

NexantThinking™

Petroleum and Petrochemical Economics

Quarterly Business Analysis

Western Europe

Quarter 4, 2017

December 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. 2018. All rights reserved.

Contents

Section	Page
1 Executive Summary	1
1.1 WESTERN EUROPE	1
2 Crude Oil, Refining and Petrochemical Feedstocks	6
2.1 CRUDE OIL AND REFINING	6
3 Olefins	14
3.1 ETHYLENE	14
3.1.1 Western Europe	14
3.2 PROPYLENE	23
3.2.1 Western Europe	23
3.3 BUTADIENE	29
3.3.1 Western Europe	29
4 Polyolefins	33
4.1 LOW DENSITY POLYETHYLENE	33
4.1.1 Western Europe	33
4.2 LINEAR LOW DENSITY POLYETHYLENE	37
4.2.1 Western Europe	37
4.3 HIGH DENSITY POLYETHYLENE	41
4.3.1 Western Europe	41
4.4 POLYPROPYLENE	45
4.4.1 Western Europe	45
5 Vinyls	49
5.1 CHLOR-ALKALI, ETHYLENE DICHLORIDE AND VINYL CHLORIDE MONOMER	49
5.1.1 Western Europe	49
5.2 POLYVINYL CHLORIDE	58
5.2.1 Western Europe	58
6 Aromatics	62
6.1 BENZENE, TOLUENE AND XYLENES	62
6.1.1 Western Europe	62
6.2 CYCLOHEXANE	75
6.2.1 Western Europe	75
7 Styrenics	78
7.1 STYRENE	78

	7.1.1 Western Europe	78
	7.2 POLYSTYRENE	82
	7.2.1 Western Europe	82
8	Butadiene Derivatives	86
	8.1 STYRENE BUTADIENE RUBBER.....	86
	8.1.1 Western Europe	86
	8.2 ACRYLONITRILE BUTADIENE STYRENE	90
	8.2.1 Western Europe	90
	8.3 BUTADIENE RUBBER.....	94
	8.3.1 Western Europe	94
9	Polyester and Intermediates	98
	9.1 MONO ETHYLENE GLYCOL AND ETHYLENE OXIDE	98
	9.1.1 Western Europe	98
	9.2 PARA-XYLENE (PX).....	104
	9.2.1 Western Europe	104
	9.3 PURIFIED TEREPHTHALIC ACID (PTA).....	109
	9.3.1 Western Europe	109
	9.4 POLYETHYLENE TEREPHTHALATE (PET)	113
	9.4.1 Western Europe	113
10	Propylene Derivatives	117
	10.1 ACRYLONITRILE.....	117
	10.1.1 Western Europe	117
	10.2 CUMENE, PHENOL AND ACETONE.....	121
	10.2.1 Western Europe	121
	10.3 BISPHENOL-A AND POLYCARBONATE	125
	10.3.1 Western Europe	125
	10.4 PROPYLENE OXIDE	134
	10.4.1 Western Europe	134
	10.5 OXO ALCOHOLS: BUTANOLS AND 2-ETHYLHEXANOL	140
	10.5.1 Western Europe	140
11	Isocyanates	147
	11.1 METHYLENE DIPHENYL DIISOCYANATE AND TOLUENE DIISOCYANATE	147
	11.1.1 Western Europe	147
12	Methanol and Derivatives.....	154
	12.1 METHANOL	154
	12.1.1 Western Europe	154

12.2	METHYL TERTIARY BUTYL ETHER.....	158
12.2.1	Western Europe	158

Figure	Page
1.1 Western Europe Cash Margin Index	4
1.2 Western Europe Cash Margin Index	4
1.3 Western Europe Cash Margin Index	4
1.4 Western Europe Cash Margin Index	5
1.5 Western Europe Return on Capital	5
1.6 Western Europe Average Operating Rate	5
2.1 Global Benchmark Crude Oil Pricing	8
2.2 Singapore Variable Cost Refining Margin	8
2.3 United States Gulf Cost Variable Cost Refining Margins	9
2.4 Western Europe Variable Cost Refinery Margins	9
2.5 South-East Asia Petrochemical Feedstock Prices	13
2.6 North-West Europe Petrochemical Feedstock Prices	13
3.1 Ethylene Cost Competitiveness Summary	16
3.2 Ethylene Prices	16
3.3 Western Europe Naphtha Cracker Variable Cost Margins	19
3.4 Western Europe Naphtha Cracker Cash Cost Margins	19
3.5 Western Europe Ethylene Cost, Price and Margins	19
3.6 Western Europe European Ethylene Prices	20
3.7 Western Europe Ethylene Production Costs	22
3.8 Western Europe Ethylene Cash Margins	22
3.9 Propylene Cost Competitiveness Summary	24
3.10 Propylene Prices	24
3.11 Western Europe Propylene Margins	27
3.12 Western Europe Propylene Cost, Price and Margin	27
3.13 Western Europe Propylene Cash Cost Margins	28
3.14 Western Europe Propylene Cost, Price and Margins	28
3.15 Butadiene Cost Competitiveness Summary	30
3.16 Butadiene Prices	30
3.17 Western Europe Butadiene Extraction Margins	32
3.18 Western Europe Butadiene Cost Price and Margins	32
4.1 LDPE Cost Competitiveness Summary	34
4.2 LDPE Prices	34
4.3 Western Europe LDPE Variable Cost Margins	36
4.4 Western Europe LDPE Cash Cost Margins	36
4.5 Western Europe LDPE Cost, Price and Margins	36

