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Adsorptive separation helps achieve carbon neutrality

Sunresin New Materials (300487.SZ) In-depth Tracking Report | 28 Jan 2022

CITICS Research

WANG Zhe
Chief Energy & Chemical Analyst
S1010513110001

Core views

Sunresin is a leader in China's adsorptive separation industry that integrates R&D and services. With carbon neutrality efforts gaining momentum, domestic and overseas NEV markets rapidly expanding, electronic and nuclear grade resins finding increasing applications, and carbon capture, utilization and storage (CCUS) technology continuing to spread, the Company has entered a phase of rapid growth across segments. We are bullish on the Company's continued rapid earnings growth. We maintain our 2021E-23E earnings forecasts of Rmb323mn/ Rmb448mn/Rmb575mn and EPS forecasts of Rmb1.47/2.04/2.62 and reiterate the 2022E target price of Rmb120 (implying 60x 2022E PE) and the "BUY" rating.

Sunresin is a leading integrated adsorptive separation solution provider with booming application scenarios amid the carbon neutrality drive

Sunresin is a leading integrated adsorptive separation solution provider in China, driven by technology and services. The Company's adsorptive separation resins play an important role in the entire process of moving towards carbon peaking and neutrality, including energy transition on the energy supply side, separation and purification in the intermediate process, energy conservation, carbon footprint reduction, and capture of CO_2 and organic waste gas. As the world steadily moves towards carbon neutrality, the Company is expected to see its market share rise rapidly by leveraging its world-leading R&D and services.

Adsorptive separation facilitates energy transition with accelerated penetration in a potential Rmb10bn market

The domestic energy transition continues. 1) In the new energy sector, we expect that domestic lithium carbonate demand will reach nearly 600kt by 2025, representing a lithium brine extraction production line investment market of more than Rmb10bn. With its adsorptive separation resin products having been applied in multiple mature energy metal extraction production lines, the Company is expected to benefit from the lithium extraction capacity expansion in the domestic market. 2) In the nuclear power sector, the Company is one of the few domestic companies capable of producing uniform particle size resins and, with a product uniformity coefficient of 1.05-1.1, is close to world leaders in the industry. In view of the strong nuclear power growth in China, we expect the domestic nuclear grade adsorbent resin market to reach nearly Rmb2bn by 2030. The Company has carried out collaborative research with several nuclear power companies on related subjects and is expected to gain an increasing market share in the existing and incremental import substitution market.

Adsorptive separation helps reduce carbon footprint

The carbon footprint of bio-based degradable plastics is less than 1/3 of that of petroleum-based plastics. China is vigorously promoting the use of bio-based degradable plastics, of which polylactic acid (PLA) is the most mature in terms

Sunresin New Materials	**300487**
Rating	**BUY (Reiterate)**
Current price	Rmb96.19
Target price	Rmb120.00
Total equity	220mn
Shares o/s	128mn
Market cap	Rmb21.1bn
3M ADV	Rmb333mn
52W high/low	Rmb110.0/38.0
1M absolute gain	12.02%
6M absolute gain	16.27%
LTM absolute gain	114.64%

of technology development. We expect that by 2030, the domestic demand for PLA will reach 3.4mt, representing a lactic acid purification resin market of at least Rmb1.6bn. The Company has established excellent cooperation with leading domestic PLA producers such as Jindan Lactic Acid Technology and BBCA Biochemical and is strongly positioned to capitalize on incremental demand in the market. The Company is also expected to take up a sizable market share in the BDO purification market (BDO is an upstream material PBAT, another promising biodegradable plastic). In addition, the Company's products are increasingly substituting imported counterparts in the life science segment by delivering environmental friendliness and cost reduction at once.

CCUS technology has vast potential with "adsorptive separation" set to benefit from carbon trading

CCUS technology is the most important means to reduce carbon dioxide emissions. According to a forecast of the Department of Science and Technology for Social Development, Ministry of Science and Technology, China's CCUS market will reach an annual value of more than Rmb330bn by 2025, pointing to the huge potential of CCUS technology. Sunresin's proprietary Seplite-CT polymeric adsorbent product with a macroreticular pore structure has been exported to Europe and other markets. With the continued promotion and expansion of CCUS applications in China, we expect the Company to play an important role in carbon capture and help China to have a bigger say in the global carbon trading system.

Potential risks

1) Significant price volatility of raw materials; 2) intensified industry competition; 3) progress in various business segments missing expectations.

Investment strategy

With carbon neutrality efforts steadily gaining momentum, domestic and overseas NEV markets rapidly expanding, electronic and nuclear grade resins finding increasing applications, and CCUS technology continuing to spread, the Company has entered a phase of rapid growth across segments. We are bullish on the Company's continued rapid earnings growth. We maintain our 2021E-23E earnings forecasts of Rmb323mn/Rmb448mn/Rmb575mn and EPS forecasts of Rmb1.47/2.04/2.62 and reiterate the 2022E target price of Rmb120 (implying 60x 2022E PE with reference to historical valuations of comparable companies) and the "BUY" rating.

Item/Year	2019	2020	2021E	2022E	2023E
Operating revenue (Rmb mn)	1,012	923	1,211	1,539	1,958
Operating revenue (YoY,%)	60.1%	-8.8%	31.2%	27.1%	27.3%
Net profit (Rmb mn)	251	202	323	448	575
Net profit (YoY,%)	75.4%	-19.6%	59.8%	38.8%	28.4%
EPS (Rmb, Basic)	1.14	0.92	1.47	2.04	2.62
Gross margin	49.8%	46.6%	47.4%	48.3%	48.8%
ROE (%)	19.9%	12.2%	15.1%	17.8%	19.2%
BVPS (Rmb)	5.74	7.51	9.73	11.46	13.65
PE (x)	84.4	104.6	65.4	47.2	36.7
PB (x)	16.8	12.8	9.9	8.4	7.0
PS (x)	20.9	22.9	17.5	13.7	10.8
EV/EBITDA (x)	65.9	60.3	49.6	37.3	29.7

