

MARKETS AND PROFITABILITY

Market Insights: Polylactic Acid - 2021

July 2021



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. 2021. All rights reserved.



Contents

1	Executive Summary	1
2	Introduction	7
2.1	Overview	7
2.2	Key End-Use Markets for Polylactic Acid.....	9
2.2.1	Packaging	9
2.2.2	Fibre.....	10
2.2.3	Medical	11
2.2.4	Electronics.....	11
2.2.5	Agricultural	12
2.2.6	Other	12
2.2.6.1	Automotive Applications.....	12
2.2.6.2	Others.....	15
3	Market Outlook	16
3.1	Global	16
3.1.1	Market Overview.....	16
3.1.2	Market Drivers	18
3.1.2.1	PLA as a Renewable Source.....	18
3.1.2.2	Properties	19
3.1.2.3	Certification	22
3.1.3	Market Constraints.....	22
3.1.3.1	Recycling Challenges.....	22
3.1.3.2	Properties	23
3.1.3.3	Legislative Measures.....	25
3.1.4	Competitive Landscape.....	26
3.1.5	Supply and Demand.....	27
3.1.6	Price Forecasts	29
3.2	Asia Pacific (excluding China).....	30
3.2.1	Market Overview.....	30
3.2.2	Market Drivers	31
3.2.2.1	Legislation	32
3.2.2.2	Certification	35
3.2.3	Market Constraints.....	36
3.2.3.1	Single-use Plastic Ban	36
3.2.3.2	Lack of Composting Infrastructure.....	36
3.2.3.3	Pricing	36
3.2.4	Competitive Landscape.....	37
3.2.5	Supply and Demand.....	38
3.3	China	40
3.3.1	Market Overview.....	40
3.3.2	Market Drivers	40
3.3.3	Market Constraints.....	41
3.3.3.1	Pricing	41



3.3.4	Competitive Landscape.....	42
3.3.5	Supply and Demand.....	44
3.4	North America.....	45
3.4.1	Market Overview.....	45
3.4.2	Market Drivers	45
3.4.2.1	Composting Infrastructure.....	46
3.4.2.2	Single-Use Plastic Bans	47
3.4.2.3	Corporate Sustainability Goals	49
3.4.2.4	USDA BioPreferred Program	50
3.4.2.5	Certification	51
3.4.3	Market Constraints.....	52
3.4.3.1	Plastic Bag Bans.....	52
3.4.3.2	Pricing	53
3.4.4	Competitive Landscape.....	53
3.4.5	Supply and Demand.....	54
3.5	South America.....	55
3.5.1	Market Overview.....	55
3.5.2	Market Drivers	56
3.5.3	Market Constraints.....	56
3.5.3.1	Pricing	57
3.5.4	Competitive Landscape.....	57
3.5.5	Supply and Demand.....	57
3.6	Western Europe.....	59
3.6.1	Market Overview.....	59
3.6.2	Market Drivers	60
3.6.2.1	Packaging, Waste, and Plastic Bags Legislative Initiatives.....	60
3.6.2.2	Tax Benefits.....	63
3.6.2.3	Composting	64
3.6.2.4	Certification	65
3.6.2.5	Corporate Sustainability Goals	65
3.6.3	Market Constraints.....	66
3.6.3.1	Pricing	67
3.6.4	Competitive Landscape.....	67
3.6.5	Supply and Demand.....	68
3.7	Central Europe.....	70
3.7.1	Market Overview.....	70
3.7.2	Market Drivers	70
3.7.3	Market Constraints.....	71
3.7.3.1	Pricing	71
3.7.4	Competitive Landscape.....	72
3.7.5	Supply and Demand.....	72
3.8	Eastern Europe.....	73
3.8.1	Market Overview.....	73



3.8.2	Market Drivers	73
3.8.3	Market Constraints.....	73
3.8.3.1	Pricing	74
3.8.4	Competitive Landscape.....	75
3.8.5	Supply and Demand.....	75
3.9	Middle East	76
3.9.1	Market Overview.....	76
3.9.2	Market Drivers	76
3.9.3	Market Constraints.....	77
3.9.3.1	Pricing	78
3.9.4	Competitive Landscape.....	78
3.9.5	Supply and Demand.....	78
3.10	Africa	80
3.10.1	Market Overview.....	80
3.10.2	Market Drivers	80
3.10.3	Market Constraints.....	81
3.10.3.1	Pricing	82
3.10.4	Competitive Landscape.....	82
3.10.5	Supply and Demand.....	83
4	Cost Competitiveness.....	84
4.1	Cost Structure and Assumptions	84
4.1.1	Variable Costs	85
4.1.1.1	Feedstock Costs	85
4.1.1.2	Utility Costs	86
4.1.2	Direct Fixed Costs.....	86
4.1.3	Allocated Fixed Costs.....	87
4.1.4	Plant Capacity.....	88
4.1.5	Other Considerations	88
4.2	Delivered Cost Assumptions	89
4.2.1	Freight Costs	89
4.2.2	Tariffs	89
4.3	Delivered Cost Competitiveness	91
5	Polylactic Acid Market Summary.....	92
Appendices		
A	Global Capacity Listing	94



