full-Range Technologies.....	32
3.1	Overview.....	32
3.1.1	Introduction.....	32
3.1.2	General Chemistry and Process Types	33
3.2	Chevron Phillips	40
3.2.1	Process Chemistry	40
3.2.2	Process Description	41
3.2.3	Typical Product Distribution	44
3.3	INEOS	45
3.3.1	Process Chemistry	45
3.3.2	Process Description	46
3.3.3	Typical Product Distribution	48



3.4	Shell (SHOP).....	49
3.4.1	Process Chemistry	49
3.4.2	Process Description	51
3.4.3	Typical Product Distribution	58
3.5	Idemitsu (LINEALENE).....	59
3.5.1	Process Chemistry	59
3.5.2	Process Description	60
3.5.3	Typical Product Distribution	64
3.6	ExxonMobil (Elevexx).....	65
3.6.1	Process Chemistry	65
3.6.2	Process Description	66
3.6.3	Typical Product Distribution	69
3.7	Sabir/Linde (α-SABLIN®)	70
3.7.1	Process Chemistry	70
3.7.2	Process Description	71
3.7.3	Typical Product Distribution	75
3.8	Axens (AlphaSelect™)	76
3.8.1	Process Chemistry	76
3.8.2	Process Description	77
3.8.3	Typical Product Distribution	79
3.9	UOP (Linear-1)	80
3.9.1	Process Chemistry	80
3.9.2	Process Description	80
3.9.3	Typical Product Distribution	83
4	On-Purpose Technologies.....	84
4.1	Introduction.....	84
4.2	On-Purpose Butene-1 Technologies.....	85
4.2.1	Axens, Ethylene Dimerization (AlphaButol®).....	85
4.2.1.1	Process Chemistry	85
4.2.1.2	Process Description	86
4.2.2	Lummus Technology (CPT)	88
4.2.2.1	Process Chemistry	88
4.2.2.2	Process Description	90
4.2.3	Zeon Corporation, Extractive Distillation (GPD Process).....	92
4.2.3.1	Process Chemistry	94
4.2.3.2	Process Description	94
4.3	On-Purpose Hexene-1 Technologies.....	97
4.3.1	Axens, Ethylene Trimerization (AlphaHexol™).....	97
4.3.1.1	Process Chemistry	97
4.3.1.2	Process Description	98
4.3.2	Chevron Phillips, Ethylene Trimerization (1-Hexene Select)	101
4.3.2.1	Process Chemistry	101
4.3.2.2	Process Description	102



4.3.3	Lummus Technology (CPT)	105
4.3.3.1	Process Chemistry	105
4.3.3.2	Process Description	108
4.3.4	Mitsui Chemicals, Ethylene Trimerization (MET Process)	111
4.3.4.1	Process Chemistry	111
4.3.4.2	Process Description	112
4.3.5	Sasol, Fischer-Tropsch-Derived, Recovery	114
4.3.5.1	Process Chemistry	114
4.3.5.2	Process Description	116
4.4	On-Purpose Octene-1 Technologies	122
4.4.1	Dow Chemical, Butadiene Telomerization	122
4.4.1.1	Process Chemistry	122
4.4.1.2	Process Description	125
4.4.2	Sasol, Ethylene Tetramerization	127
4.4.2.1	Process Chemistry	127
4.4.2.2	Process Description	128
4.4.3	Sasol, Fischer-Tropsch-Derived, Recovery	131
4.4.3.1	Process Chemistry	131
4.4.3.2	Process Description	131
4.4.4	Sasol, Fischer-Tropsch-Derived, Heptene-Based Recovery	136
4.4.4.1	Process Chemistry	136
4.4.4.2	Process Description	136
4.5	On-Purpose Decene-1 Technologies	141
4.5.1	Elevance Renewable Sciences	141
4.5.1.1	Process Chemistry	141
4.5.1.2	Process Description	142
5	Developing Technologies	144
5.1	Bio-Ethanol Dehydration (Braskem)	145
5.1.1	Braskem	145
5.1.2	Chematur Engineering/Scientific Design	148
5.2	Godrej-Lurgi Process	150
5.2.1	Process Description	150
5.2.1.1	Hydrolysis of Triglycerides	150
5.2.1.2	Direct Hydrogenation to Fatty Acids to Fatty Alcohols	151
5.2.1.3	Godrej-Lurgi Process: Dehydration of Fatty Alcohols to LAOs	152
5.3	Chevron Phillips (LAOs via Dehydroformylation or Dehydroxymethylation)	157
5.3.1	Process Chemistry	157
5.3.1.1	Dehydroformylation	157
5.3.1.2	Dehydroxymethylation	159
6	Process Economics	160
6.1	Costing Basis	160
6.1.1	Investment Basis	160