Source: Wind, CITICS Research forecast Note: Closing price as of 27 Jan 2022

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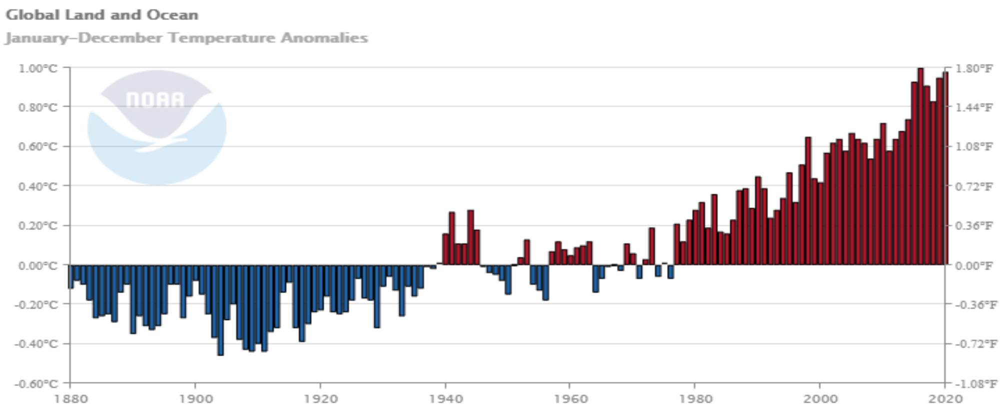
Adsorptive separation is a promising technology for global carbon neutrality

Carbon neutrality is an important goal for the world in the 21st century

The widespread use of fossil fuels contributes to global warming. Although electricity and oil, as the "new energy" during the second industrial revolution, have brought about a global leap in productivity since the mid-nineteenth century, the accumulation of carbon dioxide in the atmosphere from the burning of fossil fuels has also contributed to a gradual increase in global temperatures. According to the US National Oceanic and Atmospheric Administration (NOAA), the global average temperature has increased by 1°C since 1880, which has triggered a variety of climate anomalies such as the melting of the North and South polar ice caps, local climate change, and frequent extreme weather events. If humans do not limit their carbon emissions, it is expected that the global average temperature will continue to rise by 3°C by 2050, which will cause a significant rise in sea level and have a huge negative impact on the human world.

Fig. 1: Global average temperature, 1880-2020



Source: NOAA

Achieving "carbon neutrality" is critical for addressing global warming. In 1992, the *United Nations Framework Convention on Climate Change* (UNFCCC) was signed, kicking off a concerted global effort to address global warming. Following the signing in 1997 of the *Kyoto Protocol* that set the conservative goal of slowing temperature rise by 0.02-0.28℃ by 2050, the Paris Agreement was signed by 178 countries in 2015 that commits countries to limit the global average temperature rise to well below 2℃ above pre-industrial levels。 On 1 Nov 2021, the 26th session of the Conference of the Parties (COP26) to the UNFCCC reached a global climate deal aimed at achieving net zero emissions and limiting global warming to 1.5°C by 2050.

China is committed to achieving domestic "carbon neutrality" by 2060. Since the 18th CPC National Congress, the concept of green development has consistently guided China's top-down policy designs. At the 75th Session of the United Nations General Assembly, President Xi Jinping announced that China would strive to peak CO_2 emissions before 2030 and achieve carbon neutrality before 2060. The carbon peaking and neutrality goals will give a strong impetus to the energy transition and zero carbon emission technology development in China.

Adsorptive separation is expected to become an important means to advance carbon neutrality

Achieving "carbon neutrality" depends on: 1) energy transition from fossil energy to clean energy; **2) energy conservation** to reduce the carbon footprint of human activity; **3) the development of carbon sequestration technology** to help achieve “net zero emissions," which will give China an edge in the upcoming carbon trading market.

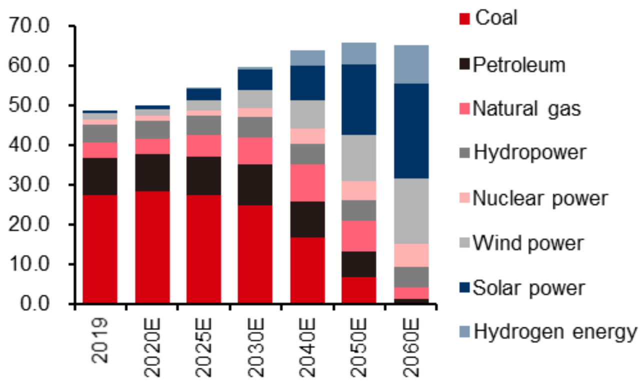
Adsorptive separation technology plays an important role in all of the above scenarios. From the energy supply side, adsorptive separation technology can be used to extract and recover energy metals and produce nuclear grade ultrapure water, which can help promote clean energy rapidly; in terms of the intermediate stage, adsorptive separation technology is expected to help the production of bio-based degradable plastics such as PLA and reduce the carbon footprint of petroleum-based degradable plastics; in the development and research of pollutant treatment and resource recovery, the organic wastewater from petrochemical, dye, pharmaceutical, electronic and metal industries can be used to reduce the carbon footprint of petroleum-based degradable plastics; in the development and research of pollutant treatment and resource utilization, adsorptive separation technology can be used to control the emission of toxic pollutants such as organic wastewater, wastewater polluted by heavy metals, and waste batteries generated by petrochemical, dye, pharmaceutical, electronic, metal and other industries and at the same time to achieve the enrichment, recovery and comprehensive utilization of resources, thus delivering both economic and social benefits. Adsorbent resins can also be used to capture carbon dioxide in exhaust gas and even in the atmosphere, helping to achieve “net zero emissions.” As a leading adsorptive separation solution provider in China, Sunresin will play an important role in moving towards carbon neutrality.

Adsorbent resins help drive energy transition

Mature “adsorption + membrane” separation processes provide a viable lithium extraction solution

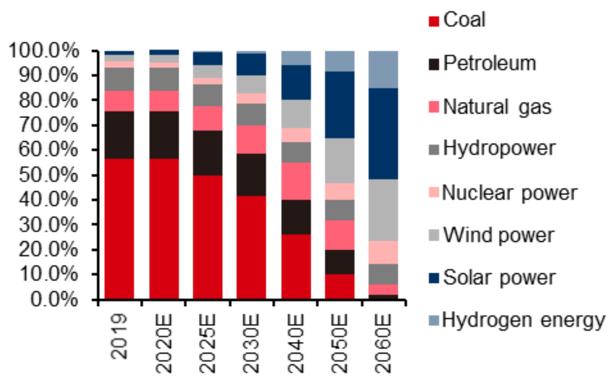
Clean energy is expected to replace fossil energy as the primary energy source in China by 2060. In 2020, fossil energy accounted for 83.6% of total energy consumption in China, and non-fossil energy accounted for 16.4%. Coal, oil and natural gas accounted for 56.7%, 18.9% and 8.0% of total energy consumption, respectively, with a combined fossil energy share of 83.6%. Hydropower, wind power, nuclear power and PV solar power accounted for 9.1%, 3.1%, 2.4% and 1.7%, respectively, with a combined non-fossil energy share of 16.4%. We predict that in the carbon neutral scenario by 2060, clean energy will account for more than 90% of China's energy structure, with PV solar, wind, hydrogen and nuclear power expected to account for 36.5%, 25%, 15.2% and 9%, respectively, and become the primary energy source in China and that green energy storage will also have achieved significant development by then.

