

MARKETS AND PROFITABILITY

Profitability and Price Forecast: Aromatics - 2023

October 2023



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 (BVI) Ltd. 2023. All rights reserved.



Contents

1	Executive Summary	1
1.1	Introduction.....	1
2	Economic Assumptions and Forecast Methodology	2
2.1	Introduction.....	2
2.2	Scenarios	3
2.3	Crude Oil	4
2.3.1	Crude Oil Price Basis	4
2.3.2	Crude Oil Scenarios	5
2.3.3	Low Crude Oil Price	7
2.3.4	Medium Crude Oil Price	7
2.3.5	High Crude Oil Price	7
2.4	Economic Growth.....	8
2.4.1	Forecasting Methodology/Assumptions	8
2.4.2	Global Economic Growth	8
2.5	Inflation.....	12
2.6	Exchange Rates	13
2.6.1	Forecasting Methodology and Assumptions	13
2.6.2	Outlook for the Euro	13
2.7	Profitability Forecasting Methodology	14
2.7.1	Introduction.....	14
2.7.2	Price Influences.....	15
2.7.3	Petrochemical Production Costs	17
2.7.4	Driving Forces for Profitability	19
2.7.5	Cyclicality of the Petrochemical Industry	23
3	Petrochemical and Polymer Industry Profitability	25
3.1	Asia Pacific.....	25
3.2	United States.....	27
3.3	Western Europe	29
4	Petrochemical Feedstocks and Refining Products Pricing	31
4.1	Naphtha.....	33
4.2	Gasoline	34
4.3	Fuel Oil	35
4.4	Natural Gas	36
4.5	Ethane	38
4.6	Propane.....	39
4.7	Coal	40
4.8	Carbon Costs	41
5	Gasoline Valuation of Aromatics	42
5.1	Introduction.....	42
5.2	Gasoline Blend Value Mechanism	44



5.2.1	Volatility Effect.....	44
5.2.2	Volumetric Effect	45
5.2.3	Octane Effect.....	45
5.2.3.1	Asian Octane Values	45
5.2.3.2	United States Octane Values.....	46
5.2.3.3	Western Europe Octane Values	47
6	Aromatics Rich Feedstocks (Reformate and Pygas).....	49
6.1	Introduction.....	49
6.2	Asia Pacific.....	50
6.2.1	Reformate Valuation Mechanism	50
6.2.2	Reformate Profitability Projections	50
6.2.3	Pygas Valuation Mechanism.....	52
6.3	United States.....	53
6.3.1	Reformate Valuation Mechanism	53
6.3.2	Reformate Profitability Projections	53
6.3.3	Pygas Valuation Mechanism.....	54
6.4	Western Europe	55
6.4.1	Reformate Valuation Mechanism	55
6.4.2	Reformate Profitability Projections	55
6.4.3	Pygas Valuation Mechanism.....	57
7	Benzene.....	58
7.1	Introduction.....	58
7.1.1	Pricing Basis and Mechanism	60
7.1.2	Regional Price Definitions	61
7.2	Asia Pacific.....	62
7.2.1	Profitability Projections	62
7.2.2	Price Projections	66
7.3	United States.....	67
7.3.1	Profitability Projections.....	67
7.3.2	Price Projections	70
7.4	Western Europe	71
7.4.1	Profitability Projections.....	71
7.4.2	Price Projections	74
7.5	Regional Price Spreads	75
8	Toluene.....	77
8.1	Introduction.....	77
8.1.1	Pricing Basis and Mechanism	77
8.2	Asia Pacific.....	79
8.2.1	Price Projections	79
8.3	United States.....	81
8.3.1	Price Projections	81
8.4	Western Europe	83
8.4.1	Price Projections	83



