



# Lithium Iron Phosphate Cathode Material Market Research Report

---

Date: January, 2024  
Author: Brendan Jephcott

Prepared by:

**GOLDEN** DRAGON CAPITAL

## Table of Contents

Executive Summary .....	2
1.0 Introduction .....	19
1.1 LFP Cathode Material Industry Development Trends .....	19
1.2 Lithium-Ion Battery Technology .....	21
1.3 Mainstream Cathode Materials .....	27
1.4 Cathode Positioning within the Industry Chain .....	29
2.0 Lithium Iron Phosphate Cathode Material .....	30
2.1 Structure of Phospho-Olivines .....	30
2.2 LFP Working Principal .....	30
2.3 LFP Product Performance .....	31
2.3.1 Advantages .....	31
2.3.2 Disadvantages .....	33
3.0 Lithium Iron Phosphate Cathode Material Processing Methods .....	35
3.1 Principal LFP Production Processes .....	35
3.1.1 Solid Phase Synthesis .....	37
3.1.2 Liquid Phase Synthesis .....	42
3.2 LFP Product Modification Methods .....	45
3.2.1 Nanoization .....	45
3.2.2 Carbon Coating .....	46
3.2.3 Doping .....	47
3.3 LFP Solid-phase Synthesis Method vs Liquid-phase Synthesis Method .....	48
3.4 LFP Upstream Raw Materials .....	48
3.4.1 Lithium Carbonate .....	49
3.4.2 Ferrous Oxalate .....	53
3.4.3 Ferric Phosphate .....	54
3.4.4 Iron Powder .....	58
3.4.5 Iron Oxide .....	58
3.4.6 Ferric Nitrate .....	59
3.4.6 Phosphoric Acid .....	60
3.4.7 Monoammonium Phosphate .....	64
3.5 LFP Final Product Specifications .....	65
4.0 Chinese Lithium Iron Phosphate Standards .....	75
4.1 Lithium Iron Phosphate .....	75
4.1.1 GB/T 30835-2014 Carbon composite lithium iron phosphate cathode material for lithium-ion batteries 75	
4.1.2 YS/T 1027-2015 Lithium iron phosphate .....	76

GOLDEN DRAGON CAPITAL LIMITED

Address: 9QRC, 9 Queen's Road Central, Central, Hong Kong, China  
 Telephone: +852 4647 0122  
 All correspondence to email: [bjepcott@goldendragoncapital.com](mailto:bjepcott@goldendragoncapital.com)  
 Website: [www.goldendragoncapital.com](http://www.goldendragoncapital.com)

# GOLDEN DRAGON CAPITAL

4.1.3	GB/T 33822-2017 Nano composite lithium iron phosphate.....	78
4.2	Lithium Iron Phosphate Upstream Raw Materials.....	80
4.2.1	GB/T 11075-2013 Lithium carbonate.....	80
4.2.2	YS/T 582-2013 Battery grade lithium carbonate.....	80
4.2.3	YS/T 546-2021 High purity lithium carbonate.....	81
4.2.4	YS/T 1552-2022 Crude lithium carbonate.....	82
4.2.5	GB/T 23853-2022 Lithium carbonate made of brine.....	83
4.2.6	HG/T 4701-2021 Iron phosphate for battery minerals.....	84
4.2.7	GB/T 2091-2008 Phosphoric acid for industry use.....	85
4.2.8	HG/T 4069-2022 Wet purified phosphoric acid for industry use.....	85
4.2.9	HG/T 5742-2020 Ammonium dihydrogen phosphate for battery materials.....	86
5.0	Commercialisation.....	87
5.1	LFP Intellectual Property Rights.....	87
5.2	New Energy Vehicles.....	88
5.3	Energy Storage Systems.....	97
6.0	Competitive Landscape.....	107
6.1	China LFP Cathode Material Production.....	107
6.2	Overseas LFP Cathode Material Production and Proposed Projects.....	112
6.2.1	Asia (excl China).....	112
6.2.2	North America.....	117
6.2.3	Europe.....	121
7.0	Market Pricing.....	124
7.1	LFP Cathode Material.....	124
8.0	Market Size Forecast.....	127
	References.....	130
	Appendix 1: Hunan Yuneng New Energy Battery Material Co., Ltd.....	136
1.0	Hunan Yuneng New Energy Battery Material Co., Ltd.....	137
1.1	Corporate Overview.....	137
1.2	LFP Cathode Material Business.....	137
1.3	Financials (1USD: 7CNY).....	147
1.4	Competitor Analysis (1USD: 7CNY).....	152
	Disclaimer.....	154