4.6	LLDPE Cost Competitiveness Summary	38
4.7	LLDPE Prices	38
4.8	Western Europe LLDPE Variable Cost Margins	40
4.9	Western Europe LLDPE Cash Cost Margins	40
4.10	Western Europe LLDPE Cost, Price and Margins	40
4.11	HDPE Cost Competitiveness Summary	42
4.12	HDPE Prices	42
4.13	Western Europe HDPE Variable Cost Margins.....	44
4.14	Western Europe HDPE Cash Cost Margins	44
4.15	Western Europe HDPE Cost, Price and Margins.....	44
4.16	Polypropylene Cost Competitiveness Summary	46
4.17	Polypropylene Prices.....	46
4.18	Western Europe Polypropylene Variable Cost Margins.....	48
4.19	Western Europe Polypropylene Cash Cost Margins.....	48
4.20	Western Europe Polypropylene Cost, Price and Margins.....	48
5.1	VCM Cost Competitiveness Summary.....	50
5.2	VCM Prices	50
5.3	EDC Prices.....	51
5.4	Western Europe ECU Cash Cost Margins	53
5.5	Western Europe ECU Cost and Margin	53
5.6	Western Europe Ethylene Dichloride Variable Cost Margins	55
5.7	Western Europe Ethylene Dichloride Cash Cost Margins	55
5.8	Western Europe Ethylene Dichloride Cost, Price and Margin	55
5.9	Western Europe Vinyl Chloride Monomer Variable Cost Margins	57
5.10	Western Europe Vinyl Chloride Monomer Cash Cost Margins.....	57
5.11	Western Europe Vinyl Chloride Monomer Cost, Price and Margins	57
5.12	PVC Cost Competitiveness Summary	59
5.13	PVC Prices	59
5.14	Western Europe PVC Variable Cost Margins	61
5.15	Western Europe PVC Cash Cost Margins	61
5.16	Western Europe PVC Cost, Price and Margin	61
6.1	Benzene Cost Competitiveness Summary	64
6.2	Benzene Prices	64
6.3	Mixed Xylenes Cost Competitiveness Summary	65
6.4	Mixed Xylenes Prices	65
6.5	Western Europe Aromatics Prices	66

6.6	Western Europe Spot Price Differentials to Premium Unleaded Gasoline	66
6.7	Western Europe Reformer Cash Cost Margins	68
6.8	Western Europe Reformer Margins	68
6.9	Western Europe Benzene Cash Cost Margins	71
6.10	Western Europe Benzene Cost Price and Margin	71
6.11	Western Europe Benzene Cost Price and Margin	71
6.12	Western Europe Mixed Xylenes Cash Cost Margins	74
6.13	Western Europe Mixed Xylenes Cost, Price and Margins	74
6.14	Western Europe Mixed Xylenes Cash Cost Margins	74
6.15	Cyclohexane Prices.....	75
6.16	Western Europe Cyclohexane Margins.....	77
6.17	Western Europe Cyclohexane Leader Cost Price and Margin	77
7.1	Styrene Cost Competitiveness Summary	79
7.2	Styrene Prices	79
7.3	Western Europe Styrene Variable Cost Margins	81
7.4	Western Europe Styrene Cash Cost Margins	81
7.5	Western Europe Styrene Cost, Price and Margin	81
7.6	Polystyrene Cost Competitiveness Summary	83
7.7	Polystyrene Prices.....	83
7.8	Western Europe Polystyrene Variable Cost Margins.....	85
7.9	Western Europe Polystyrene Cash Cost Margins.....	85
7.10	Western Europe Polystyrene Cost, Price and Margin.....	85
8.1	Styrene Butadiene Rubber Cost Competitiveness Summary	87
8.2	Styrene Butadiene Rubber Prices	87
8.3	Western Europe Styrene Butadiene Rubber Margins.....	89
8.4	Western Europe Styrene Butadiene Rubber Leader Cost Price and Margin.....	89
8.5	Acrylonitrile Butadiene Styrene Cost Competitiveness Summary	91
8.6	Acrylonitrile Butadiene Styrene Prices	91
8.7	Western Europe Acrylonitrile Butadiene Styrene Margins	93
8.8	Western Europe Acrylonitrile Butadiene Styrene Leader Cost Price and Margin.....	93
8.9	Butadiene Rubber Cost Competitiveness Summary.....	95
8.10	Butadiene Rubber Prices	95
8.11	Western Europe Butadiene Rubber Margins	97
8.12	Western Europe Butadiene Rubber Cost Price and Margin	97
9.1	Mono Ethylene Glycol Cost Competitiveness Summary.....	99
9.2	Mono Ethylene Glycol Prices	99

