



Petroleum and Petrochemical Economics

Quarterly Business Analysis

Quarter 2, 2017
June 2017



This Report was prepared by Nexant, Inc. ("Nexant") and is part of the NexantThinking™ suite. Except where specifically stated otherwise 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 of Nexant. Aforesaid information has not been independently verified or otherwise examined to determine its accuracy, completeness or financial feasibility. Neither Nexant, Subscriber 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. Nexant does not represent or warrant that any assumed conditions will come to pass.

The Report is submitted on the understanding that the Subscriber will maintain the contents confidential except for the Subscriber's internal use. The Report should not be reproduced, distributed or used without first obtaining prior written consent by Nexant. Each Subscriber agrees to use reasonable effort to protect the confidential nature of the Report.

Copyright © by Nexant Inc. 2017. All rights reserved.

Contents

Section		Page
1	Executive Summary	1
1.1	ASIA PACIFIC	1
1.2	UNITED STATES	3
1.3	WESTERN EUROPE	5
2	Crude Oil, Refining and Petrochemical Feedstocks	13
2.1	CRUDE OIL AND REFINING	13
2.2	UNITED STATES NGLS	21
3	Olefins	24
3.1	ETHYLENE	24
3.1.1	Asia Pacific	24
3.1.2	United States	25
3.1.3	Western Europe	26
3.2	PROPYLENE	49
3.2.1	Asia Pacific	49
3.2.2	United States	49
3.2.3	Western Europe	51
3.3	BUTADIENE	67
3.3.1	Asia Pacific	67
3.3.2	United States	68
3.3.3	Western Europe	69
4	Polyolefins	78
4.1	LOW DENSITY POLYETHYLENE	78
4.1.1	Asia Pacific	78
4.1.2	United States	79
4.1.3	Western Europe	79
4.2	LINEAR LOW DENSITY POLYETHYLENE	88
4.2.1	Asia Pacific	88
4.2.2	United States	89
4.2.3	Western Europe	89
4.3	HIGH DENSITY POLYETHYLENE	99
4.3.1	Asia Pacific	99
4.3.2	United States	100

4.3.3	Western Europe	100
4.4	POLYPROPYLENE	109
4.4.1	Asia Pacific.....	109
4.4.2	United States.....	110
4.4.3	Western Europe	110
5	Vinyls.....	120
5.1	CHLOR-ALKALI, ETHYLENE DICHLORIDE AND VINYL CHLORIDE MONOMER	120
5.1.1	Asia Pacific.....	120
5.1.2	United States.....	120
5.1.3	Western Europe	121
5.2	POLYVINYL CHLORIDE.....	143
5.2.1	Asia Pacific.....	143
5.2.2	United States.....	143
5.2.3	Western Europe	144
6	Aromatics	153
6.1	BENZENE, TOLUENE AND XYLENES.....	153
6.1.1	Asia Pacific.....	153
6.1.2	United States.....	154
6.1.3	Western Europe	156
6.2	CYCLOHEXANE	196
6.2.1	United States.....	196
6.2.2	Western Europe	196
7	Styrenics.....	202
7.1	STYRENE	202
7.1.1	Asia Pacific.....	202
7.1.2	United States.....	202
7.1.3	Western Europe	203
7.2	POLYSTYRENE	211
7.2.1	Asia Pacific.....	211
7.2.2	United States.....	211
7.2.3	Western Europe	212
8	Butadiene Derivatives	220
8.1	STYRENE BUTADIENE RUBBER.....	220
8.1.1	Asia Pacific.....	220
8.1.2	United States.....	220
8.1.3	Western Europe	221

8.2	ACRYLONITRILE BUTADIENE STYRENE	229
8.2.1	Asia Pacific.....	229
8.2.2	United States.....	229
8.2.3	Western Europe	230
8.3	BUTADIENE RUBBER.....	238
8.3.1	Asia Pacific.....	238
8.3.2	United States.....	238
8.3.3	Western Europe	239
9	Polyester and Intermediates	247
9.1	MONO ETHYLENE GLYCOL AND ETHYLENE OXIDE	247
9.1.1	Asia Pacific.....	247
9.1.2	United States.....	247
9.1.3	Western Europe	248
9.2	PARA-XYLENE (PX).....	261
9.2.1	Asia Pacific.....	261
9.2.2	United States.....	261
9.2.3	Western Europe	261
9.3	PURIFIED TEREPHTHALIC ACID (PTA).....	273
9.3.1	Asia Pacific.....	273
9.3.2	United States.....	273
9.3.3	Western Europe	273
9.4	POLYETHYLENE TEREPHTHALATE (PET)	283
9.4.1	Asia Pacific.....	283
9.4.2	United States.....	283
9.4.3	Western Europe	284
10	Propylene Derivatives	293
10.1	ACRYLONITRILE.....	293
10.1.1	Asia Pacific.....	293
10.1.2	United States.....	293
10.1.3	Western Europe	294
10.2	CUMENE, PHENOL AND ACETONE.....	302
10.2.1	Asia Pacific.....	302
10.2.2	United States.....	303
10.2.3	Western Europe	304
10.3	BISPHENOL-A AND POLYCARBONATE	315
10.3.1	Asia Pacific.....	315