Fig. 2: China's energy consumption forecast (100mn tce)



Source: National Bureau of Statistics, CITICS Research forecast

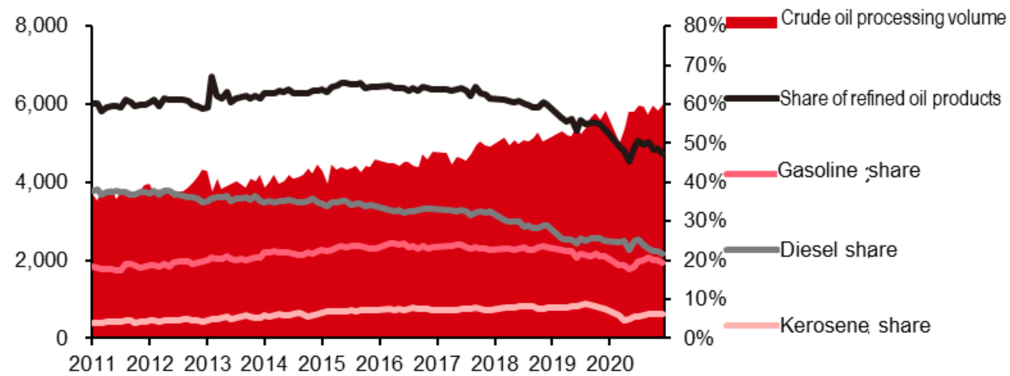
Fig. 3: China's energy consumption structure forecast (%)



Source: National Bureau of Statistics, CITICS Research forecast

Refined products still dominate petroleum energy consumption. At present, gasoline and diesel, which has an increased share in refined oil products, take up an overwhelming majority of refined oil product consumption in China. In other words, transportation sector use accounts for more than 90% of petroleum consumption which currently accounts for 18.9% of China's total energy consumption. If this portion of carbon-emitting energy consumption could be replaced with renewable energy, it would reduce China's carbon emissions by more than 15%, which would be of great significance for achieving carbon peaking by 2030.

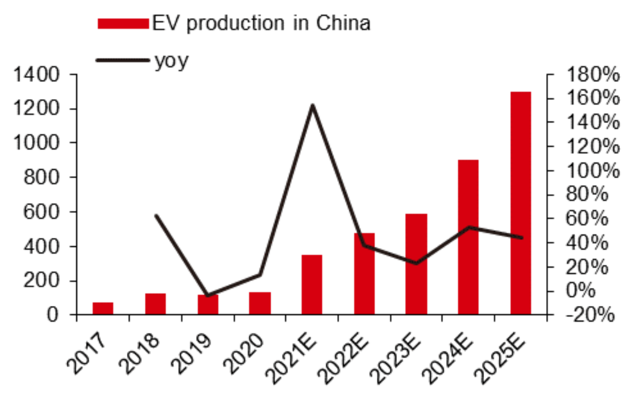
Fig. 4: China's monthly crude oil processing volume and breakdown (10,000 t)



Source: NOAA, CITICS Research

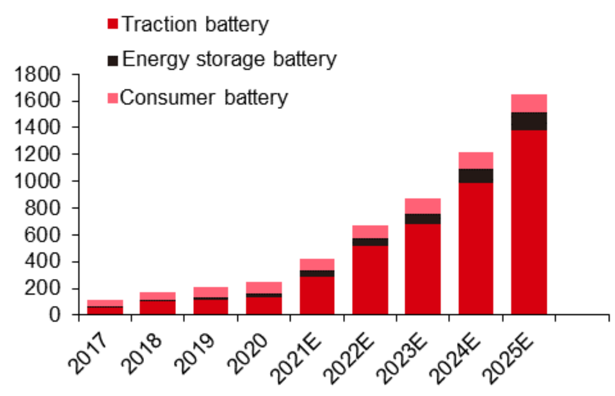
Driven by policy, new energy increasingly replaces petrochemical energy. All countries are stepping up efforts on NEVs. In its *New Energy Vehicle Industry Development Plan (2021-2035)*, China aims to increase its NEV penetration rate to 20% in 2025 and 40% in 2030, compared to 20% and 30% for the EU and 50% by 2030 for the US. According to CITICS Research NEV Team's forecast, domestic NEV production will reach 3.48mn units in 2021 and 13mn units in 2025 and domestic traction battery and energy storage battery installed capacity will reach 775GWh and 65 GWh respectively by 2025, or 12.3 and 5.0 times of their respective levels in 2020. Global traction battery, energy storage battery and 3C battery installed capacity is expected to reach 1,380, 132 and 137 GWh, respectively, or 10.1, 4.7 and 1.6 times their respective levels in 2020. The world has entered a period of rapid explosion in demand for lithium batteries.

Fig. 5: Domestic NEV production (10k vehicles)



Source: CAAM, CITICS Research forecast

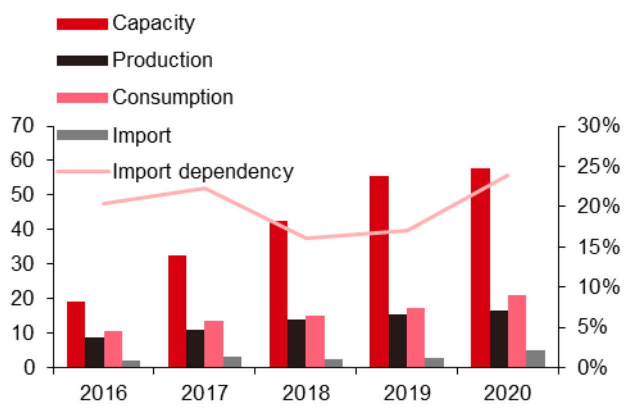
Fig. 6: Global lithium battery installed capacity forecast (GWh)



Source: CAAM, GG-LB.com, CITICS Research forecast

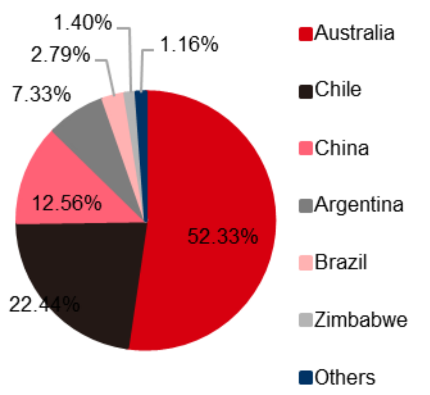
China's lithium supply for traction batteries still relies on imports. Both ternary batteries and lithium iron phosphate batteries have lithium carbonate as a core raw material. According to chem99.com, China produced 167,000t of lithium carbonate and consumed 210,000t, with 24% relying on imports. According to statistics from SMM, due to factors such as technology and resource status, lithium carbonate extracted from ores accounted for 78.6% of China's total lithium carbonate production in 2019. According to statistics from USGS, China's lithium production capacity accounted for only 12.56% of the world. Due to insufficient lithium production from ores and brines, China's lithium self-sufficiency rate has long stayed below 30%.