---

GOLDEN DRAGON CAPITAL LIMITED

Address: 9QRC, 9 Queen's Road Central, Central, Hong Kong, China  
Telephone: +852 4647 0122  
All correspondence to email: [bjephcott@goldendragoncapital.com](mailto:bjephcott@goldendragoncapital.com)  
Website: [www.goldendragoncapital.com](http://www.goldendragoncapital.com)

## Table of Figures

Figure 1: China Installed Capacity of Ternary Batteries and LFP Batteries (GWh).....	20
Figure 2: Changes in BYD LFP Battery System Energy Density (Wh/kg).....	20
Figure 3: LFP cathode material commercial applications.....	21
Figure 4: Parts of a Lithium-ion Battery.....	22
Figure 5: Discharging and Charging of a Lithium-ion Battery.....	23
Figure 6: Component materials and auxiliary materials used to manufacture cathode material.....	24
Figure 7: Schematics of inner structures of commercial Lithium-ion Batteries.....	25
Figure 8: Tesla Model 3 lithium iron phosphate prismatic battery pack (illustrative).....	26
Figure 9: Lithium-ion battery component material average cost composition.....	26
Figure 10: Electric vehicle average cost composition.....	27
Figure 11: Power system average cost composition.....	27
Figure 12: Radar chart of several cathode material types and their product indicators.....	29
Figure 13: LIB industry chain.....	29
Figure 14: LFP schematic of the crystal structure.....	30
Figure 15: Charging and Discharging of a LiFePO <sub>4</sub> Battery.....	31
Figure 16: Working principal of LFP cathode material.....	31
Figure 17: LFP voltage profile.....	32
Figure 18: LFP two-phase crystal structure.....	32
Figure 19: LFP cycle life.....	33
Figure 20: LFP Battery Pack Thermal Management Enables All-Climate Operation.....	34
Figure 21: Solid-phase synthesis and liquid-phase synthesis method types.....	35
Figure 22: Distribution of LFP cathode material production (by method).....	36
Figure 23: LFP cathode material (illustrative).....	36
Figure 24: Solid-phase synthesis method principal flowsheet.....	37
Figure 25: Solid-phase synthesis — carbothermal reduction method principal flowsheet.....	39
Figure 26: BTR — Solid-phase processing flowsheet for the production of LFP cathode material.....	39
Figure 27: Solid-phase synthesis — carbothermal reduction method using ferric oxide flowsheet.....	41
Figure 28: Liquid-phase synthesis — autothermal evaporating method used by Shenzhen Dynanonic.....	44
Figure 29: LFP product modification — Nanoization.....	46
Figure 30: LFP product modification — Carbon coating.....	46
Figure 31: LFP product modification — Capacity with carbon coating.....	47
Figure 32: LFP product modification — Electrochemical performance modified by mg doping.....	47
Figure 33: Process flowsheet for extracting lithium from spodumene by the sulfuric acid method.....	50
Figure 34: Process flowsheet for extracting lithium from lepidolite by sodium sulfate roasting method.....	51
Figure 35: Flowsheet for extracting lithium from brines.....	52
Figure 36: Ferric phosphate iron production flowsheet.....	54
Figure 37: Ferric phosphate sodium and ammonia production flowsheet.....	54
Figure 38: Processing flowsheet of producing iron phosphate by sodium method.....	55
Figure 39: Processing flowsheet of producing iron phosphate by ammonia method.....	55
Figure 40: Wanrun New Energy ferric phosphate processing flowsheet.....	57
Figure 41: Wanrun New Energy vertically integrated LFP cathode material processing flowsheet.....	57
Figure 42: Shenzhen Dynanonic — Ferric nitrate processing flowsheet.....	59
Figure 43: Phosphoric acid preparation methods.....	60
Figure 44: Process flowsheet for producing phosphoric acid by dihydrate method.....	61
Figure 45: Process flowsheet for producing purified phosphoric acid.....	63
Figure 46: Flowsheet for producing industrial grade monoammonium phosphate using wet phosphoric acid.....	65
Figure 47: Flowsheet for two-step production of industrial grade monoammonium phosphate.....	65
Figure 48: China EV-Type LIB Installed Capacity.....	89
Figure 49: Energy density of LFP Qilin batteries made from CATL and used by Tesla Models 3 and Y.....	90
Figure 50: CATL Qilin battery (illustrative).....	90