10.3.2	United States	316
10.3.3	Western Europe	317
10.4	PROPYLENE OXIDE	338
10.4.1	Asia Pacific	338
10.4.2	United States	338
10.4.3	Western Europe	339
10.5	OXO ALCOHOLS: BUTANOLS AND 2-ETHYLHEXANOL	352
10.5.1	Asia Pacific	352
10.5.2	United States	352
10.5.3	Western Europe	353
11	Isocyanates	368
11.1	METHYLENE DIPHENYL DIISOCYANATE AND TOLUENE DIISOCYANATE	368
11.1.1	Asia Pacific	368
11.1.2	United States	368
11.1.3	Western Europe	369
A	Cost of Production Models	384

Figure		Page
1.1	United States Cash Margin Index	8
1.2	United States Cash Margin Index	8
1.3	United States Cash Margin Index	8
1.4	United States Cash Margin Index	9
1.5	United States Average Return on Replacement Capital.....	9
1.6	United States Average Operating Rate.....	9
1.7	Western Europe Cash Margin Index.....	11
1.8	Western Europe Cash Margin Index.....	11
1.9	Western Europe Cash Margin Index.....	11
1.10	Western Europe Cash Margin Index	12
1.11	Western Europe Return on Capital	12
1.12	Western Europe Average Operating Rate	12
2.1	Global Benchmark Crude Oil Pricing	15
2.2	Singapore Variable Cost Refining Margin.....	15
2.3	United States Gulf Cost Variable Cost Refining Margins.....	15
2.4	Western Europe Variable Cost Refinery Margins	16
2.5	South-East Asia Petrochemical Feedstock Prices	20
2.6	North-West Europe Petrochemical Feedstock Prices, North-West Europe.....	20
2.7	United States Gulf Coast Petrochemical Feedstock Prices	21
2.8	United States Ethane Extraction Cash Margin.....	23
2.9	United States Ethane Extraction Margins	23
3.1	Ethylene Cost Competitiveness Summary.....	28
3.2	Ethylene Prices	28
3.3	Asia Ethylene Cash Cost Margins – Standard Naphtha Cracker	33
3.4	China Ethylene Cost Price and Margins	33
3.5	China Ethylene Cash Cost Margins	33
3.6	China Ethylene Return on Investment	34
3.7	China Ethylene Cost Price and Margins	34
3.8	United States Gulf Coast Ethylene Prices.....	36
3.9	United States Ethane Cracker Cash Cost Margins	36
3.10	United States Ethylene Cost, Price and Margin	36
3.11	United States Ethane/Propane Mix Feed Cracker Cash Cost Margins	38
3.12	United States Ethylene Cost, Price and Margin	38
3.13	United States Naphtha Cracker Cash Cost Margins.....	40
3.14	United States Ethylene Cost, Price and Margin	40

3.15	United States Ethylene Production Costs	42
3.16	United States Ethylene Profitability	42
3.17	Western Europe Naphtha Cracker Variable Cost Margins	45
3.18	Western Europe Naphtha Cracker Cash Cost Margins	45
3.19	Western Europe Ethylene Cost, Price and Margins.....	46
3.20	Western Europe European Ethylene Prices	46
3.21	Western Europe Ethylene Production Costs.....	48
3.22	Western Europe Ethylene Cash Margins	48
3.23	Propylene Cost Competitiveness Summary	52
3.24	Propylene Prices	52
3.25	Asia Propylene Cash Cost Margins, Propane Dehydrogenation	57
3.26	China Propylene Cost Price and Margins	57
3.27	China Propylene Cost Price and Margins	57
3.28	China Propylene Cash Cost Margins	58
3.29	China Propylene Return on Investment	58
3.30	United States Propylene Price Comparison.....	61
3.31	United States Propylene Cash Cost Margins.....	61
3.32	United States Propylene Leader Cost Price and Margin	61
3.33	United States Propylene Margins.....	62
3.34	United States Propylene Leader Cost Price and Margin	62
3.35	Western Europe Propylene Margins	65
3.36	Western Europe Propylene Cost, Price and Margin	65
3.37	Western Europe Propylene Cash Cost Margins	66
3.38	Western Europe Propylene Cost, Price and Margins	66
3.39	Butadiene Cost Competitiveness Summary	70
3.40	Butadiene Prices	70
3.41	Asia Butadiene Cash Cost Margins, Mixed C ₄ Extraction.....	73
3.42	China Butadiene Cost Price and Margins	73
3.43	United States Butadiene Margins.....	75
3.44	United States Butadiene Cost, Price and Margin.....	75
3.45	Western Europe Butadiene Extraction Margins	77
3.46	Western Europe Butadiene Cost Price and Margins	77
4.1	LDPE Cost Competitiveness Summary	80
4.2	LDPE Prices	80
4.3	Asia LDPE Variable Cost Margins	83
4.4	Asia LDPE Cash Cost Margins	83