8.5	Regional Price Spreads	85
9	Mixed Xylenes.....	86
9.1	Introduction.....	86
9.1.1	Pricing Basis and Mechanism	86
9.1.2	Regional Price Definitions	87
9.2	Asia Pacific.....	88
9.2.1	Profitability Projections	88
9.2.2	Price Projections	91
9.3	United States.....	93
9.3.1	Profitability Projections	93
9.3.2	Price Projections	96
9.4	Western Europe	97
9.4.1	Profitability Projections.....	97
9.4.2	Price Projections	100
9.5	Regional Price Spreads	102
10	<i>para</i>-Xylene	103
10.1	Introduction.....	103
10.1.1	Pricing Basis and Mechanism	104
10.1.2	Regional Price Definitions	104
10.2	Asia Pacific.....	105
10.2.1	Profitability Projections	105
10.2.2	<i>Price Projections</i>	109
10.3	United States.....	110
10.3.1	Profitability Projections.....	110
10.3.2	Price Projections	114
10.4	Western Europe	115
10.4.1	Profitability Projections.....	115
10.4.2	Price Projections	119
10.5	Regional Price Spreads	120
11	<i>ortho</i>-Xylene	122
11.1	Introduction.....	122
11.1.1	Pricing Basis and Mechanism	122
11.1.2	Regional Price Definitions	122
11.2	Asia Pacific.....	123
11.2.1	Profitability Projections.....	123
11.2.2	Price Projections	123
11.3	United States.....	124
11.3.1	Profitability Projections.....	124
11.3.2	Price Projections	124
11.4	Western Europe	125
11.4.1	Profitability Projections.....	125
11.4.2	Price Projections	125
11.5	Regional Price Spreads	126



Figures

Figure 1	Crude Oil Price Scenarios	6
Figure 2	World Economic Performance and Outlook	9
Figure 3	United States GDP Price Deflator	12
Figure 4	Euro Versus U.S. Dollar	13
Figure 5	Petrochemical Simulator Forecast Methodology	14
Figure 6	Petrochemical Price Influences	16
Figure 7	Production Cost Elements	17
Figure 8	Price Influences in the Cost Curve	19
Figure 9	Return on Capital and Operating Rate	20
Figure 10	Western Europe Average Return on Investment	21
Figure 11	United States Average Return on Investment	21
Figure 12	Petrochemical Industry Profitability and Operating Rate	23
Figure 13	Asian Petrochemical Industry Profitability	25
Figure 14	United States Petrochemical Industry Profitability	27
Figure 15	Western Europe Petrochemicals Industry Profitability	29
Figure 16	United States Petrochemical Feedstock and Refined Product Prices	32
Figure 17	United States Petrochemical Feedstock Prices Relative to WTI Crude Oil	32
Figure 18	Global Naphtha Prices	33
Figure 19	Global Premium Gasoline Prices	34
Figure 20	Global High Sulphur Fuel Oil Prices	35
Figure 21	Global Natural Gas Prices	36
Figure 22	United States Ethane Prices	38
Figure 23	Global Propane Prices	39
Figure 24	China Coal Prices	40
Figure 25	EU Emissions Trading Scheme Cost of Carbon	41
Figure 26	Asia Aromatics Prices & Gasoline Prices	43
Figure 27	United States Aromatics Prices & Gasoline Prices	43
Figure 28	West European Aromatics & Gasoline Prices	43
Figure 29	South-East Asia Octane Value Projections	45
Figure 30	United States Octane Value Projections	47
Figure 31	Western Europe Octane Value Projections	48
Figure 32	Asia Reformate Cash Margin Projections	51
Figure 33	United States Reformate Margin Projections	54
Figure 34	Western Europe Reformate Cash Margin Projections	56
Figure 35	Western Europe Pygas: Naphtha Value Ratios	57
Figure 36	Asia Benzene Production by Source (2022)	58
Figure 37	United States Benzene Production by Source (2022)	59
Figure 38	Western Europe Benzene Production by Source (2022)	60
Figure 39	Asia Benzene Extraction Cash Margin Projections	62
Figure 40	Asia Benzene Toluene Conversion Cash Margin Projections	62
Figure 41	North-East Asia Benzene Cost Profitability and Price Projections	66
Figure 42	North-East Asia Benzene Price Scenarios	66