6.1.2	Pricing Basis.....	160
6.1.3	Cost of Production Basis.....	163
6.2	Cost of Production Analysis.....	164
6.2.1	Full-Range Linear Alpha Olefins.....	165
6.2.2	On-Purpose Butene-1.....	167
6.2.3	On-Purpose Hexene-1.....	169
6.2.4	On-Purpose Octene-1.....	171
7	Carbon Intensity.....	173
7.1	Carbon Intensity Accounting Methodology.....	173
7.2	Overview.....	175
7.3	Full-Range Linear Alpha Olefins.....	176
7.4	On-Purpose Butene-1.....	179
7.5	On-Purpose Hexene-1.....	180
7.6	On-Purpose Octene-1.....	181
8	Commercial Applications - Complete.....	182
8.1	Introduction.....	182
8.2	Polyethylene Comonomers.....	185
8.3	Detergent Intermediates.....	186
8.3.1	Detergent-Range Alcohols.....	186
8.3.2	Linear Alkylbenzene (LAB).....	186
8.3.3	Alpha Olefin Sulfonates.....	187
8.3.4	Alkylamines.....	187
8.4	Polyalphaolefins.....	188
8.5	Linear Plasticizers Alcohols.....	189
8.6	Polybutene-1.....	190
8.7	Other Applications.....	191
9	Regional Capacity Analysis - Complete.....	192
9.1	Global Capacity.....	192
9.2	North America Capacity.....	197
9.3	Western Europe Capacity.....	198
9.4	Asia Pacific Capacity.....	199
9.5	Rest of the World Capacity.....	202

Appendices

A	Cost of Production Estimates for Full-Range Linear Alpha Olefins.....	206
B	Cost of Production Estimates for On-Purpose Butene-1.....	226
C	Cost of Production Estimates for On-Purpose Hexene-1.....	235
D	Cost of Production Estimates for On-Purpose Octene-1.....	243
E	Definitions of Capital Cost Terms Used in Process Economics.....	254
F	Definitions of Operating Cost Terms Used in Process Economics.....	258
G	TECH Program Title Index (2014-2024).....	261