4.5	China LDPE Cost Price and Margins	83
4.6	United States LDPE Variable Cost Margins	85
4.7	United States LDPE Cash Cost Margins.....	85
4.8	United States LDPE Leader Cost, Price and Margin	85
4.9	Western Europe LDPE Variable Cost Margins	87
4.10	Western Europe LDPE Cash Cost Margins	87
4.11	Western Europe LDPE Cost, Price and Margins	87
4.12	LLDPE Cost Competitiveness Summary	91
4.13	LLDPE Prices	91
4.14	Asia LLDPE Variable Cost Margins	94
4.15	Asia LLDPE Cash Cost Margins	94
4.16	China LLDPE Cost Price and Margins	94
4.17	United States LLDPE (Butene-1) Variable Cost Margins.....	96
4.18	United States LLDPE (Butene-1) Cash Cost Margins	96
4.19	United States LLDPE (Butene-1) Leader Cost, Price and Margins	96
4.20	Western Europe LLDPE Variable Cost Margins	98
4.21	Western Europe LLDPE Cash Cost Margins	98
4.22	Western Europe LLDPE Cost, Price and Margins	98
4.23	HDPE Cost Competitiveness Summary.....	101
4.24	HDPE Prices	101
4.25	Asia HDPE Variable Cost Margins	104
4.26	Asia HDPE Cash Cost Margins.....	104
4.27	China HDPE Cost Price and Margins	104
4.28	United States HDPE Margins (Injection Moulding) Variable Cost Margins.....	106
4.29	United States HDPE Margins (Injection Moulding) Cash Cost Margins	106
4.30	United States HDPE (Injection Moulding) Leader Cost Price and Margin	106
4.31	Western Europe HDPE Variable Cost Margins.....	108
4.32	Western Europe HDPE Cash Cost Margins	108
4.33	Western Europe HDPE Cost, Price and Margins.....	108
4.34	Polypropylene Cost Competitiveness Summary.....	112
4.35	Polypropylene Prices.....	112
4.36	Asia Polypropylene Variable Cost Margins	115
4.37	Asia Polypropylene Cash Cost Margins	115
4.38	China Polypropylene Cost Price and Margins	115
4.39	United States Polypropylene Variable Cost Margins	117
4.40	United States Polypropylene Cash Cost Margins	117

4.41	United States Polypropylene Leader Cost, Price and Margin.....	117
4.42	Western Europe Polypropylene Variable Cost Margins.....	119
4.43	Western Europe Polypropylene Cash Cost Margins.....	119
4.44	Western Europe Polypropylene Cost, Price and Margins.....	119
5.1	VCM Cost Competitiveness Summary.....	122
5.2	VCM Prices	122
5.3	Asia Ethylene Dichloride Variable Cost Margins.....	125
5.4	Asia Ethylene Dichloride Cash Cost Margins	125
5.5	China Ethylene Dichloride Cost Price and Margins	125
5.6	Asia Vinyl Chloride Monomer Variable Cost Margins	129
5.7	Asia Vinyl Chloride Monomer Cash Cost Margins	129
5.8	China Vinyl Chloride Monomer Cost Price and Margins	130
5.9	South-East Asia Vinyl Chloride Monomer Cost Price and Margins	130
5.10	United States Chlor-Alkali Cash Cost Margins	132
5.11	United States Chlor-Alkali Leader Cost, Price, and Margin	132
5.12	United States EDC Variable Cost Margins.....	134
5.13	United States EDC Cash Cost Margins	134
5.14	United States EDC Leader Cost, Price, and Margin	134
5.15	United States Vinyl Chloride Variable Cost Margins.....	136
5.16	United States Vinyl Chloride Cash Cost Margins.....	136
5.17	United States Vinyl Chloride Leader Costs, Price, and Margin	136
5.18	Western Europe ECU Cash Cost Margins	138
5.19	Western Europe ECU Cost and Margin	138
5.20	Western Europe Ethylene Dichloride Variable Cost Margins	140
5.21	Western Europe Ethylene Dichloride Cash Cost Margins	140
5.22	Western Europe Ethylene Dichloride Cost, Price and Margin	140
5.23	Western Europe Vinyl Chloride Monomer Variable Cost Margins	142
5.24	Western Europe Vinyl Chloride Monomer Cash Cost Margins	142
5.25	Western Europe Vinyl Chloride Monomer Cost, Price and Margins	142
5.26	PVC Cost Competitiveness Summary	145
5.27	PVC Prices	145
5.28	South-East Asia PVC Variable Cost Margins	148
5.29	South-East Asia PVC Cash Cost Margins	148
5.30	South-East Asia PVC Cost Price and Margins	148
5.31	United States PVC Pipe-Grade Variable Cost Margins	150
5.32	United States PVC Pipe-Grade Cash Cost Margins	150

5.33	United States PVC Pipe Grade Leader Cost, Price and Margin.....	150
5.34	Western Europe PVC Variable Cost Margins	152
5.35	Western Europe PVC Cash Cost Margins	152
5.36	Western EuropePVC Cost, Price and Margin	152
6.1	Benzene Cost Competitiveness Summary	158
6.2	Benzene Prices	158
6.3	Mixed Xylenes Cost Competitiveness Summary	159
6.4	Mixed Xylenes Prices	159
6.5	Asia Reformer Cash Cost Margins.....	162
6.6	China Reformer Cost, Price and Margin	162
6.7	Asia Benzene Cash Cost Margins	165
6.8	China Benzene Cost, Price and Margin	165
6.9	China Mixed Xylenes Margins.....	170
6.10	China Mixed Xylenes, Price and Margin	171
6.11	China Mixed Xylenes, Price and Margin	171
6.12	United States Toluene Recovery for Chemicals versus Blending Into Gasoline	172
6.13	United States Aromatics Prices.....	172
6.14	United States Reformer Margins.....	174
6.15	United States Reformate Cost, Price and Margin	174
6.16	United States Benzene Extraction Margins	177
6.17	United States Benzene – Toluene Conversion Cash Cost Margins	177
6.18	United States Benzene Cost Price and Margins	178
6.19	United States Benzene Cost, Price and Margin.....	178
6.20	United States Benzene Production Costs	180
6.21	United States Mixed Xylenes – Reformate Extraction Cash Cost Margins	183
6.22	United States Mixed Xylenes – Toluene Conversion Cash Cost Margins	183
6.23	United States Mixed Xylenes Cost Price and Margin	184
6.24	United States Mixed Xylenes Cost Price and Margin	184
6.25	United States Xylenes Production Costs	186
6.26	Western Europe Aromatics Prices	187
6.27	Western Europe Spot Price Differentials to Premium Unleaded Gasoline	187
6.28	Western Europe Reformer Cash Cost Margins	189
6.29	Western Europe Reformer Margins	189
6.30	Western Europe Benzene Cash Cost Margins	192
6.31	Western Europe Benzene Cost Price and Margin	192
6.32	Western Europe Benzene Cost Price and Margin	192