Figures

Figure 1	PLA Applications in Automotive Parts ⁽¹⁾	13
Figure 2	World's First Bio Based Car ⁽¹⁾	14
Figure 3	3D Printed Lamborghini Aventador ⁽¹⁾	15
Figure 4	Global Polylactic Acid Demand by Region, 2020	16
Figure 5	Global PLA Demand by End Use, 2020	17
Figure 6	Greenhouse Gas Emissions Comparison for Plastics Production	19
Figure 7	Greenhouse Gas Emissions of Different Packaging Films	20
Figure 8	Disintegration Time PLA/PHA Blends	24
Figure 9	Studies of PLA Blends, 1996-2018 ⁽¹⁾	25
Figure 10	Global Polylactic Acid Capacity by Region.....	26
Figure 11	Capacity by Producer, 2020	26
Figure 12	Global Polylactic Acid Supply, Demand, and Trade.....	27
Figure 13	Global PLA Net Exports (Imports)	28
Figure 14	Global Polylactic Acid Pricing Forecast.....	29
Figure 15	Asia Pacific (excluding China) PLA Demand by End Use, 2020	31
Figure 16	Japanese Prices for PLA versus Selected Conventional Plastics	37
Figure 17	Asia Pacific (excluding China) PLA Supply, Demand, and Trade.....	39
Figure 18	China PLA Demand by End Use, 2020	40
Figure 19	Chinese Prices for PLA versus Selected Conventional Plastics	41
Figure 20	China PLA Supply, Demand, and Trade	44
Figure 21	North America PLA Demand by End Use, 2020	45
Figure 22	Municipal Solid Waste Management in the United States	46
Figure 23	Generation of Municipal Solid Waste in the United States.....	47
Figure 24	United States Prices for PLA versus Selected Conventional Plastics	53
Figure 25	North America PLA Supply, Demand, and Trade	54
Figure 26	South America PLA Demand by End Use, 2020.....	55
Figure 27	Prices for PLA versus Selected Conventional Plastics in Argentina and Brazil.....	57
Figure 28	South America PLA Supply, Demand, and Trade.....	57
Figure 29	Western Europe PLA Demand by End Use, 2020	59
Figure 30	Prices for PLA versus Selected Conventional Plastics in Netherland and Germany.....	67
Figure 31	Western Europe PLA Supply, Demand, and Trade	69
Figure 32	Central Europe PLA Demand by End Use, 2020	70
Figure 33	Prices for PLA versus Selected Conventional Plastics in Czech Republic and Poland	71
Figure 34	Central Europe PLA Supply, Demand, and Trade	72
Figure 35	Eastern Europe PLA Demand by End Use, 2020	73
Figure 36	Prices for PLA versus Selected Conventional Plastics in Kazakhstan and Russia	74
Figure 37	Eastern Europe PLA Supply, Demand, and Trade	75
Figure 38	Middle East PLA Demand by End Use, 2020	76
Figure 39	Prices for PLA versus Selected Conventional Plastics in Turkey	78
Figure 40	Middle East PLA Supply, Demand, and Trade.....	79
Figure 41	Africa PLA Demand by End Use, 2020	80



Figure 42	Prices for PLA versus Selected Conventional Plastics in Kazakhstan and Russia	82
Figure 43	Africa PLA Supply, Demand, and Trade	83
Figure 44	Components of Delivered Cost to Market	84
Figure 45	Polylactic Acid Delivered Cash Cost Competitiveness to China	91
Figure 46	Porter's Five Forces Analysis of PLA Business	92

Tables

Table 1	Key Physical and Thermodynamic Properties for Polylactic Acid Resin.....	2
Table 2	PLA Strengths and Weaknesses.....	3
Table 3	Properties of PLA and PET	5
Table 4	Properties of Polymers used in Automobiles	8
Table 5	Global PLA Demand by Region	13
Table 6	Comparison of Properties of PLA versus Conventional Plastics	23
Table 7	Global Polylactic Acid Supply, Demand, and Trade.....	27
Table 8	Government Tax Incentives Thailand.....	34
Table 9	Asia Pacific (excluding China) PLA Capacity	37
Table 10	Asia Pacific (excluding China) PLA Supply, Demand, and Trade.....	39
Table 11	China PLA Capacity	43
Table 12	China PLA Supply, Demand, and Trade	44
Table 13	Selected Packaging Products USDA Certified Biobased.....	51
Table 14	North America PLA Capacity	53
Table 15	North America PLA Supply, Demand, and Trade	54
Table 16	South America PLA Supply, Demand, and Trade	58
Table 17	West European Bio-Waste Collection	64
Table 18	Western Europe PLA Capacity	68
Table 19	Western Europe PLA Supply, Demand, and Trade	69
Table 20	Central Europe PLA Supply, Demand, and Trade	72
Table 21	Eastern Europe PLA Supply, Demand, and Trade	75
Table 22	Middle East PLA Supply, Demand, and Trade.....	79
Table 23	Africa PLA Supply, Demand, and Trade	83
Table 24	Feedstock Price Assumptions	85
Table 25	Utility Rates	86
Table 26	Wage Assumptions.....	86
Table 27	Capital Cost Location Factors	87
Table 28	Polylactic Acid Plants Modelled.....	88
Table 29	Freight Costs, Delivered to China (Shanghai).....	89
Table 30	Tariffs Due on Imports into China.....	90
Table 31	Global Polylactic Acid Capacity	94