H References 264

Figures

Figure 1	Linear Alpha Olefins, Main Markets and Applications	1
Figure 2	Cost of Production Summary for Full-Range Linear Alpha Olefin Processes	4
Figure 3	Cost of Production Summary for On-Purpose Butene-1 Processes	5
Figure 4	Cost of Production Summary for On-Purpose Hexene-1 Processes	6
Figure 5	Cost of Production Summary for On-Purpose Octene-1 Processes	7
Figure 6	Comparison of Carbon Intensities of Full-Range Technologies in the USGC	8
Figure 7	Comparison of Carbon Intensities of On-Purpose Butene-1 Technologies in different regions	9
Figure 8	Comparison of Carbon Intensities of On-Purpose Hexene-1 Technologies in different regions	10
Figure 9	Comparison of Carbon Intensities of On-Purpose Octene-1 Technologies in different regions	11
Figure 10	Global Linear Alpha Olefins Demand by Fraction, 2023	12
Figure 11	Global Linear Alpha Olefins Demand by End-Use, 2023	12
Figure 12	Global Linear Alpha Olefins Capacity by Fraction, 2023	13
Figure 13	Linear Alpha Olefins, Main Markets and Applications	15
Figure 14	Reactions during Dehydrogenation of <i>n</i> -Paraffins	17
Figure 15	Schematic View of C ₄ Streams	18
Figure 16	Global Share of Capacity by Producer	24
Figure 17	Linear Alpha Olefin Value Chain of Leading Global Producers	26
Figure 18	Overview of Single-Step Ethylene Oligomerization Process	34
Figure 19	Overview of Two-Step Ethylene Oligomerization Process	35
Figure 20	Theoretical Alpha Olefin Distribution by Single-Step Ethylene Oligomerization	36
Figure 21	Theoretical Alpha Olefin Distribution by Two-Step Ethylene Oligomerization	37
Figure 22	Comparative Theoretical Alpha Olefin Carbon Distributions	38
Figure 23	Chevron Phillips, Full-Range AO Process Overview	42
Figure 24	Chevron Phillips, Full-Range LAO Process, Reaction and Primary Splitting Sections	43
Figure 25	Chevron Phillips Full Range LAO Distribution	44
Figure 26	INEOS Full-Range LAO Process	47
Figure 27	INEOS Full-Range LAO Distributions	48
Figure 28	Overview of Shell's Higher Olefins Process	50
Figure 29	Shell Higher Olefins Process (SHOP), Oligomerization Section	52
Figure 30	Shell Higher Olefins Process (SHOP), Alpha Olefin Separation Section	55
Figure 31	Shell Higher Olefins Process (SHOP), Isomerization and Disproportionation (I/D) Section	57
Figure 32	SHOP Mass Balance for Geismar Plant	58
Figure 33	SHOP LAO/LIO Distributions	58
Figure 34	Flow Diagram of Idemitsu Linear Alpha Olefins Process (LINEALENE)	59
Figure 35	Idemitsu LAO Process, Oligomerization Section	61
Figure 36	Idemitsu LAO Process, Distillation Section, C ₆ /C ₈ Split Option	62



Figure 37	Idemitsu LAO Process, Distillation Section, C ₈ /C ₁₀ Split Option	63
Figure 38	Idemitsu Full-Range LAO Distribution	64
Figure 39	ExxonMobil Full Range Elevexx LAO Process.....	68
Figure 40	ExxonMobil Full Range Elevexx™ LAO Distributions	69
Figure 41	α-SABLIN Catalytic Cycle.....	70
Figure 42	SABIC/Linde Alpha-SABLIN Full-Range LAO Process.....	73
Figure 43	SABIC LAO separation Process.....	74
Figure 44	α-SABLIN Carbon Number Distribution.....	75
Figure 45	Axens AlphaSelect Selective Ethylene Oligomerization Process for LAOs	78
Figure 46	AlphaSelect Carbon Number Distribution.....	79
Figure 47	UOP Linear-1 Full-Range LAO Process.....	81
Figure 48	UOP LINEAR-1 Full-Range LAO Distribution.....	83
Figure 49	Axens AlphaButol Ethylene Dimerization Process for Butene-1	87
Figure 50	Lummus Technology CPT Process for Butene-1	91
Figure 51	Illustrative Integrated C ₄ Complex	92
Figure 52	Zeon Extractive Distillation Process for Butene-1	95
Figure 53	Axens AlphaHexol Ethylene Trimerization Process for Hexene-1	99
Figure 54	Chevron Phillips Hexene-1 Process. Trimerization, and Separation Sections	104
Figure 55	Hexene Isomers Thermodynamic Equilibrium.....	107
Figure 56	Simplified Block Flow Diagram of Lummus CPT Process for Hexene-1 Production	108
Figure 57	Mitsui MET Hexene-1 Process	113
Figure 58	Schematic of Sasol's Secunda® Complex	114
Figure 59	Sasol Fischer-Tropsch-Derived Alpha Olefin Distribution	115
Figure 60	Block Flow Diagram for Sasol Hexene-1 Process from Synthol	116
Figure 61	Sasol Hexene-1 Recovery from Fischer-Tropsch Liquids Process, Pre-Treatment and Etherification	119
Figure 62	Sasol Hexene-1 Recovery from Fischer-Tropsch Liquids Process, Super-Fractionation, Extractive Distillation, and Polishing.....	121
Figure 63	Dow Butadiene Telomerization Process for Octene-1	126
Figure 64	Sasol Ethylene Tetramerization Process for Octene-1	129
Figure 65	Block Flow Diagram Schematic of Sasol's Octene Train I	132
Figure 66	Block Flow Diagram Schematic of Sasol's Octene Train II	133
Figure 67	Sasol/Linde Azeotropic Distillation Process	135
Figure 68	Sasol Octene-1 Process from Mixed C ₇ Stream	137
Figure 69	Elevance Metathesis Process for Decene-1.....	143
Figure 70	Bio-ethanol to Green Ethylene: Conceptual Process Flow	145
Figure 71	Braskem Ethanol Dehydration Process.....	147
Figure 72	Ethylene from Ethanol (Chematur Route)	149
Figure 73	Godrej-Lurgi Process Block Flow Diagram	150
Figure 74	Production of Fatty Acids and Glycerine by Hydrolysis.....	151
Figure 75	Direct Hydrogenation of Fatty Acids to Fatty Alcohol Reaction Chemistry	151
Figure 76	Direct Hydrogenation of Fatty Acids to Fatty Alcohol Block Flow Diagram.....	152
Figure 77	Dehydration of Fatty Alcohols to LAOs Reaction Chemistry	152