6.33	Western Europe Mixed Xylenes Cash Cost Margins	195
6.34	Western Europe Mixed Xylenes Cost, Price and Margins	195
6.35	Western Europe Mixed Xylenes Cash Cost Margins	195
6.36	Cyclohexane Prices.....	197
6.37	United States Cyclohexane Margins	199
6.38	United States Cyclohexane Leader Cost, Price and Margin.....	199
6.39	Western Europe Cyclohexane Margins.....	201
6.40	Western Europe Cyclohexane Leader Cost Price and Margin	201
7.1	Styrene Cost Competitiveness Summary	204
7.2	Styrene Prices	204
7.3	South-East Asia Styrene Variable Cost Margins	206
7.4	South-East Asia Styrene Cash Cost Margins	206
7.5	South-East Asia Styrene Cost, Price and Margin	206
7.6	United States Styrene Variable Cost Margins.....	208
7.7	United States Styrene Cash Cost Margins.....	208
7.8	United States Styrene Leader Cost, Price and Margin	208
7.9	Western Europe Styrene Variable Cost Margins	210
7.10	Western Europe Styrene Cash Cost Margins	210
7.11	Western Europe Styrene Cost, Price and Margin	210
7.12	Polystyrene Cost Competitiveness Summary.....	213
7.13	Polystyrene Prices.....	213
7.14	South-East Asia Polystyrene Variable Cost Margins	215
7.15	South-East Asia Polystyrene Cash Cost Margins	215
7.16	South-East Asia Styrene Cost, Price and Margin	215
7.17	United States Polystyrene Variable Cost Margins	217
7.18	United States Polystyrene Cash Cost Margins	217
7.19	United States Polystyrene Leader Margins.....	217
7.20	Western Europe Polystyrene Variable Cost Margins.....	219
7.21	Western Europe Polystyrene Cash Cost Margins	219
7.22	Western Europe Polystyrene Cost, Price and Margin.....	219
8.1	Styrene Butadiene Rubber Cost Competitiveness Summary	222
8.2	Styrene Butadiene Rubber Prices	222
8.3	South-East Asia Styrene Butadiene Rubber Margins	224
8.4	South-East Asia Styrene Butadiene Rubber Cost, Price and Margin	224
8.5	United States Styrene Butadiene Rubber Margins	226
8.6	United States Styrene Butadiene Rubber Cost Price and Margin	226

8.7	Western Europe Styrene Butadiene Rubber Margins	228
8.8	Western Europe Styrene Butadiene Rubber Leader Cost Price and Margin.....	228
8.9	Acrylonitrile Butadiene Styrene Cost Competitiveness Summary	231
8.10	Acrylonitrile Butadiene Styrene Prices	231
8.11	South-East Asia Acrylonitrile Butadiene Styrene Margins	233
8.12	South-East Asia Acrylonitrile Butadiene Styrene Cost, Price and Margin	233
8.13	United States Acrylonitrile Butadiene Styrene Margins	235
8.14	United States Acrylonitrile Butadiene Styrene Leader Cost Price and Margin	235
8.15	Western Europe Acrylonitrile Butadiene Styrene Margins	237
8.16	Western Europe Acrylonitrile Butadiene Styrene Leader Cost Price and Margin	237
8.17	Butadiene Rubber Cost Competitiveness Summary.....	240
8.18	Butadiene Rubber Prices	240
8.19	South-East Asia Butadiene Rubber Margins	242
8.20	South-East Asia Butadiene Rubber Cost, Price and Margin.....	242
8.21	United States Butadiene Rubber Margins.....	244
8.22	United States Butadiene Rubber Leader Cost Price and Margin	244
8.23	Western Europe Butadiene Rubber Margins	246
8.24	Western Europe Butadiene Rubber Cost Price and Margin	246
9.1	Mono Ethylene Glycol Cost Competitiveness Summary.....	249
9.2	Mono Ethylene Glycol Prices	249
9.3	Asia Mono Ethylene Glycol Variable Cost Margins.....	253
9.4	Asia Mono Ethylene Glycol Cash cost Margins	253
9.5	China Mono Ethylene Glycol Cost, Price and Margin	254
9.6	China Mono Ethylene Glycol Cost, Price and Margin	254
9.7	United States Mono Ethylene Glycol Variable Cost Margins	256
9.8	United States Mono Ethylene Glycol Cash Cost Margins.....	256
9.9	United States Mono Ethylene Glycol Leader Cost, Price and Margin	256
9.10	Western Europe Ethylene Oxide Variable Cost Margins	258
9.11	Western Europe Ethylene Oxide Cash Cost Margins	258
9.12	Western Europe Ethylene Oxide Cost Price and Margin	258
9.13	Western Europe Ethylene Glycol Variable Cost Margins.....	260
9.14	Western Europe Ethylene Glycol Cash Cost Margins	260
9.15	Western Ethylene Glycol Cost Price and Margin	260
9.16	<i>para</i> -Xylene Cost Competitiveness Summary	263
9.17	<i>para</i> -Xylene Prices	263
9.18	China <i>para</i> -Xylene Cash Cost Margins	266