Fig. 7: Domestic lithium carbonate supply and demand, 2016-2020 (10kt)



Source: chem99.com, CITICS Research

Fig. 8: Distribution of lithium production worldwide, 2019 (%)



Source: USGS, CITICS Research

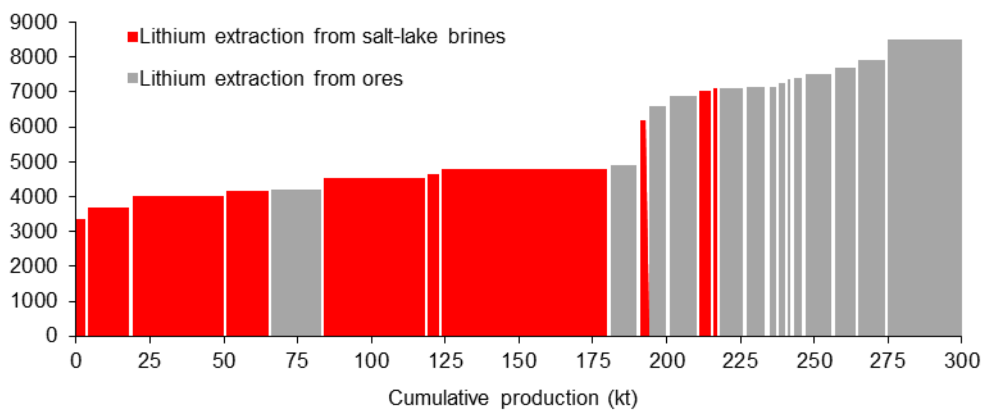
Lithium extraction from brines is an important direction of lithium production. According to USGS, global lithium resources are mainly concentrated in salt lake brines, accounting for 68%, and more than 50% of lithium resources are concentrated in South America, where the vast majority are concentrated in salt lakes. Although the lithium content in lithium-containing minerals is higher compared to brines, lithium production from the former requires energy-intensive and high-pollution processes such as calcination and acid leaching and is much more expensive and carbon-intensive higher than lithium production from brines. According to Roskill's cost analysis, the global cost of lithium extraction from salt lake brines in 2019 was Rmb20,000-40,000/t, and the cost was even below Rmb20,000/t for richly endowed salt lakes, while the cost of lithium extraction from all kinds of lithium-containing ores is generally above Rmb40,000/t.

Table 1: Comparison of environmental friendliness of lithium extraction from brines and ores

	Lithium extraction from brines	**Lithium extraction from ores**
Production of lithium carbonate	CO_2 emissions: 2.7-3.1t CO_2/t Energy consumption: 30,000-36,000 MJ/t Water consumption: 15.5-32.8 m^3/t	CO_2 emissions: 20.4t CO_2/t Energy consumption: 218,000 MJ/t Water consumption: 77 m3/t
Production of lithium hydroxide	CO_2 emissions: 6.9-7.3t CO_2/t Energy consumption: 76,600-82,900 MJ/t Water consumption: 31-50 m^3/t	CO_2 emissions: 15.7t CO_2/t Energy consumption: 187,200 MJ/t Water consumption: 69 m^3/t

Source: *Resources, Conservation & Recycling* (Ming Xu), CITICS Research

Fig. 9: Cost curve of global lithium compounds (US$/t, LCE)



Source: Roskill, CITICS Research

China's lithium resources are concentrated in low-grade salt lake brines, making extraction more difficult. According to the China Geological Survey, lithium resources in China occur in three forms, including salt-lake brine, spodumene and lepidolite, with salt-lake brine accounting for 81.6%. Qinghai, Tibet and Sichuan are the top three lithium-producing regions in China, with reserves accounting for 43.4%, 31.1% and 10.6%, respectively. However, compared with overseas (where magnesium-lithium ratio is generally below 20), domestic salt lakes are less rich in lithium with magnesium-lithium ratio of more than 40, and the ratio in Chaerhan Salt Lake is as high as 1577.4, making lithium extraction in China much more difficult.

Table 2: Magnesium and lithium content of major global lithium brine deposits

Deposit	Country	Li (%)	Mg (%)	Mg/Li
Uyuni	Bolivia	0.032	0.65	20.3
Atacama	Chile	0.157	0.97	6.4
Dong Taijinaier	China	0.085	2.99	35.2
Xi Taijinaier	China	0.022	1.99	90.5
Chaerhan	China	0.0031	4.89	157.7
Yiliping	China	0.021	1.28	60.9
Zabuye	China	0.08	0.002	0.025
Silver Peak	US	0.016	0.019	1.2

Deposit	Country	Li (%)	Mg (%)	Mg/Li
Hombre Muerto	Argentina	0.076	0.12	1.6
Tincon	Argentina	0.037	0.37	10
Olaroz	Argentina	0.066	0.19	2.9
Cauchari	Argentina	0.051	0.15	2.9
Mariana	Argentina	0.026	0.359	14.1
Sal de Vida	Argentina	0.063	0.14	2.2

Source: "Global lithium resources and outlook" (Yang Huipeng, Liu Lin, Ding Guofeng), CITICS Research

The "adsorption + membrane" approach is a viable method to extract lithium from salt-lake brines in China. After years of development, four mainstream processes have been developed for lithium extraction from salt lake brines, including adsorption, precipitation, membrane and extraction. Among the four processes, the precipitation process is not suitable because salt lakes in China have high magnesium-lithium ratios; the membrane process is not mature enough and is generally used in conjunction with other techniques; and the extraction process has high requirements on equipment and is environmentally unfriendly, with the step of environmental treatment further increasing cost and making industrial production inviable. In contrast, the adsorption process is relatively simple. Consisting of two simple steps of adsorption and desorption and allowing the flexible design of adsorbents to efficiently extract lithium from brines in different states and with different components, it delivers economic effectiveness, environmental friendliness and industrial production at once.

