

Special Report

Prices, Margins, and Costs in an Era of High Oil Prices

January 2013



44 South Broadway, White Plains, New York 10601, USA
Tel: +1 914 609 0300 Fax: +1 914 609 0399

Copyright © by Nexant Ltd. 2013. All rights reserved.

This report was prepared by Nexant, Inc. ("NEXANT") and is part of the ChemSystems Topical Report Program. 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.

Contents

Section	Page
1 Executive Summary	1
1.1 INTRODUCTION	1
1.2 RESULTS	3
1.3 CONCLUSIONS.....	3
2 Introduction.....	6
2.1 ECONOMIC ASSUMPTIONS AND METHODOLOGY OVERVIEW	6
2.2 OIL PRICE SCENARIOS	6
2.2.1 Crude Oil Price Basis.....	7
2.2.2 Crude Oil Scenarios	7
2.3 PRICE FORECASTING METHODOLOGY.....	8
2.3.1 PPE Methodology	8
2.3.2 Price Influences.....	9
2.3.3 Experience.....	10
2.3.4 Price Correlation Methodology.....	11
3 Price Forecasts	14
3.1 PETROCHEMICAL FEEDSTOCKS AND REFINED PRODUCTS	14
3.1.1 Introduction.....	14
3.1.2 Natural Gas	16
3.2 OLEFINS	17
3.2.1 Ethylene	17
3.2.2 Propylene	26
3.2.3 Butadiene	37
3.3 POLYOLEFINS.....	43
3.3.1 Polyolefins Summary.....	43
3.3.2 Low Density Polyethylene (LDPE)	46
3.3.3 Linear Low Density Polyethylene (LLDPE)	49
3.3.4 High Density Polyethylene (HDPE)	53
3.3.5 Polypropylene (PP)	57

3.4	VINYLS	61
3.4.1	Chlor-alkali	61
3.4.2	Ethylene Dichloride (EDC).....	64
3.4.3	Vinyl Chloride Monomer (VCM).....	69
3.4.4	Polyvinyl Chloride (PVC).....	74
3.5	AROMATICS	79
3.5.1	Introduction.....	79
3.5.2	Reformate and PYGAS.....	83
3.5.3	Benzene.....	85
3.5.4	Toluene	92
3.5.5	Mixed Xylenes	96
3.6	STYRENICS.....	100
3.6.1	Styrene	100
3.6.2	General Purpose Polystyrene (GPPS).....	105
3.6.3	Acrylonitrile Butadiene Styrene (ABS).....	110
3.6.4	Styrene Butadiene Rubber (SBR)	114
3.7	POLYESTER AND INTERMEDIATES	118
3.7.1	<i>para</i> -Xylene	118
3.7.2	<i>ortho</i> -Xylene	124
3.7.3	Mono-Ethylene Glycol (MEG).....	127
3.7.4	Purified Terephthalic Acid (PTA)	132
3.7.5	Polyethylene Terephthalate (PET).....	136
3.8	OTHER ETHYLENE DERIVATIVES	141
3.8.1	Ethanolamines.....	141
3.8.2	VAM	143
3.8.3	Isopropanol	146
3.9	OTHER PROPYLENE DERIVATIVES.....	149
3.9.1	Acrylonitrile (ACN).....	149
3.9.2	Cumene, Phenol and Acetone	154
3.9.3	Propylene Oxide.....	162
3.9.4	Polyether Polyols	165

3.9.5	<i>N</i> -Butanol.....	167
3.9.6	2-Ethylhexyl Alcohol.....	169
3.9.7	Acrylic Acid.....	172
3.9.8	Butyl Acrylate.....	175
3.10	OTHER C ₄ DERIVATIVES.....	178
3.10.1	MMA.....	178
3.10.2	PMMA	181
3.10.3	BDO	184
3.10.4	MTBE	187
3.11	OTHER AROMATIC DERIVATIVES	189
3.11.1	Cyclohexane.....	189
3.11.2	Caprolactam	193
3.12	OTHER METHANOL DERIVATIVES	195
3.12.1	Acetic Acid	195

Appendix		Page
A	U.S. Price Forecasts	A-1
B	Western Europe Price Forecasts	B-1
C	Asia Pacific Price Forecast.....	C-1