Figure 78	Godrej-Lurgi Process.....	154
Figure 79	Dehydroformylation process route.....	157
Figure 80	Dehydroxymethylation process route via Linear Primary Alcohol.....	159
Figure 81	Dehydroxymethylation process route via Terminal Vicinal Diol	159
Figure 82	Cost of Production Summary for Full-Range Linear Alpha Olefin Processes.....	166
Figure 83	Cost of Production Summary for On-Purpose Butene-1 Processes	168
Figure 84	Cost of Production Summary for On-Purpose Hexene-1 Processes	170
Figure 85	Cost of Production Summary for On-Purpose Octene-1 Processes	171
Figure 86	Comparison of Carbon Intensities of different LAO production technologies in the USGC	175
Figure 87	Comparison of Carbon Intensities of Full-Range Technologies in the USGC	176
Figure 88	Comparison of Carbon Intensities of Full-Range Technologies in Western Europe.....	177
Figure 89	Comparison of Carbon Intensities of Full-Range Technologies in China	178
Figure 90	Comparison of Carbon Intensities of On-Purpose Butene-1 Technologies in different regions	179
Figure 91	Comparison of Carbon Intensities of On-Purpose Hexene-1 Technologies in different regions	180
Figure 92	Comparison of Carbon Intensities of On-Purpose Octene-1 Technologies in different regions	181
Figure 93	Linear Alpha Olefins, Main Markets and Applications	182
Figure 94	Global Linear Alpha Olefins Demand by End-Use, 2023	184
Figure 95	Global Linear Alpha Olefin Demand by Fraction, 2023	184
Figure 96	Global Linear Alpha Olefins Capacity by Region, 2023	192
Figure 97	Global Linear Alpha Olefin Capacity by Fraction, 2023	193
Figure 98	Global Butene-1 Capacity by Region, 2023	194
Figure 99	Global Hexene-1 Capacity by Region, 2023	194
Figure 100	Global Octene-1 Capacity by Region, 2023	195
Figure 101	Global Higher Alpha Olefins Capacity by Region, 2023.....	195
Figure 102	Global Split of LAO Capacity by Company.....	196
Figure 103	North America Market Share of Top Producers, 2023	197
Figure 104	Western Europe Market Share of Top Producers	198
Figure 105	Asia Pacific Market Share of Top Producers.....	201
Figure 106	Rest of the World Market Share of Top Producers	204

Tables

Table 1	License and Commercial Status of On Purpose Technologies.....	3
Table 2	List of Linear Alpha Olefins.....	14
Table 3	C ₄ Stream Compositions	19
Table 4	Typical Alpha Olefin Composition Based on Feedstock	20
Table 5	Full-Range Alpha Olefin Ethylene Oligomerization Processes	22
Table 6	License and Commercial Status of On Purpose technologies	23
Table 7	Strategic/ Business Considerations.....	25
Table 8	Properties of C ₄ to C ₂₀ Linear Alpha Olefins.....	27