Table 3: Comparison of main processes of lithium extraction from brines

	Adsorption method	Precipitation method	Membrane method	Extraction method
Description	This method uses aluminum salt or manganese oxide as sorbent to selectively adsorb lithium in brine and then elutes with specific reagents	This method adds alkali and oxalic acid to the brine to precipitate magnesium, calcium and other interfering ions and then precipitates out the lithium ions	This method uses a nanofiltration membrane or electrodialysis for specific ions to pass through the membrane system to achieve enrichment or separation	This method enriches lithium in a solvent by using the difference in its solubility or partition coefficient between two solvents that are insoluble (or slightly soluble) in each other
Advantages	Simple process and no pollution to the environment, more suitable for lithium recovery from brine with a high Mg/Li ratio	Simple process and low cost	Electrodialysis can be directly applied to high Mg/Li brines with low energy consumption	Direct application to high Mg/Li brines with low energy consumption
Disadvantages	Aluminum or manganese loss	Not suitable for high Mg/Li brines, which require substantially increased precipitant use	High membrane system cost and membrane contamination	High corrosiveness of extraction system, high requirements for equipment (even requiring ceramics) and environmental unfriendliness, making it difficult for large-scale industrial production
Enterprises	Lake Lithium, Zangge Lithium,	SQM, ALB, Orocobre, etc.	Minmetals Salt Lake, Qinghai Lithium,	Xinghua Lithium, Jintai Lithium

	Adsorption method	Precipitation method	Membrane method	Extraction method
	Jintai Lithium, etc.		HXR Lithium, etc.	
Salt lakes	Chaerhan Salt Lake	Atacama Salt Lake, Olaroz Salt Lake, etc.	Dong Taijinaier, Xi Taijinaier, Yiliping	Da Qaidam Salt Lake, Balun Mahai Lake

Source: "Research and development of lithium brine extraction technology" (LIU Dongfan, SUN Shuying, YU Jianguo), CITICS Research

Lithium brine extraction represents a market of over Rmb10bn in China. We estimate the size of the domestic market of lithium extraction from salt-lake brine from two dimensions:

1) Demand side: Domestic lithium carbonate demand is expected to reach 600kt by 2025, with production line investment expected to reach Rmb10bn. Taking into account the rapid development of the NEV industry and the domestic distribution of lithium resources, it is expected that by 2025, the lithium carbonate required for NEVs and energy storage alone will reach nearly 600kt. Assuming that at least 20% of the domestic lithium demand is met by domestic adsorption-based lithium brine extraction, at the current price, each 10ktpa of capacity will require c. Rmb1bn in lithium extraction equipment investment (including adsorption and membrane separation), of which the adsorption part will account for c. 50-60%, i.e., the total whole production line investment will reach Rmb10bn, including Rmb5-6bn in adsorption equipment investment. Anticipating the cost reduction brought by process innovation and assuming that the central tendency of a whole production line investment is Rmb500mn, the whole production line investment market is expected to reach Rmb5bn, including Rmb2.5bn-Rmb3bn for the adsorption part.

Table 4: Lithium carbonate demand growth from traction and energy storage battery in China

Item	Unit consumption	2018	2019	2020	2021E	2022E	2023E	2024E	2025E
Total production of NEVs		125	121	137	348	480	590	900	1,300
Battery capacity per NEV (kW)		45	50	42	45	57	58	59	60
Total traction battery demand (GWh)		57	62	63	157	274	342	531	775
Energy storage battery demand (GWh)		3	9	13	19	26	36	49	65
Total energy storage + traction battery demand (GWh)		59.56	70.94	75.54	175.46	299.56	378.27	579.62	839.98
Total lithium carbonate demand (t)	0.07	4.17	4.97	5.29	12.28	20.97	26.48	40.57	58.80
Incremental lithium carbonate demand (t)		1.73	0.80	0.32	6.99	8.69	5.51	14.09	18.22
Incremental lithium extraction installation market (Rmb100mn)	-	-	-	-	13.99	17.37	11.02	28.19	36.45

Source: Wind, chem99.com, baiinfo.com, CITICS Research forecast

2) Supply side: According to CITICS Research Metal Team's report, *China's salt lake lithium extraction: The inflection point has appeared* (28 Jun 2021), major domestic lithium brine extraction companies have nearly 250ktpa of completed capacity and capacity under construction, which will reach 30ktpa if long-term planned capacity is included. With the 130ktpa of completed capacity excluded, there will be an additional nearly 200ktpa capacity coming over the long term. Assuming a central tendency of a whole production line investment of Rmb500mn, the domestic lithium brine extraction market size is Rmb10bn.

Table 5: Major lithium brine extraction projects in China

Enterprise	Completed capacity/t	Planned capacity/t	Total long-term capacity/t
Qinghai Salt Lake Potash	3	2	10
Zangge Lithium	1	1	2
Minmetals Salt Lake	1	1	2
CITIC Guoan Lithium	1	2	3
Qinghai Lithium	1	-	1
Qinghai Lithium Resources	1	1	2
HXR Lithium	2	0	2
Jintai Lithium	0.6	0.4	1
Xinghua Lithium	1	0	1
Tibet Mineral Development	0.5	-	0.5
Guoneng Mining	0	1	5
Jinhai Lithium	0	1	1
Total	13.1	9.4	30.5

Source: official announcements and websites, CITICS Research (Guoneng Mining's planned production line is lithium hydroxide)

To sum up, we expect the domestic lithium brine extraction production line investment market to reach nearly Rmb5bn by 2025 and the domestic lithium brine extraction segment to reach Rmb10bn over the long term without considering resin replacement and other factors.

Sunresin is a mature "adsorption + membrane" solution provider in China. In 2018, Sunresin put into production its 10ktpa demonstration lithium extraction line in Lenghu in Qinghai, where the lithium brine deposit is low-grade with a lithium content of 0.075g/L and magnesium-lithium ratio as high as 1300:1, marking the maturity of the Company's lithium brine extraction technology. Subsequently, Sunresin signed lithium brine extraction contracts with a number of enterprises. As of 1Q21, Sunresin had completed the construction of three major lithium extraction lines, including Zangge Lithium (10ktpa), Jintai Phase I (3ktpa+ 4ktpa) and Minmetals Salt Lake (1ktpa + 4ktpa renovation and expansion), and participated in multiple pilot plant projects under construction. At present, its solutions have achieved full coverage of low, medium and high grade lithium brine deposits.