9.19	South-East Asia <i>para</i> -Xylene Cash Cost Margins	266
9.20	China <i>para</i> -Xylene Cost, Price and Margin.....	266
9.21	United States <i>para</i> -Xylene Extraction and Isomerisation Margins.....	268
9.22	United States <i>para</i> -Xylene Cash Cost Margins	268
9.23	United States <i>para</i> -Xylene Return on Investment.....	269
9.24	United States <i>para</i> -Xylene Leader Cost, Price and Margin	269
9.25	Western Europe <i>para</i> -Xylene Margins (Leader)	271
9.26	Western Europe <i>para</i> -Xylene Cost Price and Margin	271
9.27	Western Europe <i>para</i> -Xylene Cash Cost Margins	272
9.28	Western Europe <i>para</i> -Xylene Return on Investment	272
9.29	PTA Cost Competitiveness Summary.....	275
9.30	PTA Prices	275
9.31	Asia PTA Variable Cost Margins	278
9.32	Asia PTA Cash Cost Margins.....	278
9.33	China PTA Cost, Price and Margin	278
9.34	United States PTA Fibre Grade Variable Cost Margins.....	280
9.35	United States PTA Fibre Grade Cash Cost Margins.....	280
9.36	United States PTA Fibre Grade Cost, Price and Margin.....	280
9.37	Western Europe PTA Margins	282
9.38	Western Europe PTA Cost, Price and Margins.....	282
9.39	PET Cost Competitiveness Summary.....	285
9.40	PET Bottle Grade Prices	285
9.41	Asia PET Bottle Grade Variable Cost Margins	288
9.42	Asia PET Bottle Grade Cash Cost Margins	288
9.43	China PET Bottle Grade Cost, Price and Margins	288
9.44	United States PET Bottle Grade Variable Cost Margins	290
9.45	United States PET Bottle Grade Cash Cost Margins.....	290
9.46	United States PET Bottle Grade Leader Cost, Price and Margin	290
9.47	Western Europe PET Bottle Grade Margins	292
9.48	Western Europe PET Bottle Grade Leader Cost, Price and Margin	292
10.1	Acrylonitrile Cost Competitiveness Summary	295
10.2	Acrylonitrile Prices.....	295
10.3	China Acrylonitrile Margins	297
10.4	China Acrylonitrile Cost, Price and Margin.....	297
10.5	United States Acrylonitrile Margins	299
10.6	United States Acrylonitrile Leader Cost, Price and Margin	299

10.7 United States Acrylonitrile Leader Margins	299
10.8 Western Europe Acrylonitrile Margins	301
10.9 Western Europe Acrylonitrile Cost Price and Margin.....	301
10.10 Phenol Cost Competitiveness Summary.....	305
10.11 Phenol Prices	305
10.12 Asia Integrated Cumene Phenol Variable Cost Margins.....	308
10.13 Asia Integrated Cumene Phenol Cash Cost Margins	308
10.14 China Phenol Cost, Price and Margin	308
10.15 United States Cumene Cash Cost Margins	310
10.16 United States Cumene Leader Cost, Price and Margin	310
10.17 United States Phenol Variable Cost Margins	312
10.18 United States Phenol Cash Cost Margins.....	312
10.19 United States Phenol Cost Price and Margin.....	312
10.20 Western Europe Integrated Cumene/Phenol Margins	314
10.21 Western Europe Phenol Cost Price and Margin	314
10.22 Bisphenol A Cost Competitiveness Summary	318
10.23 Bisphenol A Prices	318
10.24 South-East Asia Bisphenol A Variable Cost Margins.....	320
10.25 South-East Asia Bisphenol A Cash Cost Margins	320
10.26 South-East Asia Bisphenol A Leader Cost Price and Margin	320
10.27 United States Bisphenol A Margins.....	322
10.28 United States Bisphenol A Leader Cost Price and Margin	322
10.29 Western Europe Bisphenol A Margins	324
10.30 Western Europe Bisphenol A Leader Cost Price and Margin	324
10.31 Polycarbonate Cost Competitiveness Summary.....	325
10.32 Polycarbonate Prices	325
10.33 South-East Asia Polycarbonate Variable Cost Margins.....	328
10.34 South-East Asia Polycarbonate Cash Cost Margins	328
10.35 South-East Asia Polycarbonate Interfacial Cost Price and Margin	329
10.36 South-East Asia Polycarbonate Melt Phase Cost Price and Margin	329
10.37 United States Polycarbonate Variable Cost Margins	332
10.38 United States Polycarbonate Cash Cost Margins	332
10.39 United States Polycarbonate Cost, Price Margin - Interfacial	333
10.40 United States Polycarbonate Margins – Melt Phase Non-Phosgene	333
10.41 Western Europe Polycarbonate Variable Cost Margins.....	336
10.42 Western Europe Polycarbonate Cash Cost Margins	336