GOLDEN DRAGON CAPITAL LIMITED

Address: 9QRC, 9 Queen's Road Central, Central, Hong Kong, China  
 Telephone: +852 4647 0122  
 All correspondence to email: [bjephcott@goldendragoncapital.com](mailto:bjephcott@goldendragoncapital.com)  
 Website: [www.goldendragoncapital.com](http://www.goldendragoncapital.com)

# GOLDEN DRAGON CAPITAL

Figure 51: Tesla Model 3 and Model Y .....	91
Figure 52: Energy density of LFP blade battery made by BYD and used by BYD Models Han and Tang .....	91
Figure 53: BYD Blade battery (illustrative) .....	92
Figure 54: BYD Han EV and Tang EV .....	92
Figure 55: LFP batteries installed capacity (2022) .....	93
Figure 56: BYD Qin Plus EV model using an LFP battery has 400km~600km mileage per charge .....	94
Figure 57: China installed capacity of LFP batteries used in buses (Jan-2021 to Jul 2022) .....	95
Figure 58: China installed capacity of LFP batteries used in special cars (Jan-2021 to Jul 2022) .....	96
Figure 59: China installed capacity of LFP batteries used in passenger cars (Jan-2021 to Jul 2022).....	96
Figure 60: Installed capacity and proportion of LFP batteries and ternary batteries (Jan-2020 to Jul 2022).....	97
Figure 61: Energy storage product market share (2021).....	99
Figure 62: Electrochemical energy storage market share (2021).....	99
Figure 63: Global electrochemical energy storage installed capacity .....	100
Figure 64: LFP batteries applied in energy storage industry .....	100
Figure 65: Proportion of installed capacity of electrochemical energy storage by battery type .....	101
Figure 66: One-time input cost of mainstream energy storage battery types (CNY per kWh) .....	103
Figure 67: Full-cycle cost of mainstream energy storage battery types (CNY per kWh) .....	103
Figure 68: Cycle life mainstream energy storage battery types .....	104
Figure 69: 5G base station in China.....	105
Figure 70: 5G base station construction forecast (2019 to 2025E) .....	105
Figure 71: Global energy storage battery shipment forecast (2019 to 2025E) .....	106
Figure 72: China energy storage battery shipment forecast (2019 to 2025E) .....	106
Figure 73: China LFP cathode material production (2017 to 2022 Jan-May).....	108
Figure 74: Market share of LFP cathode material producers in China in 2021 .....	109
Figure 75: China LFP cathode material market consumption in 2021 .....	109
Figure 76: Avenira LFP plant schematic flow sheet .....	115
Figure 77: 6K UniMelt® microwave plasma production system .....	118
Figure 78: Nano One One-pot synthesis for lithium-ion battery cathode material precursors .....	119
Figure 79: Standard Cathode Material Process vs Nano One Cathode Material Process .....	121
Figure 80: IBU-tec LFP cathode material production plans.....	121
Figure 81: IBU-tec LFP cathode material production process.....	122
Figure 82: IBU-tec IDO indirectly heated rotary kiln .....	122
Figure 83: Lithium iron phosphate cathode material price May 2019 to June 2023 .....	126
Figure 84: Lithium carbonate price trend Jan 2021 to Jul 2023 .....	126
Figure 85: Comparison of price between lithium carbonate and lithium iron phosphate Jan 2020 to April 2023.....	127
Figure 86: Global Demand for Lithium Iron Phosphate cathode 2021 to 2025E .....	128

---

GOLDEN DRAGON CAPITAL LIMITED

Address: 9QRC, 9 Queen's Road Central, Central, Hong Kong, China  
Telephone: +852 4647 0122  
All correspondence to email: [bjepcott@goldendragoncapital.com](mailto:bjepcott@goldendragoncapital.com)  
Website: [www.goldendragoncapital.com](http://www.goldendragoncapital.com)