Table 9	Commercial Butene-1 Specifications	28
Table 10	Commercial Hexene-1 Specifications	28
Table 11	Commercial Octene-1 Specifications	29
Table 12	Commercial Decene-1 Specifications	29
Table 13	Commercial Dodecene-1 Specifications	29
Table 14	Commercial Tetradecene-1 Specifications.....	30
Table 15	Commercial Hexadecene-1 Specifications.....	30
Table 16	Commercial Octadecene-1 Specifications	30
Table 17	Commercial Eicosene-1+ Specifications	30
Table 18	Theoretical Alpha Olefin Distribution by Single-Step Ethylene Oligomerization	36
Table 19	Theoretical Alpha Olefin Distribution by Two-Step Ethylene Oligomerization	37
Table 20	Indicative Alpha Olefin Composition.....	59
Table 21	ExxonMobil Full Range Elevexx LAO Process Conditions	65
Table 22	Butene-1 to Decene-1 Product Distribution with AlphaSelect	76
Table 23	Typical Product Characteristics from AlphaSelect	76
Table 24	License and Commercial Status of On Purpose technologies	84
Table 25	Typical Specifications for Butene-1 from AlphaButol	86
Table 26	Performance Characteristics for Butene-1 from Lummus CPT	90
Table 27	C ₄ Stream Compositions	93
Table 28	C ₄ Component Properties in DMF	94
Table 29	Relative Volatilities in Various Polar Solvents	96
Table 30	Typical Specifications for Hexene-1 from AlphaHexol	98
Table 31	Performance Characteristics for Hexene-1 from Lummus CPT	107
Table 32	Sasol Fischer-Tropsch-Derived Mixed Hexene/Hexane Stream Composition	117
Table 33	Typical Analysis of a Crude C ₄ Stream from a Naphtha Cracker.....	122
Table 34	Product Distribution for Dow's Octene-1 Process	124
Table 35	Results from Sasol's Ethylene Tetramerization Patent	127
Table 36	Assumed Sasol Mixed C ₇ Feedstock Composition	138
Table 37	Boiling Points of Various Octanol Isomers	139
Table 38	Boiling Points of Components in Dehydration Reactor Effluent	140
Table 39	Godrej-Lurgi Process Hydrocarbon Product Distribution	155
Table 40	Carbon Chain Distribution of LAO Product.....	155
Table 41	Prices of Raw Materials, By-products, Utilities, and Wages	162
Table 42	Cost of Production Summary for Full-Range Linear Alpha Olefin Processes, USGC and Western Europe.....	165
Table 43	Cost of Production Summary for Full-Range Linear Alpha Olefin Processes, Middle East, China, and Japan	166
Table 44	Cost of Production Summary for On-Purpose Butene-1 Processes	167
Table 45	Cost of Production Summary for On-Purpose Hexene-1 Processes	169
Table 46	Cost of Production Summary for On-Purpose Octene-1 Processes	171
Table 47	Comparison of Carbon Intensities of different LAO production technologies	175
Table 48	Comparison of Carbon Intensities of Full-Range Technologies in the USGC	176
Table 49	Comparison of Carbon Intensities of Full-Range Technologies in Western Europe.....	177