10.43 Western Europe Polycarbonate Interfacial Cost Price and Margin.....	337
10.44 Western Europe Polycarbonate Melt Phase Cost Price and Margin	337
10.45 Propylene Oxide Cost Competitiveness Summary	340
10.46 Propylene Oxide Prices.....	340
10.47 South-East Asia Propylene Oxide Variable Cost Margins	343
10.48 South-East Asia Propylene Oxide Cash Cost Margins	343
10.49 South-East Asia Propylene Oxide Cost Price and Margin	344
10.50 South-East Asia Propylene Oxide Cost Price and Margin	344
10.51 United States Propylene Oxide Margins	347
10.52 United States Propylene Oxide Cost Price and Margin	347
10.53 United States Propylene Oxide Cost Price and Margin	347
10.54 Western Europe Propylene Oxide Variable Cost Margins	350
10.55 Western Europe Propylene Oxide Cash Cost Margins.....	350
10.56 Western Europe Propylene Oxide Cost Price and Margin.....	351
10.57 Western Europe Propylene Oxide Cost Price and Margin.....	351
10.58 Oxo Alcohols Cost Competitiveness Summary	354
10.59 <i>n</i> -Butanol Prices	354
10.60 2EH Prices	355
10.61 South-East Asia Butanol Margins	357
10.62 South-East Asia Butanol Cost, Price and Margin	357
10.63 South-East Asia 2-Ethylhexanol Margins.....	359
10.64 South-East Asia 2-Ethylhexanol Cost, Price and Margin.....	359
10.65 United States Butanol Margins.....	361
10.66 United States Butanol Cost, Price and Margin.....	361
10.67 United States 2-Ethylhexanol Margins	363
10.68 United States 2-Ethylhexanol Cost, Price and Margin	363
10.69 Western Europe Butanol Margins	365
10.70 Western Europe Butanol Cost, Price and Margin	365
10.71 Western Europe 2-Ethylhexanol Margins.....	367
10.72 Western Europe 2-Ethylhexanol Cost, Price and Margin.....	367
11.1 Isocyanates Cost Competitiveness Summary	370
11.2 MDI Prices	371
11.3 TDI Prices.....	371
11.4 South-East Asia MDI and Intermediates Costs.....	373
11.5 South-East Asia MDI Margins	373
11.6 South-East Asia TDI and Intermediates Costs	375

11.7 South-East Asia TDI Margins	375
11.8 United States MDI and Intermediates Costs	377
11.9 United States MDI Margins	377
11.10 United States TDI and Intermediates Costs	379
11.11 United States TDI Margins	379
11.12 Western Europe MDI and Intermediates Costs	381
11.13 Western Europe MDI Margins	381

Table	Page
1.1 United States Petrochemical Profitability Summary.....	7
1.2 Western Europe Petrochemical Profitability Summary	10
2.1 Monthly Crude Oil Pricing	14
2.2 Singapore Refinery Costs, Revenue and Margins	17
2.3 United States Gulf Coast Refinery Costs, Revenue, and Margins	18
2.4 Western Europe Refinery Costs, Revenue and Margins	19
2.5 United States Gulf Coast Petrochemical Feedstock Spot Prices	21
2.6 United States Ethane Recovery Leader Costs, Revenues, and Margins	22
3.1 China Ethylene Costs, Revenues and Margins	29
3.2 China Ethylene Costs, Revenues and Margins	30
3.3 China Ethylene Costs, Revenues and Margins	31
3.4 South-East Asia Ethylene Costs, Revenues and Margins	32
3.5 United States Ethylene Leader Costs, Revenues, and Margins (Ethane Cracker)	35
3.6 United States Ethylene Leader Costs, Revenues, and Margins (Ethane/Propane Mixed Feed Cracker)	37
3.7 United States Ethylene Leader Costs, Revenues, and Margins (Standard Naphtha Cracker).....	39
3.8 United States Ethylene Production Costs (Cracker Feedstock Competitiveness)	41
3.9 Western Europe Ethylene Leader Costs, Revenues and Margins Standard Naphtha Cracker with Butadiene and Benzene Extraction.....	43
3.10 Western Europe Ethylene Leader Costs, Revenues and Margins Basic Naphtha Cracker (Standard Severity)	44
3.11 Western Europe Ethylene Costs	47
3.12 China Propylene Costs, Revenues and Margins	53
3.13 China Propylene Costs, Revenues and Margins	54
3.14 China Propylene Costs, Revenues and Margins	55
3.15 South-East Asia Propylene Costs, Revenues and Margins.....	56