Sunresin has sufficient orders in hand for domestic lithium brine extraction projects. According to the latest announcement, the Company has signed a 10ktpa lithium carbonate EPC project with Jinhai Lithium, a holding subsidiary of Eve Energy, and a 15-year not less than 150kt lithium hydroxide processing contract with Guoneng Mining. Sunresin has been well-established as the most mature "adsorption + membrane" lithium brine extraction process provider in China.

Sunresin has superior lithium extraction solutions and provides multiple cooperation models. Compared with other adsorbent resin companies, Sunresin can not only provide lithium adsorbents but also allow process adjustments according to brine deposit conditions and provide the corresponding adsorbents compatible with the adjusted process, and sell continuous ion exchange equipment as well; moreover, it supports process operation on customers' premises by providing them with a complete technical package. The Company is not only a resin provider but also an integrated "high performance adsorbent materials + advanced equipment" solution provider. For example, in the latest cooperation processing service agreement with Guoneng Mining, Sunresin can get both guaranteed income and sales revenue sharing.

Table 6: Modes of cooperation between Sunresin and lithium brine extraction enterprises

	Jintai Lithium	Zangge Mining	Minmetals Salt Lake	Qinghai Salt Lake Potash	Jinhai Lithium	Guoneng Mining
Mode of cooperation	After adjustments made by Jintai in Oct, the 3ktpa project has been completed and the 4ktpa project has been adjusted to apply the purchase and sales model, with the whole 7ktpa capacity being operated by Sunresin and operating expenses paid by Jintai. At present, Sunresin has a 4.39% stake in Jintai Lithium.	Zangge purchases adsorption equipment from Sunresin with other equipment purchased separately and operates the project by itself.	Sunresin provides production line transformation services for two projects with a production capacity of 1ktpa and 4ktpa, respectively.	Sunresin provides mother liquor recovery technology for Qinghai Salt Lake Potash's participation in BYD's 600tpa pilot production line.	Sunresin is responsible for the whole line design, construction, commissioning and training of lithium carbonate project to produce qualified products.	Sunresin is responsible for the construction of the production line, the design and manufacture of production line equipment, installation and commissioning, as well as the management of the processing production operation after the production line is put into operation, and the output of lithium hydroxide products in line with the contract.
Existing capacity	3ktpa	10ktpa	10ktpa	10ktpa	-	-
Capacity under construction	4ktpa		5ktpa process optimization	20ktpa	10ktpa	10ktpa
Process technology	Adsorption + membrane	Adsorption method	Gradient coupling membrane separation and multi-level lithium-ion concentration high Mg/Li ratio brine lithium extraction	Adsorption and "adsorption + membrane"	Adsorption + membrane	Adsorption + membrane
Salt lakes	Qinghai Balun Mahai Lake	Qinghai Chaerhan Salt Lake	Qinghai Yiliping Salt Lake	Qinghai Chaerhan Salt Lake	Qinghai Da Qaidam Salt Lake	Tibetan Kyetsé Tsakha and Lungmu Tso salt lakes

Source: official announcements, CITICS Research (Guoneng Mining's planned production line is lithium hydroxide)

Table 7: Lithium extraction technology and progress in industrial production of comparable companies

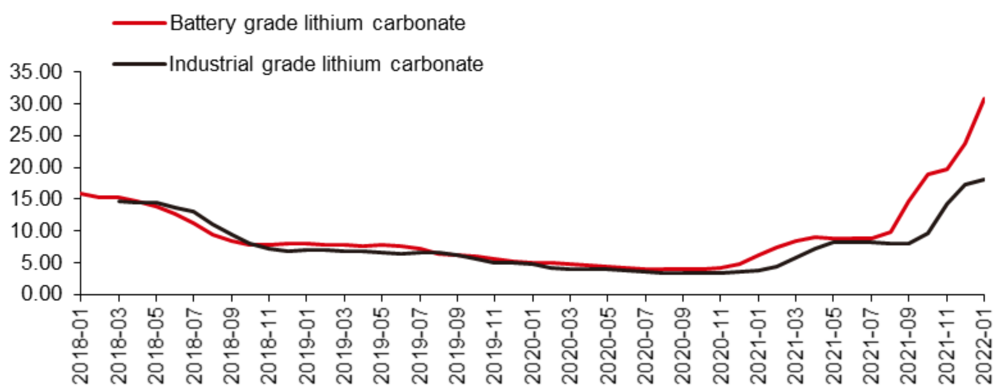
Company	Technology	Technology source	Technology stage
Lake Lithium (Qinghai Salt Lake Industry Co., Ltd.)	Adsorption + membrane	First-generation adsorption technology from Russia	Industrial production
Jiuwu Hi-Tech	Membrane separation	Proprietary	Further optimization required
	Adsorption + membrane	Proprietary	Pilot plant established with industrial production ye to be achieved
Zhengguang Industrial	-	-	Ongoing research collaboration with a university with no result produced yet
Infund Holding	Adsorption + membrane	Second-generation adsorption technology from Russia	The Infund subsidiary responsible for lithium extraction from brine was liquidated
Xinhua Chemical	Extraction method	Proprietary	Pilot-scale production
Sunresin New Materials	**Adsorption + membrane**	**Proprietary**	**Provider of lithium extraction technology, adsorptive separation equipment and adsorptive separation materials**

Source: official announcements, CITICS Research

Sunresin continues to make breakthroughs in equipment with a one-button switch between raw and tail brine. On 25 Oct 2021, the Company announced that it was awarded a contract for a Minmetals project and would attempt for the first time a 4ktpa production line and the delivery of one-button switch between raw and tail brine through a multi-pass valve system, among others. At present, all major lithium brine extraction production lines use tail brine from potash production as the raw material. However, production capacity under this method is limited by potash production and cannot meet the rising lithium demand. The breakthrough of lithium extraction technology from raw brine is expected to improve the efficiency as well as yield of lithium extraction and further expand brine development scenarios. According to the progress of order implementation and yield data published by the two companies, Sunresin posts a yield of more than 90% versus only 70%-85% for Minmetals Salt Lake, which explains why Minmetals selected Sunresin as its provider of technology of lithium extraction from raw brine in its tender process.

Sunresin is expected to fully benefit from the rapid expansion cycle of lithium production. Since the end of 2020, lithium prices have returned to the upward cycle, and the current price of lithium carbonate has exceeded Rmb300,000/t and could rise further. On 12 Jan, GUO Shougang, deputy director of Equipment Industry Department I of the Ministry of Industry and Information Technology, emphasized enhancing the security of key resources and accelerating the development of domestic lithium resources. With the combination of high lithium prices and favorable policy, domestic lithium production will enter a new round of capacity expansion, from which Sunresin, as a producer with products successfully used in standard demonstrative industrial production lines, stands to benefit greatly.