Table 50	Comparison of Carbon Intensities of Full-Range Technologies in China	178
Table 51	Comparison of Carbon Intensities of On-Purpose Butene-1 Technologies in different regions	179
Table 52	Comparison of Carbon Intensities of On-Purpose Hexene-1 Technologies in different regions	180
Table 53	Comparison of Carbon Intensities of On-Purpose Octene-1 Technologies in different regions	181
Table 54	North America Linear Alpha Olefins Capacity, 2023	197
Table 55	Western Europe Linear Alpha Olefins Capacity, 2023	198
Table 56	Asia Pacific Linear Alpha Olefins Capacity, 2023	199
Table 57	Rest of the World Linear Alpha Olefins Capacity, 2023	202
Table 58	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: Chevron Phillips, Ethylene Oligomerization, USGC Basis	206
Table 59	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: INEOS, Ethylene Oligomerization, USGC Basis	207
Table 60	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: Shell (SHOP), Ethylene Oligomerization, USGC Basis	208
Table 61	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: SABIC/Linde (α -SABLIN), Ethylene Oligomerization, USGC Basis	209
Table 62	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: Axens (AlphaSelect), Ethylene Oligomerization, USGC Basis	210
Table 63	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: ExxonMobil (Elevexx), Ethylene Oligomerization, USGC Basis	211
Table 64	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: INEOS, Ethylene Oligomerization, Western Europe Basis	212
Table 65	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: Shell (SHOP), Ethylene Oligomerization, Western Europe Basis	213
Table 66	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: SABIC/Linde (α -SABLIN), Ethylene Oligomerization, Western Europe Basis	214
Table 67	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: Axens (AlphaSelect), Ethylene Oligomerization, Western Europe Basis	215
Table 68	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: Chevron Phillips, Ethylene Oligomerization, Middle East Basis	216
Table 69	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: INEOS, Ethylene Oligomerization, Middle East Basis	217
Table 70	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: Shell (SHOP), Ethylene Oligomerization, Middle East Basis	218
Table 71	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: SABIC/Linde (α -SABLIN), Ethylene Oligomerization, Middle East Basis	219
Table 72	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: Axens (AlphaSelect), Ethylene Oligomerization, Middle East Basis	220
Table 73	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: SABIC/Linde (α -SABLIN), Ethylene Oligomerization, China Basis	221
Table 74	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: Axens (AlphaSelect), Ethylene Oligomerization, China Basis	222
Table 75	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: SABIC/Linde (α -SABLIN), Ethylene Oligomerization, Japan Basis	223



Table 76	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: Axens (AlphaSelect), Ethylene Oligomerization, Japan Basis	224
Table 77	Cost of Production Estimate for Full-Range Linear Alpha Olefins Process: Idemitsu, Ethylene Oligomerization, Japan Basis	225
Table 78	Cost of Production Estimate for On-Purpose Butene-1 Process: Axens (AlphaButol), Ethylene Dimerization, USGC Basis	226
Table 79	Cost of Production Estimate for On-Purpose Butene-1 Process: Zeon, Extractive Distillation, USGC Basis	227
Table 80	Cost of Production Estimate for On-Purpose Butene-1 Process: Axens (AlphaButol), Ethylene Dimerization, Western Europe Basis.....	228
Table 81	Cost of Production Estimate for On-Purpose Butene-1 Process: Zeon, Extractive Distillation, Western Europe Basis	229
Table 82	Cost of Production Estimate for On-Purpose Butene-1 Process: Axens (AlphaButol), Ethylene Dimerization, Middle East Basis	230
Table 83	Cost of Production Estimate for On-Purpose Butene-1 Process: Axens (AlphaButol), Ethylene Dimerization, China Basis	231
Table 84	Cost of Production Estimate for On-Purpose Butene-1 Process: Zeon, Extractive Distillation, China Basis	232
Table 85	Cost of Production Estimate for On-Purpose Butene-1 Process: Axens (AlphaButol), Ethylene Dimerization, Japan Basis	233
Table 86	Cost of Production Estimate for On-Purpose Butene-1 Process: Zeon, Extractive Distillation, Japan Basis.....	234
Table 87	Cost of Production Estimate for On-Purpose Hexene-1 Process: Chevron Phillips, Ethylene Trimerization, USGC Basis	235
Table 88	Cost of Production Estimate for On-Purpose Hexene-1 Process: Axens (AlphaHexol), Ethylene Trimerization, USGC Basis.....	236
Table 89	Cost of Production Estimate for On-Purpose Hexene-1 Process: Axens (AlphaHexol), Ethylene Trimerization, Western Europe Basis.....	237
Table 90	Cost of Production Estimate for On-Purpose Hexene-1 Process: Chevron Phillips, Ethylene Trimerization, Middle East Basis	238
Table 91	Cost of Production Estimate for On-Purpose Hexene-1 Process: Axens (AlphaHexol), Ethylene Trimerization, Middle East Basis	239
Table 92	Cost of Production Estimate for On-Purpose Hexene-1 Process: Axens (AlphaHexol), Ethylene Trimerization, China Basis.....	240
Table 93	Cost of Production Estimate for On-Purpose Hexene-1 Process: Axens (AlphaHexol), Ethylene Trimerization, Japan Basis	241
Table 94	Cost of Production Estimate for On-Purpose Hexene-1 Process: Sasol, Extraction from Synfuels, South Africa Basis	242
Table 95	Cost of Production Estimate for On-Purpose Octene-1 Process: Dow, Butadiene Telomerization, USGC Basis.....	243
Table 96	Cost of Production Estimate for On-Purpose Octene-1 Process: Sasol, Ethylene Tetramerization, USGC Basis	244
Table 97	Cost of Production Estimate for On-Purpose Octene-1 Process: Dow, Butadiene Telomerization, Western Europe Basis	245
Table 98	Cost of Production Estimate for On-Purpose Octene-1 Process: Sasol, Ethylene Tetramerization, Western Europe Basis.....	246
Table 99	Cost of Production Estimate for On-Purpose Octene-1 Process: Sasol, Ethylene Tetramerization, Middle East Basis	247