Figure	Page
1.1 WTI Crude Oil Price	1
2.1 Reference Crude Oil Scenarios	8
2.2 Data Flow within Nexant's Simulator	9
2.3 LLDPE Cash Costs	11
3.1 Projected Trends in Petrochemical Feedstock and Refined Product Pricing.....	15
3.2 Natural Gas Prices.....	17
3.3 United States Ethylene Prices	19
3.4 Steam Cracker Cash Cost Margin.....	21
3.5 Steam Cracker Return on Investment	21
3.6 Steam Cracker Return on Investment	23
3.7 United States Ethylene Price Forecasts.....	24
3.8 Global Ethylene Prices.....	25
3.9 United States Propylene Supply.....	27
3.10 Propylene Splitter Cash Cost Margins	32
3.11 Propane Dehydrogenation Margins	33
3.12 Propylene: Ethylene Price Ratios.....	35
3.13 United States Polymer Grade Propylene Prices.....	36
3.14 Global Polymer Grade Propylene Prices	37
3.15 Butadiene Extraction Return on Investment	40
3.16 C ₄ s Price Projections.....	41
3.17 United States Butadiene Prices	42
3.18 Global Butadiene Prices.....	43
3.19 United States Leader Polyolefin Plant Return on Investment	45
3.20 United States Polyolefin Prices.....	46
3.21 Global LDPE Prices	48
3.22 United States LDPE – LLDPE Price Differential.....	51
3.23 Global LLDPE Prices	53
3.24 Global HDPE (Injection Molding) Prices.....	56
3.25 PP: HDPE (IM) Prices and Ratio.....	59
3.26 Global Polypropylene Prices.....	60

3.27	United States Chlor-alkali Return on Investment	62
3.28	Global Caustic Soda Prices.....	63
3.29	United States Chlorine Pricing.....	64
3.30	Ethylene Dichloride Return on Investment.....	66
3.31	Ethylene Dichloride Cash Cost Margins.....	67
3.32	United States Ethylene Dichloride Prices	68
3.33	Global Ethylene Dichloride Prices.....	69
3.34	Vinyl Chloride Return on Investment.....	71
3.35	United States Vinyl Chloride Contract Price	72
3.36	Global Vinyl Chloride Prices.....	73
3.37	PVC Cash Cost Margins	76
3.38	United States PVC Prices.....	77
3.39	United States Polymer Prices.....	77
3.40	Global PVC Prices	78
3.41	United States Gasoline, Benzene, Toluene, and Mixed Xylenes Prices	80
3.42	USGC Cost of Octane	82
3.43	Reformer Cash Cost Margins.....	84
3.44	Benzene Cash Cost Margins	88
3.45	Benzene Cash Cost Margins	90
3.46	United States Benzene Prices.....	91
3.47	Global Benzene Prices	92
3.48	United States Toluene Price Premiums.....	94
3.49	United States Toluene Prices	95
3.50	Global Toluene Prices.....	95
3.51	Mixed Xylenes Cash Cost Margins	98
3.52	United States Mixed Xylenes Prices.....	99
3.53	Global Mixed Xylenes Prices	100
3.54	Styrene Return on Investment and Operating Rate.....	102
3.55	Styrene Cash Cost Margins.....	103
3.56	United States Styrene Prices	104
3.57	Global Styrene Prices.....	104

3.58	Polystyrene Cash Cost Margins	106
3.59	United States Polystyrene Prices	108
3.60	United States Polymer Prices.....	108
3.61	Global Polystyrene Prices.....	109
3.62	ABS Margins	111
3.63	ABS Price Forecast Scenarios	112
3.64	Global ABS Prices	113
3.65	SBR Margins.....	116
3.66	SBR Price Forecast Scenarios.....	117
3.67	Global SBR Prices	117
3.68	<i>para</i> -Xylene U.S. Return on Investment	119
3.69	<i>para</i> -Xylene U.S. Cash Cost Margins	121
3.70	Integrated <i>para</i> -Xylene Cash Cost Margins	122
3.71	United States <i>para</i> -Xylene Prices.....	123
3.72	Global <i>para</i> -Xylene Prices	124
3.73	<i>ortho</i> -Xylene Price Ratio to Mixed Xylenes	125
3.74	United States <i>ortho</i> -Xylene Prices.....	126
3.75	Global <i>ortho</i> -Xylene Prices	127
3.76	MEG Return on Investment.....	129
3.77	MEG Cash Cost Margins	130
3.78	United States MEG Prices	131
3.79	Global MEG Prices.....	132
3.80	PTA Cash Cost Margins	134
3.81	United States PTA Prices.....	135
3.82	Global PTA Prices	135
3.83	PET Return on Investment.....	138
3.84	PET Cash Cost Margins.....	139
3.85	United States PET Prices	140
3.86	Global PET Prices.....	141
3.87	Ethanolamine U.S. Price Forecast, Medium Crude	142
3.88	Ethanolamine U.S. Price Forecast, High Crude.....	142