Figure 43	United States Benzene Cash Margin Projections	67
Figure 44	United States Benzene Cost Profitability and Price Projections	70
Figure 45	United States Benzene Price Forecast Scenarios	70
Figure 46	Western Europe Benzene Cash Margin Projections	71
Figure 47	Western Europe Benzene Cost Profitability and Price Projections	74
Figure 48	Western Europe Benzene Price Forecast Scenarios	74
Figure 49	Global Benzene Prices	75
Figure 50	North-East Asia Alternative Toluene Valuations	79
Figure 51	North-East Asia Toluene Price Scenario	80
Figure 52	United States Alternative Toluene Valuations	81
Figure 53	United States Toluene Price Scenarios	82
Figure 54	Western Europe Alternative Toluene Values	83
Figure 55	Western Europe Toluene Price Forecast Scenarios	84
Figure 56	Global Toluene Price Projections	85
Figure 57	North-East Asia Mixed Xylenes Cash Margin Projections	89
Figure 58	North-East Asia Mixed Xylenes Cost Profitability and Price Projections	91
Figure 59	North-East Asia Alternative Mixed Xylenes Valuations	91
Figure 60	North-East Asia Mixed Xylenes Price Scenarios	92
Figure 61	United States Mixed Xylenes Cash Margin Projections	94
Figure 62	United States Mixed Xylenes Cost Profitability and Price Projections	96
Figure 63	United States Mixed Xylenes Price Scenarios	96
Figure 64	Western Europe Mixed Xylenes Cash Margin Projections	98
Figure 65	Western Europe Mixed Xylenes Cost Profitability and Price Projections	100
Figure 66	Western Europe Alternative Mixed Xylenes Valuations	101
Figure 67	Western Europe Mixed Xylenes Price Scenarios	101
Figure 68	Global Mixed Xylenes Prices	102
Figure 69	<i>para</i> -Xylene Plant Configuration	103
Figure 70	Asia <i>para</i> -Xylene Return on Investment and Operating Rate	105
Figure 71	Asia <i>para</i> -Xylene Cash Margins	106
Figure 72	Asia Integrated <i>para</i> -Xylene Cash Margins	106
Figure 73	China <i>para</i> -Xylene Cost Margin and Price Projections	109
Figure 74	North-East Asia <i>para</i> -Xylene Price Scenarios	109
Figure 75	United States <i>para</i> -Xylene Return on Investment and Operating Rate	110
Figure 76	United States <i>para</i> -Xylene Extraction Cash Margins	111
Figure 77	United States Integrated <i>para</i> -Xylene Cash Margins	111
Figure 78	United States <i>para</i> -Xylene Cost Margin and Price Projections	114
Figure 79	United States <i>para</i> -Xylene Price Scenarios	114
Figure 80	Western Europe <i>para</i> -Xylene Return on Investment and Operating Rate	115
Figure 81	Western Europe <i>para</i> -Xylene Extraction Cash Margins	116
Figure 82	Western Europe Integrated <i>para</i> -Xylene Cash Margins	116
Figure 83	Western Europe <i>para</i> -Xylene Cost Margin and Price Projections	119
Figure 84	Western Europe <i>para</i> -Xylene Price Scenarios	119
Figure 85	Global <i>para</i> -Xylene Price Projections	120
Figure 86	Asia <i>ortho</i> -Xylene / <i>para</i> -Xylene Price Ratio	123