Fig. 10: Industrial grade and battery grade lithium carbonate prices (Rmb10,000/t)



Source: Asian Metal, CITICS Research

Ion-exchange resins promote energy conservation through hydrometallurgical applications

Hydrometallurgy based on adsorbent resin enjoys unparalleled advantages in terms of energy conservation and environmental protection. Metallurgy involves the enrichment, reduction and purification of metallic elements. Among the steps, reduction is inevitably energy-intensive as it involves the transfer of electrons and has to be powered by coal or via electrolysis. For the enrichment and purification steps, the simple adsorbent resin method can be employed, which basically does not generate significant environmental pollution. In the case of gallium extraction, for example, the adsorption method does not use environmentally stressful reagents such as mercury, strong acids and bases and also avoids the carbon footprint of the production process of these toxic and harmful reagents and is therefore very friendly to the environment.

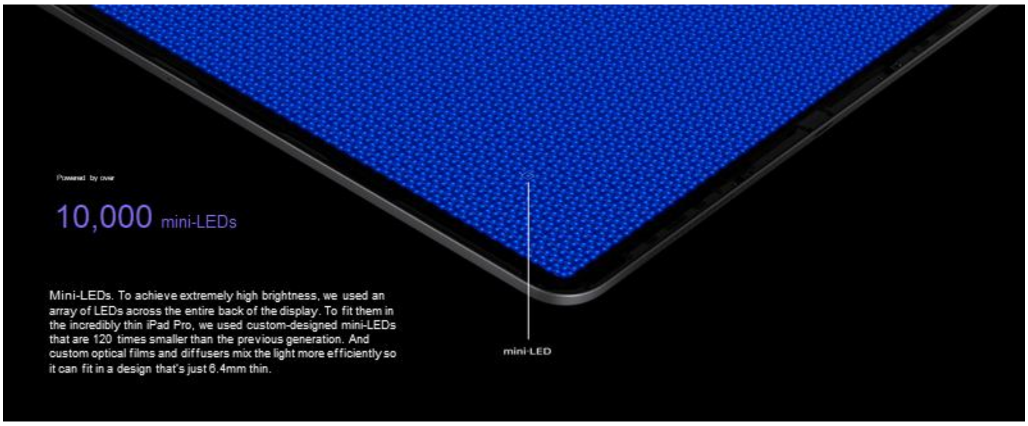
Table 8: Comparison of mainstream gallium extraction processes

	Adsorption process	**Electrolytic amalgamation process**	**Milk of lime process**	**Extraction method**
Description	Gallium is adsorbed from the Bayer mother liquor by adsorbent resin before being washed out with dilute alkali.	Gallium amalgam is obtained by electrolysis of gallium-containing solution with mercury as cathode, and then gallium is recovered from gallium amalgam.	The recycled sodium aluminate solution produced from alumina is treated with lime milk to separate gallium from aluminum, and then the enriched gallium is recovered.	Gallium is enriched in a solvent by using the difference in solubility or partition coefficient of gallium in two solvents that are insoluble (or slightly soluble) in each other.
Advantages	Simple with no chemical reagent required and no environmental pollution	Simple process and low cost	Low gallium concentration requirement	High gallium recovery rate
Disadvantages	-	Use of highly toxic mercury, which is basically banned now	Use of strong alkali, and the preparation of strong alkali consumes a lot of energy	The reagents are expensive, and the extractant is easily lost and also causes pollution.

Source: "Advances in Gallium Extraction Technologies" (LU Xiaofei, WANG Lei, WANG Xinde, NIU Xuekun), CITICS Research

Emerging technologies highlight the importance of gallium. Gallium compounds are widely used in magnets, LEDs, photovoltaics, RF, switches, etc, especially in consumer electronics, which has an intensive use of many emerging technologies that use gallium. For example, Apple has now equipped its Display Pro XDR, iPad Pro and Macbook Pro products with mini-LED display, in which the LED material must use gallium element. And gallium nitride chargers are also common today, which deliver a charging capacity of more than 100W for faster smartphone charging.

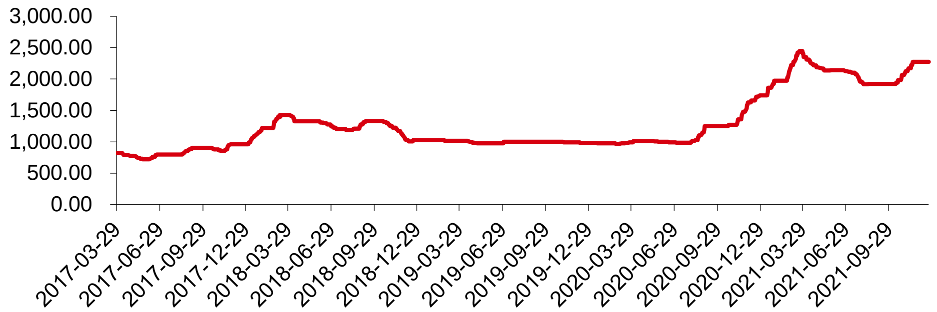
Fig. 11: Gallium-containing mini-LED panel used in iPad Pro



Source: Apple website

Gallium extraction is a mature and profitable segment of Sunresin. The Company has been engaged in gallium extraction for many years and won the second prize of National Science and Technology Progress Award in 2018 for its development of “Key technology for structural control and industrial application of adsorptive separation polymer resin materials.” At present, 80% of global gallium production is located in China. The Company is an important technology provider of gallium extraction technology. With increasing demand spurred by emerging technologies, gallium has seen an undersupply with prices continuously rising since 2020. As of 21 Dec 2021, gallium price was up more than 100% YoY. The rapid growth in gallium demand will also boost the long-term growth of the Company’s gallium extraction business.

Fig. 12: Gallium (≥99.99%) price (Rmb/t)



Source: Wind, CITICS Research

Sunresin's adsorptive separation technology thrives in hydrometallurgical applications across key metals. The Company's hydrometallurgy technology is capable of extracting relevant energy metals such as nickel, cobalt, vanadium and uranium, of which the nickel extraction technology has been granted multiple patents. The Company's nickel and cobalt projects are being actively promoted and are expected to replicate the Company's business model in the salt lake lithium extraction segment to become new sources of profit growth. The uranium extraction segment is also expected to usher in a period of high growth amid the rapid development of nuclear power in China.