3.89	Ethanolamine Global Price Forecasts, Medium Crude.....	143
3.90	VAM U.S. Price Forecast, Medium Crude.....	144
3.91	VAM U.S. Price Forecast, High Crude.....	144
3.92	VAM Global Price Forecasts.....	145
3.93	VAM U.S. Cost of Production and Price Comparison, Medium Crude.....	146
3.94	Isopropanol U.S. Price Forecast, Medium Crude	147
3.95	Isopropanol U.S. Price Forecast, High Crude.....	147
3.96	Global Isopropanol Price Forecasts, Medium Crude.....	148
3.97	Isopropanol U.S. Cost of Production and Price Comparison, Medium Crude	149
3.98	United States Acrylonitrile Return on Investment.....	151
3.99	United States Acrylonitrile Cash Cost Margins.....	152
3.100	United States Acrylonitrile Prices.....	153
3.101	Global Acrylonitrile Prices	153
3.102	Cumene Cash Cost Margins.....	156
3.103	Phenol Return on Investment.....	158
3.104	Phenol Cash Cost Margins.....	158
3.105	Phenol Cash Cost Margins.....	159
3.106	United States Cumene Prices	160
3.107	United States Phenol Prices	160
3.108	United States Acetone Prices	161
3.109	Global Phenol Prices.....	161
3.110	Global Acetone Prices.....	162
3.111	PO U.S. Price Forecast, Medium Crude	163
3.112	PO U.S. Price Forecast, High Crude.....	163
3.113	Global PO Medium Crude	164
3.114	PO U.S. Cost of Production and Price Comparison, Medium Crude	165
3.115	Polyether Polyol U.S. Price Forecast, Medium Crude.....	166
3.116	Polyether Polyol U.S. Price Forecast, High Crude	166
3.117	Global Polyether Polyol Price Forecasts, Medium Crude	167
3.118	<i>N</i> -Butanol U.S. Price Forecast, Medium Crude.....	168
3.119	<i>N</i> -Butanol U.S. Price Forecast, High Crude	168

3.120	<i>N</i> -Butanol U.S. Cost of Production and Price Comparison, Medium Crude.....	169
3.121	2EH U.S. Price Forecast	170
3.122	2EH U.S. Price Forecast	170
3.123	Global 2EH Price Forecasts	171
3.124	2-EH U.S. Cost of Production and Price Comparison, Medium Crude.....	172
3.125	Acrylic Acid U.S. Price Forecast.....	173
3.126	Acrylic Acid U.S. Price Forecast, High Crude	173
3.127	Acrylic Acid Global Price Forecasts, Medium Crude	174
3.128	Acrylic Acid U.S. Cost of Production and Price Comparison, Medium Crude.....	175
3.129	Butyl Acrylate U.S. Price Forecast, Medium Crude.....	176
3.130	Butyl Acrylate U.S Price Forecast, High Crude	176
3.131	Butyl Acrylate Global Price Forecasts, Medium Crude	177
3.132	Butyl Acrylate U.S. Cost of Production and Price Comparison, Medium Crude...	178
3.133	MMA U.S. Price Forecast, Medium Crude	179
3.134	MMA U.S. Price Forecast, High Crude.....	179
3.135	MMA Global Price Forecasts, Medium Crude	180
3.136	MMA U.S. Cost of Production and Price Comparison, Medium Crude	181
3.137	PMMA U.S. Price Forecast, Medium Crude	182
3.138	PMMA U.S. Price Forecast, High Crude.....	182
3.139	PMMA Global Price Forecasts, Medium Crude.....	183
3.140	PMMA U.S. Cost of Production and Price Comparison, Medium Crude	184
3.141	BDO U.S. Price Forecast, Medium Crude.....	185
3.142	BDO U.S. Price Forecast, High Crude	185
3.143	BDO Global Price Forecasts, Medium Crude.....	186
3.144	BDO U.S. Cost of Production and Price Comparison, Medium Crude.....	187
3.145	MTBE U.S. Price Forecast, Medium Crude	188
3.146	MTBE U.S. Price Forecast, High Crude.....	188
3.147	MTBE, Global Price Forecast, Medium Crude	189
3.148	Cyclohexane Cash Cost Margins	191
3.149	United States Cyclohexane Prices	192
3.150	Global Cyclohexane Prices	192

3.151	Caprolactam U.S. Price Forecast, Medium Crude	193
3.152	Caprolactam U.S. Price Forecast, High Crude	194
3.153	Global Caprolactam, Price Forecasts, Medium Crude.....	194
3.154	Caprolactam U.S. Cost of Production and Price Comparison, Medium Crude	195
3.155	Acetic Acid U.S. Price Forecast, Medium Crude	196
3.156	Acetic Acid U.S. Price Forecast, High Crude.....	196