3.16	United States Polymer Grade Propylene Leader Cost, Revenues, and Margins Refinery Propylene Splitter	59
3.17	United States Polymer Grade Propylene Leader Cost, Revenues, and Margins Propane Dehydrogenation	60
3.18	Western Europe Propylene Costs, Revenue and Margins Propane Dehydrogenation	63
3.19	Western Europe Propylene Costs, Revenues and Margins Refinery Propylene Splitter	64
3.20	China Butadiene Costs, Revenues and Margins Mixed C4 Extraction	71
3.21	South-East Asia Butadiene Costs, Revenues and Margins	72
3.22	United States Butadiene Costs, Revenues, and Margins Leader Plants	74
3.23	Western Europe Butadiene Costs, Revenues and Margins	76
4.1	China LDPE Costs, Revenue and Margins	81
4.2	South-East Asia LDPE Costs, Revenue and Margins	82
4.3	United States Low Density Polyethylene Leader Costs, Revenues, and Margins	84
4.4	Western Europe Low Density Polyethylene Leader Costs, Revenues and Margins	86
4.5	China LLDPE Costs, Revenue and Margins	92
4.6	South-East Asia LLDPE Costs, Revenue and Margins	93
4.7	United States Linear Low Density Leader Polyethylene Costs, Revenues, and Margins Butene-1 Grade	95
4.8	Western Europe Linear Low Density Polyethylene Leader Costs, Revenues and Margins	97
4.9	China HDPE Costs, Revenue and Margins	102
4.10	South-East Asia HDPE Costs, Revenue and Margins	103
4.11	United States High Density Polyethylene Leader Costs Revenues and Margins Injection Moulding Grade	105
4.12	Western Europe High Density Polyethylene Leader Costs, Revenues and Margins	107
4.13	China Polypropylene Costs, Revenue and Margins	113
4.14	South-East Asia Polypropylene Costs, Revenue and Margins	114
4.15	United States Polypropylene Leader Costs, Revenue, and Margins	116
4.16	Western Europe Polypropylene Leader Costs, Revenues and Margins	118
5.1	China Ethylene Dichloride Costs, Revenues and Margins	123
5.2	South-East Asia Ethylene Dichloride Costs, Revenues and Margins	124
5.3	China Vinyl Chloride Monomer Costs, Revenues and Margins	126
5.4	China Vinyl Chloride Monomer Costs, Revenues and Margins	127
5.5	South-East Asia Vinyl Chloride Monomer Costs, Revenues and Margins	128
5.6	United States Chlor-Alkali Leader Costs Revenues and Margins	131
5.7	United States Export Ethylene Dichloride Leader Costs, Revenues, and Margins	133
5.8	United States Vinyl Chloride Monomer Leader Costs, Revenues, and Margins	135
5.9	Western Europe Chlor-Alkali Leader Costs	137

5.10	Western Europe Ethylene Dichloride Leader Costs, Revenues and Margins	139
5.11	Western Europe Vinyl Chloride Monomer Leader Costs, Revenues and Margins Contract Economics	141
5.12	South-East Asia Polyvinyl Chloride Costs, Revenues and Margins	146
5.13	Polyvinyl Chloride Costs, Revenues and Margins – South-East Asia	147
5.14	United States Polyvinyl Chloride Leader Costs, Revenues, and Margins	149
5.15	Western Europe Polyvinyl Chloride Leader Costs, Revenues and Margins	151
6.1	China Reformer Costs, Revenues and Margins	160
6.2	South-East Asia Reformer Costs, Revenues and Margins	161
6.3	China Benzene Pygas Extraction Costs, Revenues and Margins	163
6.4	South-East Asia Benzene Costs, Revenues and Margins	164
6.5	China Mixed Xylenes Costs, Revenues and Margins	166
6.6	China Mixed Xylenes Costs, Revenues and Margins	167
6.7	South-East Asia Mixed Xylenes Costs, Revenues and Margins	168
6.8	South-East Asia Mixed Xylenes Costs, Revenues and Margins	169
6.9	United States Reformate Costs, Revenues, and Margins	173
6.10	United States Benzene Costs, Revenues, and Margins Toluene Hydrodealkylation.....	175
6.11	United States Benzene Costs, Revenues, and Margins Toluene Disproportionation	176
6.12	United States Benzene Production Costs	179
6.13	United States Mixed Xylenes Costs, Revenues and Margins Reformate Extraction.....	181
6.14	United States Mixed Xylenes Costs, Revenues and Margins Toluene Disproportionation (TDP).....	182
6.15	United States Mixed Xylenes Production Costs.....	185
6.16	Western Europe Reformer Leader Costs, Revenues and Margins	188
6.17	Western Europe Benzene Costs, Revenues and Margins Extraction from Pygas	190
6.18	Western Europe Benzene Costs, Revenues and Margins Toluene Hydrodealkylation.....	191
6.19	Western Europe Mixed Xylenes Costs, Revenues and Margins Toluene Disproportionation	193
6.20	Western Europe Mixed Xylenes Costs, Revenues and Margins Reformate Extraction	194
6.21	United States Cyclohexane Leader Costs, Revenues, and Margins	198
6.22	Western Europe Cyclohexane Leader Costs, Revenues and Margins.....	200
7.1	South-East Asia Styrene Costs, Revenues and Margins.....	205
7.2	United States Styrene Leader Costs, Revenues, and Margins	207
7.3	Western Europe Styrene Leader Costs, Revenues and Margins	209
7.4	South-East Asia Polystyrene Costs, Revenues and Margins	214
7.5	United States Polystyrene Leader Costs, Revenues, and Margins	216
7.6	Western Europe Polystyrene Leader Costs, Revenues and Margins	218