Table 100	Cost of Production Estimate for On-Purpose Octene-1 Process: Dow, Butadiene Telomerization, China Basis	248
Table 101	Cost of Production Estimate for On-Purpose Octene-1 Process: Sasol, Ethylene Tetramerization, China Basis	249
Table 102	Cost of Production Estimate for On-Purpose Octene-1 Process: Dow, Butadiene Telomerization, Japan Basis	250
Table 103	Cost of Production Estimate for On-Purpose Octene-1 Process: Sasol, Ethylene Tetramerization, Japan Basis	251
Table 104	Cost of Production Estimate for On-Purpose Octene-1 Process: Sasol, Extraction from Synfuels, South Africa Basis	252
Table 105	Cost of Production Estimate for On-Purpose Octene-1 Process: Sasol, C ₇ s Extraction from Synfuels, South Africa Basis	253



TECHNOLOGY & COSTS

Technoeconomics - Energy & Chemicals (TECH)

The NexantECA Subscriptions' Technoeconomics - Energy & Chemicals (TECH) program is recognized globally as the industry standard source for information relevant to the chemical process and refining industries. Technoeconomics - Energy & Chemicals (TECH) reports are available as a subscription program or on a single report basis.

Contact Details:

Americas:

Adam Chan, Managing Consultant

Phone: + 1-914-609-0326, e-mail: achan@NexantECA.com

Erica Hill, Senior Client Services Executive, Subscriptions and Reports

Phone: + 1-914-609-0386, e-mail: ehill@NexantECA.com

EMEA:

Anna Ibbotson, Vice President, Sales and Marketing

Phone: +44-207-950-1528, aibbotson@NexantECA.com

Asia:

Chommanad Thammanayakatip, Managing Consultant

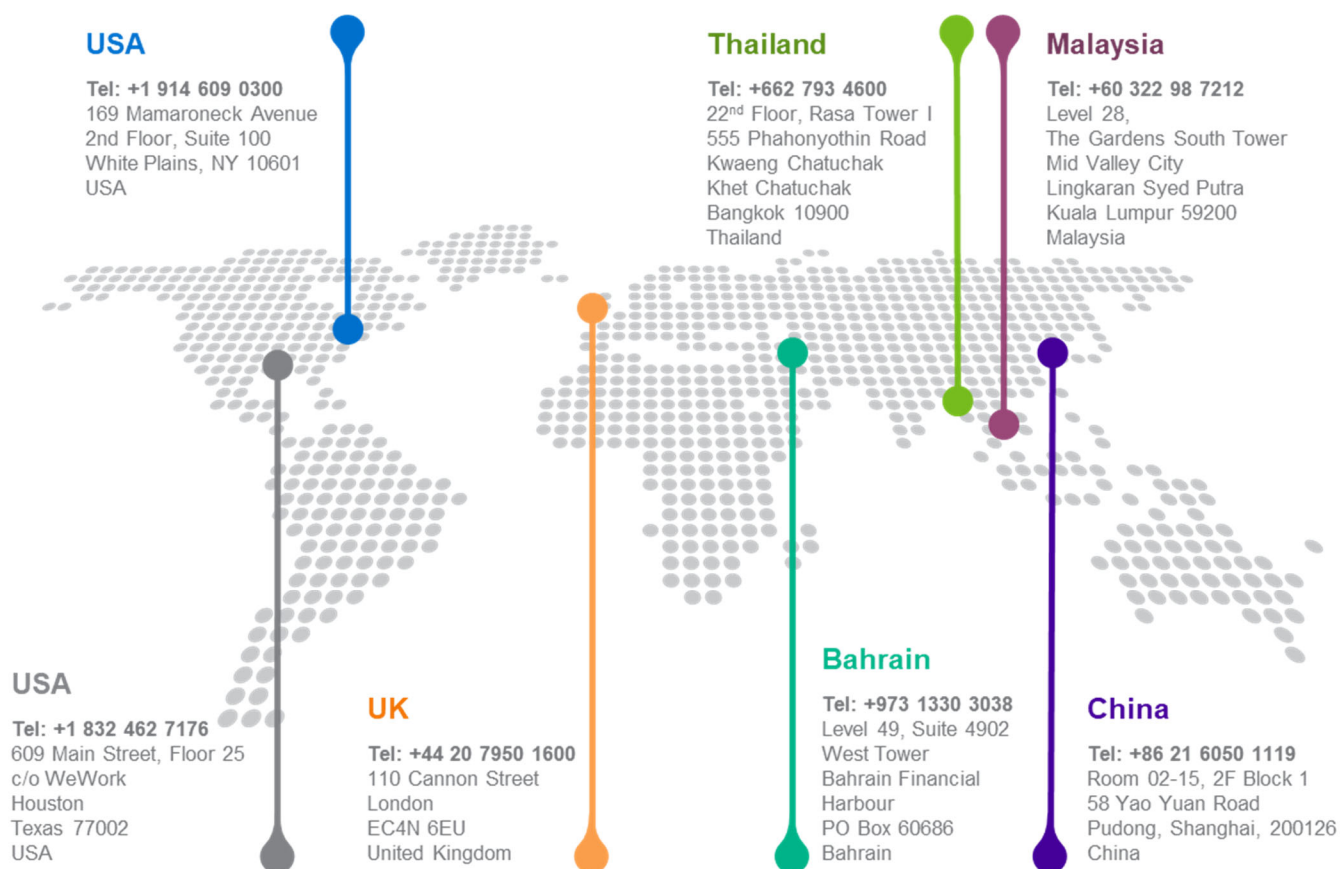
Phone: +66-2793-4606, email: chommanadt@NexantECA.com

NexantECA Subscriptions and Reports provide clients with comprehensive analytics, forecasts and insights for the chemicals, polymers, energy and cleantech industries. Using a combination of business and technical expertise, with deep and broad understanding of markets, technologies and economics, NexantECA provides solutions that our clients have relied upon for over 50 years.

Copyright © 2000-2024. NexantECA (BVI) Limited. All rights reserved



NexantECA partners with clients to help them navigate the big global energy, chemicals and materials issues of tomorrow. We provide independent advice through our consulting, subscriptions and reports, and training businesses using expertise developed in markets, economics and technology through our fifty years of operation. We are entirely dedicated to supporting sustainable development of the industry and provide expert advice with efficiency, speed, and agility.



Disclaimer

This Report was prepared by NexantECA, the Energy and Chemicals Advisory company. Except where specifically stated otherwise in this Report, the information contained here is prepared on the basis of information that is publicly available, and contains no confidential third-party technical information to the best knowledge of NexantECA. Aforesaid information has not been independently verified or otherwise examined to determine its accuracy, completeness or financial feasibility. Neither NexantECA, Client nor any person acting on behalf of either assumes any liabilities with respect to the use of or for damages resulting from the use of any information contained in this Report. NexantECA does not represent or warrant that any assumed conditions will come to pass.