9.3	Western Europe Ethylene Oxide Variable Cost Margins	101
9.4	Western Europe Ethylene Oxide Cash Cost Margins	101
9.5	Western Europe Ethylene Oxide Cost Price and Margin	101
9.6	Western Europe Ethylene Glycol Variable Cost Margins.....	103
9.7	Western Europe Ethylene Glycol Cash Cost Margins	103
9.8	Western Ethylene Glycol Cost Price and Margin	103
9.9	<i>para</i> -Xylene Cost Competitiveness Summary	105
9.10	<i>para</i> -Xylene Prices	105
9.11	Western Europe <i>para</i> -Xylene Margins (Leader)	107
9.12	Western Europe <i>para</i> -Xylene Cost Price and Margin	107
9.13	Western Europe <i>para</i> -Xylene Cash Cost Margins	108
9.14	Western Europe <i>para</i> -Xylene Return on Investment	108
9.15	PTA Cost Competitiveness Summary.....	110
9.16	PTA Prices	110
9.17	Western Europe PTA Margins	112
9.18	Western Europe PTA Cost, Price and Margins.....	112
9.19	PET Cost Competitiveness Summary.....	114
9.20	PET Bottle Grade Prices	114
9.21	Western Europe PET Bottle Grade Margins	116
9.22	Western Europe PET Bottle Grade Leader Cost, Price and Margin	116
10.1	Acrylonitrile Cost Competitiveness Summary	118
10.2	Acrylonitrile Prices.....	118
10.3	Western Europe Acrylonitrile Margins.....	120
10.4	Western Europe Acrylonitrile Cost Price and Margin	120
10.5	Phenol Cost Competitiveness Summary.....	122
10.6	Phenol Prices	122
10.7	Western Europe Integrated Cumene/Phenol Margins	124
10.8	Western Europe Phenol Cost Price and Margin	124
10.9	Bisphenol A Cost Competitiveness Summary	126
10.10	Bisphenol A Prices	126
10.11	Western Europe Bisphenol A Margins	128
10.12	Western Europe Bisphenol A Leader Cost Price and Margin	128
10.13	Polycarbonate Cost Competitiveness Summary.....	129
10.14	Polycarbonate Prices	129
10.15	Western Europe Polycarbonate Variable Cost Margins.....	132
10.16	Western Europe Polycarbonate Cash Cost Margins	132

10.17 Western Europe Polycarbonate Interfacial Cost Price and Margin	133
10.18 Western Europe Polycarbonate Melt Phase Cost Price and Margin	133
10.19 Propylene Oxide Cost Competitiveness Summary	135
10.20 Propylene Oxide Prices	135
10.21 Western Europe Propylene Oxide Variable Cost Margins	138
10.22 Western Europe Propylene Oxide Cash Cost Margins	138
10.23 Western Europe Propylene Oxide Cost Price and Margin	139
10.24 Western Europe Propylene Oxide Cost Price and Margin	139
10.25 Oxo Alcohols Cost Competitiveness Summary	141
10.26 <i>n</i> -Butanol Prices	141
10.27 2EH Prices	142
10.28 Western Europe Butanol Margins	144
10.29 Western Europe Butanol Cost, Price and Margin	144
10.30 Western Europe 2-Ethylhexanol Margins.....	146
10.31 Western Europe 2-Ethylhexanol Cost, Price and Margin.....	146
11.1 Isocyanates Cost Competitiveness Summary	148
11.2 MDI Prices.....	149
11.3 TDI Prices.....	149
11.4 Western Europe MDI and Intermediates Costs	151
11.5 Western Europe MDI Margins	151
11.6 Western Europe TDI and Intermediates Costs	153
11.7 Western Europe TDI Margins.....	153
12.1 Methanol Cost Competitiveness Summary	155
12.2 Methanol Prices.....	155
12.3 Western Europe Methanol Margins.....	157
12.4 Western Europe Methanol Cost, Price and Margin.....	157
12.5 MTBE Cost Competitiveness Summary.....	158
12.6 MTBE Prices	159
12.7 Western Europe MTBE Margins	161
12.8 Western Europe MTBE Cost, Price and Margin	161