8.1	South-East Asia Styrene Butadiene Rubber Costs, Revenues and Margins	223
8.2	United States Styrene Butadiene Rubber Costs, Revenues and Margins Typical Plants	225
8.3	Western Europe Styrene Butadiene Rubber Costs, Revenues and Margins	227
8.4	South-East Asia Acrylonitrile Butadiene Styrene Costs, Revenues and Margins	232
8.5	United States ABS Costs, Revenues and Margins Leader Plants.....	234
8.6	Western Europe Acrylonitrile Butadiene Styrene Costs, Revenues and Margins	236
8.7	Butadiene Rubber Costs, Revenues and Margins – South-East Asia.....	241
8.8	United States Butadiene Rubber Costs, Revenues and Margins Leader Plants.....	243
8.9	Western Europe Butadiene Rubber Costs, Revenues and Margins Typical Plants	245
9.1	China Mono Ethylene Glycol Costs, Revenues and Margins Ethylene Oxidation and Hydration	250
9.2	China Mono Ethylene Glycol Costs, Revenues and Margins From Coal Via DMO.....	251
9.3	South-East Asia Mono Ethylene Glycol Costs, Revenues and Margins Ethylene Oxidation and Hydration.....	252
9.4	United States Mono Ethylene Glycol Leader Costs, Revenues, and Margins.....	255
9.5	Western Europe Ethylene Oxide Leader Costs, Revenues and Margins	257
9.6	Western Europe Ethylene Glycol Leader Costs, Revenues and Margins	259
9.7	China <i>para</i> -Xylene Costs, Revenues and Margins	264
9.8	South-East Asia <i>para</i> -Xylene Costs, Revenues and Margins.....	265
9.9	United States <i>para</i> -Xylene Leader Costs, Revenues, and Margins	267
9.10	Western Europe <i>para</i> -Xylene Leader Costs, Revenues and Margins	270
9.11	China PTA Costs, Revenues and Margins.....	276
9.12	South-East Asia PTA Costs, Revenues and Margins	277
9.13	United States PTA Leader Costs, Revenues, and Margins	279
9.14	Western Europe PTA Costs, Revenues and Margins	281
9.15	China PET Bottle Grade Costs, Revenues and Margins	286
9.16	South-East Asia PET Bottle Grade Costs, Revenues and Margins.....	287
9.17	United States PET Bottle Grade Leader Costs, Revenues, and Margins.....	289
9.18	Western Europe PET Bottle Grade Leader Costs, Revenues and Margins	291
10.1	China Acrylonitrile Costs, Revenues and Margins	296
10.2	United States Acrylonitrile Leader Costs, Revenues, and Margins	298
10.3	Western Europe Acrylonitrile Leader Costs, Revenues and Margins	300
10.4	China Cumene/Phenol Costs, Revenues and Margins.....	306
10.5	South-East Asia Cumene/Phenol Costs, Revenues and Margins	307
10.6	United States Cumene Leader Costs, Revenues, and Margins	309
10.7	United States Phenol Leader Costs, Revenues, and Margins Cumene Oxidation.....	311
10.8	Western Europe Cumene/Phenol Leader Costs, Revenues and Margins.....	313

10.9	South-East Asia Bisphenol A Costs, Revenues and Margins.....	319
10.10	United States Bisphenol A (BPA) Leader Costs, Revenues, and Margins	321
10.11	Western Europe Bisphenol A Costs, Revenues and Margins	323
10.12	South-East Asia Polycarbonate Costs, Revenues and Margins Interfacial Process	326
10.13	South-East Asia Polycarbonate Costs, Revenues and Margins Melt Phase Non Phosgene Process	327
10.14	United States Polycarbonate Leader Costs, Revenues, and Margins Interfacial	330
10.15	United States Polycarbonate Leader Costs, Revenues, and Margins Melt Phase Non- Phosgene	331
10.16	Western Europe Polycarbonate Costs, Revenues and Margins Interfacial	334
10.17	Western Europe Polycarbonate Phosgene Costs, Revenues and Margins Melt Phase Non	335
10.18	South-East Asia Propylene Oxide Costs, Revenues and Margins Hydrogen Peroxide (HPPO) Process.....	341
10.19	South-East Asia Propylene Oxide Costs, Revenues and Margins Styrene (POSM) Process	342
10.20	United States Propylene Oxide Costs, Revenues and Margins Chlorohydrin (CHPO) Process	345
10.21	United States Propylene Oxide Costs, Revenues and Margins Styrene (POSM) Process ...	346
10.22	Western Europe Propylene Oxide Costs, Revenues and Margins Hydrogen Peroxide (HPPO) Process.....	348
10.23	Western Europe Propylene Oxide Costs, Revenues and Margins Styrene (POSM) Process	349
10.24	South-East Asia Butanol Costs, Revenues and Margins.....	356
10.25	South-East Asia 2-Ethylhexanol Costs, Revenues and Margins	358
10.26	United States Butanol Costs, Revenues and Margins	360
10.27	United States 2-Ethylhexanol Costs, Revenues and Margins	362
10.28	Western Europe Butanol Costs, Revenues and Margins.....	364
10.29	Western Europe 2-Ethylhexanol Costs, Revenues and Margins	366
11.1	South-East Asia MDI and Intermediates Costs, Revenues and Margins	372
11.2	South-East Asia TDI and Intermediates Costs, Revenues and Margins	374
11.3	United States MDI and Intermediates Costs, Revenues and Margins.....	376
11.4	United States TDI and Intermediates Costs, Revenues and Margins	378
11.5	Western Europe MDI and Intermediates Costs, Revenues and Margins	380
11.6	Western Europe TDI and Intermediates Costs, Revenues and Margins	382