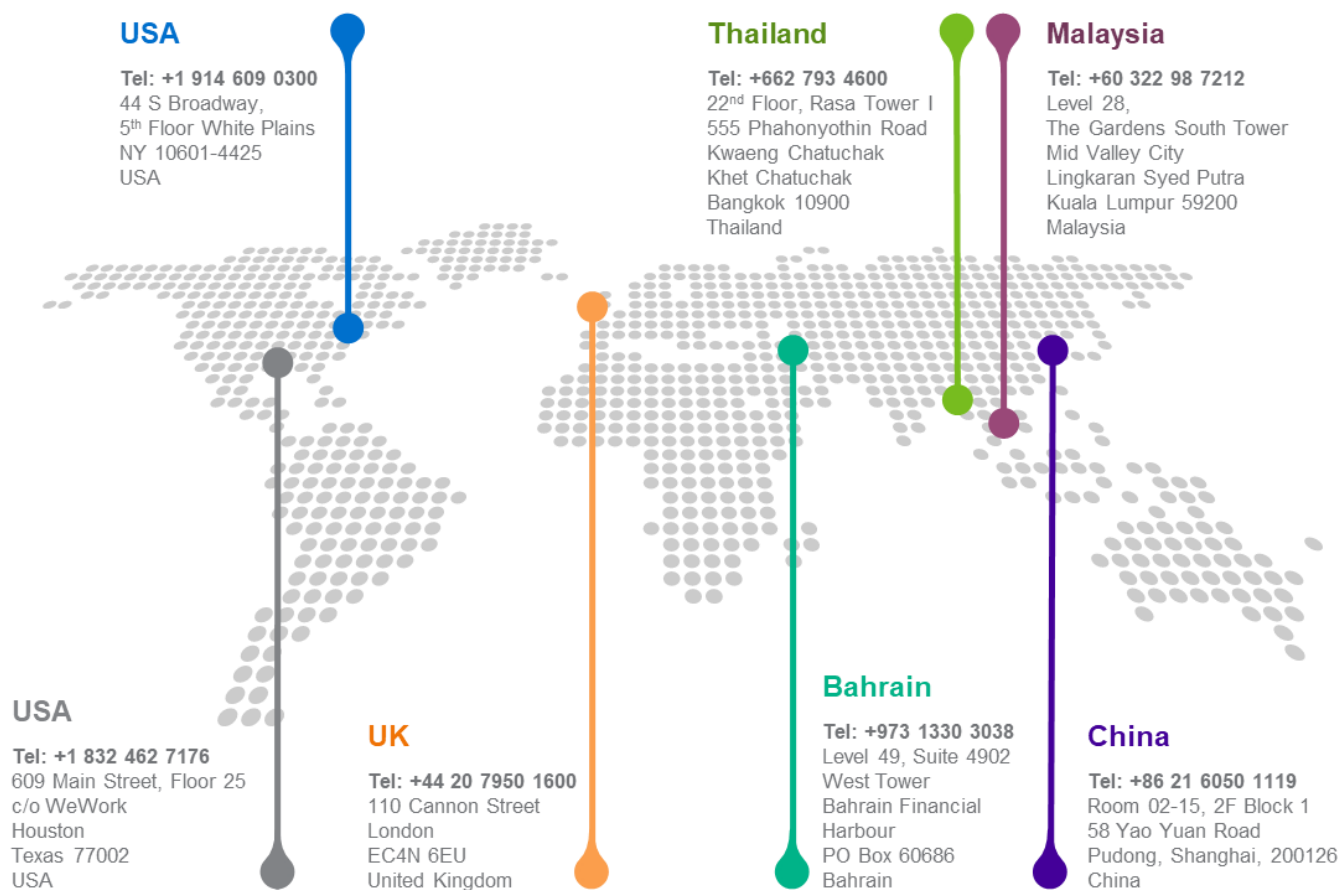
Figure 87	North-East Asia <i>ortho</i> -Xylene Price Scenarios.....	123
Figure 88	United States Xylene Isomers Prices	124
Figure 89	United States <i>ortho</i> -Xylene Price Scenarios	124
Figure 90	Western Europe <i>ortho</i> -Xylene Price Ratio to Mixed Xylenes.....	125
Figure 91	Western Europe <i>ortho</i> -Xylene Price Scenarios.....	125
Figure 92	Global <i>ortho</i> -Xylene Prices.....	126

Tables

Table 1	World Economic Growth.....	9
Table 2	Asian Reformate Blend Value Parameters in Gasoline	50
Table 3	Asia Reformer Cost and Margin Projections	51
Table 4	United States Reformer Cost and Margin Projections	54
Table 5	Western Europe Reformate Blending Value Parameters.....	55
Table 6	Western Europe Reformer Cost and Margin Projection.....	56
Table 7	Asia Benzene Cost Profitability and Price Projections	63
Table 8	United States Benzene Cost Profitability and Price Projections	69
Table 9	Western Europe Benzene Cost Profitability and Price Projections.....	73
Table 10	Mixed Xylenes Cost Profitability and Price Projections	89
Table 11	United States Mixed Xylenes Profitability and Price Projections.....	94
Table 12	Western Europe Mixed Xylenes Cost Profitability and Price Projections.....	98
Table 13	Asia <i>para</i> -Xylene Cost Profitability and Price Projections.....	107
Table 14	United States <i>para</i> -Xylene Cost Profitability and Price Projections (Xylenes Isomerisation and Extraction).....	112
Table 15	United States Integrated <i>para</i> -Xylene Cost Profitability and Price Projections.....	112
Table 16	Western Europe <i>para</i> -Xylene Cost Profitability and Price Projections (Xylenes Isomerisation and Extraction).....	117
Table 17	Integrated <i>para</i> -Xylene Cost Profitability and Price Projections.....	117



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.