Table	Page
1.1 Western Europe Petrochemical Profitability Summary	3
2.1 Monthly Crude Oil Pricing	7
2.2 Singapore Refinery Costs, Revenue and Margins	10
2.3 United States Gulf Coast Refinery Costs, Revenue, and Margins	11
2.4 Western Europe Refinery Costs, Revenue and Margins	12
3.1 Western Europe Ethylene Leader Costs, Revenues and Margins Standard Naphtha Cracker with Butadiene and Benzene Extraction.....	17
3.2 Western Europe Ethylene Leader Costs, Revenues and Margins Basic Naphtha Cracker (Standard Severity)	18
3.3 Western Europe Ethylene Costs	21
3.4 Western Europe Propylene Costs, Revenue and Margins Propane Dehydrogenation	25
3.5 Western Europe Propylene Costs, Revenues and Margins Refinery Propylene Splitter	26
3.6 Western Europe Butadiene Costs, Revenues and Margins	31
4.1 Western Europe Low Density Polyethylene Leader Costs, Revenues and Margins	35
4.2 Western Europe Linear Low Density Polyethylene Leader Costs, Revenues and Margins.....	39
4.3 Western Europe High Density Polyethylene Leader Costs, Revenues and Margins	43
4.4 Western Europe Polypropylene Leader Costs, Revenues and Margins.....	47
5.1 Western Europe Chlor-Alkali Leader Costs	52
5.2 Western Europe Ethylene Dichloride Leader Costs, Revenues and Margins	54
5.3 Western Europe Vinyl Chloride Monomer Leader Costs, Revenues and Margins Contract Economics	56
5.4 Western Europe Polyvinyl Chloride Leader Costs, Revenues and Margins.....	60
6.1 Western Europe Reformer Leader Costs, Revenues and Margins	67
6.2 Western Europe Benzene Costs, Revenues and Margins Extraction from Pygas	69
6.3 Western Europe Benzene Costs, Revenues and Margins Toluene Hydrodealkylation.....	70
6.4 Western Europe Mixed Xylenes Costs, Revenues and Margins Toluene Disproportionation	72
6.5 Western Europe Mixed Xylenes Costs, Revenues and Margins Reformate Extraction	73
6.6 Western Europe Cyclohexane Leader Costs, Revenues and Margins.....	76
7.1 Western Europe Styrene Leader Costs, Revenues and Margins	80
7.2 Western Europe Polystyrene Leader Costs, Revenues and Margins.....	84
8.1 Western Europe Styrene Butadiene Rubber Costs, Revenues and Margins	88
8.2 Western Europe Acrylonitrile Butadiene Styrene Costs, Revenues and Margins	92
8.3 Western Europe Butadiene Rubber Costs, Revenues and Margins Typical Plants	96
9.1 Western Europe Ethylene Oxide Leader Costs, Revenues and Margins	100

9.2	Western Europe Ethylene Glycol Leader Costs, Revenues and Margins	102
9.3	Western Europe <i>para</i> -Xylene Leader Costs, Revenues and Margins	106
9.4	Western Europe PTA Costs, Revenues and Margins	111
9.5	Western Europe PET Bottle Grade Leader Costs, Revenues and Margins	115
10.1	Western Europe Acrylonitrile Leader Costs, Revenues and Margins	119
10.2	Western Europe Cumene/Phenol Leader Costs, Revenues and Margins.....	123
10.3	Western Europe Bisphenol A Costs, Revenues and Margins	127
10.4	Western Europe Polycarbonate Costs, Revenues and Margins Interfacial	130
10.5	Western Europe Polycarbonate Phosgene Costs, Revenues and Margins Melt Phase Non	131
10.6	Western Europe Propylene Oxide Costs, Revenues and Margins Hydrogen Peroxide (HPPO) Process	136
10.7	Western Europe Propylene Oxide Costs, Revenues and Margins Styrene (POSM) Process	137
10.8	Western Europe Butanol Costs, Revenues and Margins.....	143
10.9	Western Europe 2-Ethylhexanol Costs, Revenues and Margins	145
11.1	Western Europe MDI and Intermediates Costs, Revenues and Margins	150
11.2	Western Europe TDI and Intermediates Costs, Revenues and Margins	152
12.1	Western Europe Methanol Costs, Revenues and Margins	156
12.2	Western Europe MTBE Costs, Revenues and Margins.....	160