## List of Tables

Table 1: Changes in China's EV Subsidy Standards (2015 to 2022) .....	19
Table 2: Comparison of mainstream cathode materials used in high-performance LIB .....	28
Table 3: Comparison of the solid-phase synthesis and liquid-phase synthesis method types .....	48
Table 4: LFP Cathode Material Processing Methods & Raw Material Requirements.....	49
Table 5: Hubei Wanrun New Energy Technology Co., Ltd Battery grade iron oxalate product specifications.....	53
Table 6: Comparison of mainstream ferric phosphate principal production methods .....	56
Table 7: Wanrun New Energy iron phosphate product series .....	57
Table 8: Hubei Wanrun New Energy Technology Co., Ltd Battery grade iron oxide product specifications.....	59
Table 9: Shenzhen Dynanonic — Ferric Nitrate Production Process .....	60
Table 10: Comparison of Phosphoric Acid Preparation by Thermal and Wet processes .....	62
Table 11: Types and Characteristics of Wet Phosphoric Acid Purification Processes .....	63
Table 12: Phosphoric acid product grades and applications .....	64
Table 13: Comparison of LFP cathode material products .....	66
Table 14: Hunan Yuneng New Energy Battery Material Co., Ltd — LFP cathode material products .....	67
Table 15: Shenzhen Dynanonic — Nano lithium phosphate products .....	68
Table 16: Wanrun New Energy — LFP cathode material product series and performance .....	71
Table 17: Chongqing Terui Battery Materials Co., Ltd - TR200 Type LFP main product indicators .....	72
Table 18: Chongqing Terui Battery Materials Co., Ltd - TR100 Type LFP main product indicators .....	73
Table 19: Chongqing Terui Battery Materials Co., Ltd - TR300-1 Type LFP main product indicators .....	74
Table 20: Lithium iron phosphate-carbon composite cathode materials for lithium-ion battery (GB/T30835-2014) .....	76
Table 21: Lithium iron phosphate standard (YS/T 10127-2015).....	77
Table 22: Nano Lithium Iron Phosphate Standard (GB/T 33822-2017).....	78
Table 23: Lithium Carbonate Standard (GB/T 11075-2013).....	80
Table 24: Battery Grade Lithium Carbonate Standard (YS/T 582-2013).....	81
Table 25: High Purity Lithium Carbonate Standard (YS/T 546-2021).....	82
Table 26: Crude Lithium Carbonate Standard (YS/T 1552-2022) .....	82
Table 27: Lithium Carbonate made of Brine Standard (GB/T 23853-2022) .....	83
Table 28: Battery-grade Iron Phosphate Standard (HG/T 4701—2021) .....	84
Table 29: Industrial Phosphoric Acid produced by Thermal Method (GB/T 2091-2008) .....	85
Table 30: Wet purification of Phosphoric Acid produced by solvent extraction (HG/T 4069-2022) .....	86
Table 31: Ammonium dihydrogen phosphate for battery minerals (HG/T 5742—2020).....	87
Table 32: Mainstream auto companies using LFP batteries in new energy vehicles .....	93
Table 33: Comparison of mainstream auto company new energy vehicles models using LFP batteries .....	94
Table 34: Comparison of mainstream energy storage methods.....	98
Table 35: Comparison of sodium-ion battery vs. lithium-ion battery energy storage technical indicators.....	102
Table 36: Production capacity of lithium iron phosphate by Company in China as of August 2021 .....	107
Table 37: Production, sales, and market share of major Chinese LFP cathode material producers in 2021 .....	108
Table 38: Major LFP cathode material producers and their customer relationships.....	110
Table 39: Cooperation between battery factories and LFP cathode enterprises.....	111
Table 40: Ternary cathode material companies plans to enter the LFP cathode material supply chain.....	111
Table 41: Titanium dioxide companies plans to enter the LFP cathode material supply chain .....	112
Table 42: Phosphate chemical companies plans to enter the LFP cathode material supply chain .....	112
Table 43: Avenir LFP plant raw material consumption and utility rates .....	115
Table 44: Summary of the LFP Scoping Study key financial outcomes .....	116
Table 45: Assumed raw material costs .....	116
Table 46: IBUvolt®, LFP cathode material chemical and physical properties .....	123
Table 47: Calculation of Global Demand for Lithium Iron Phosphate cathode .....	128
Table 48: Calculation of Supply and Demand of Lithium Iron Phosphate Industry.....	128