Table 9: Sunresin's hydrometallurgy business expansion

Metal	Progress
Nickel	The Company's high-efficiency nickel adsorbent reached the best levels reported by international companies in the performance test of nickel ore in East Asia. With proprietary processes, it has provided nearly Rmb40mn worth of integrated solutions consisting of adsorbent materials and system equipment for overseas customers.
Cobalt	The Company's whole production line contract for a DRC-based project is currently in the stage of equipment installation, with the start of production expected in 2022. The project is expected to play a demonstration role and help the Company secure contracts from other cobalt mines in the DRC.
Uranium	Stable annual supply for African mines
Gold	Stable supply of adsorbents worth over Rmb1mn for Europe and Africa
Vanadium	Supply contracts worth over Rmb10mn for vanadium production from stone coal

Source: Company announcement, CITICS Research

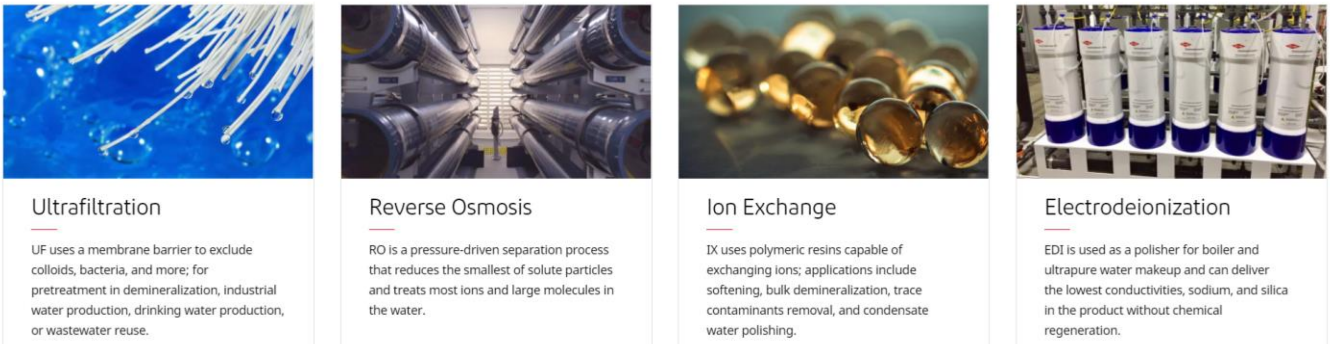
Electronic and nuclear grade resins exhibit huge growth potential

Company is world-leading in UPS ion-exchange resins

Ultrapure water production is technically very demanding. Pure water has almost no impurities except water molecules and is widely used in industrial manufacturing, recirculating, and food, medical and laboratory-related water uses. Resistivity, bacterial content, microparticles, gas molecules (dissolved oxygen, dissolved nitrogen) and TOC are important indicators of ultrapure water. The specific water quality requirements vary according to the needs of different industries. Sunresin proposed in 2019 that ultrapure water products mainly refer to electronic and nuclear grade ultrapure water, which requires conductivity above 18MQ and TOC <1-5ppb, or even down to the ppt level, with greater purity than food and medical grade ultra-pure water.

The high-end ultrapure water market is teeming with opportunities with few players. At present, domestic resin manufacturers focus more on traditional water treatment applications, such as industrial and civil water treatment, wastewater treatment, and food or medical grade ultrapure water production. The high-end segment of electronic and nuclear grade ultrapure water has high technical requirements and is highly lucrative, with stable demand from customers in electronic industries such as nuclear power and chip and circuit board manufacturing. At present, this segment is dominated by DOW, Mitsubishi and Purolite, which combine to have a market share of more than 90%; Sunresin currently only has a market share of 2% with significant headroom for market share growth.

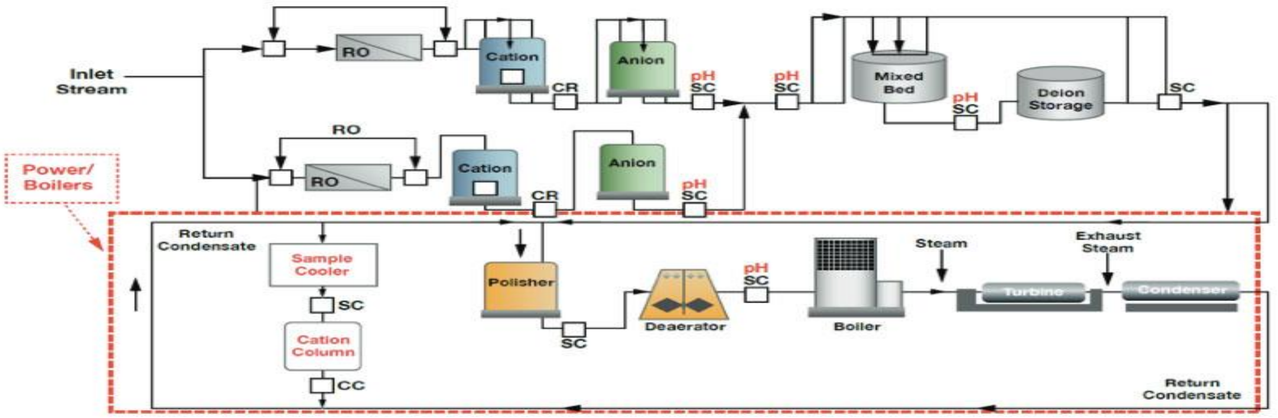
Fig. 13: Four main water purification and separation technologies (with increasing product purity from left to right)



Source: DuPont website

The preparation process of electronic and nuclear grade ultrapure water is complex. Ordinary water is pretreated and enters the first-level system of primary purification and disinfection (controlled to the ppm level) and then the second-level system (reverse osmosis), at which stage separation takes place using a special resin with the product having a purity of 15ppb (for photovoltaics and LCD applications); the product passes through ion exchange resins (cation exchange resin and anion exchange resin) to achieve a purity of 5ppb (optimally as pure as 200ppt and suitable for semiconductor applications); and purity can be further enhanced through a final step of circular polishing and refining for applications that require an even higher purity. Sunresin offers mature and globally advanced resin products that can be used in the above-mentioned three steps where resin is used.

Fig. 14: Schematic of ultrapure water production within a power plant (blue and green for cation and anion exchange resin, respectively)



Source: "Understanding Ultrapure Water and the Difficulties with pH Measurement" (YOKOGAWA website)

Electronic and nuclear grade ultrapure water requires ion exchange resins with high uniformity. Uniform particle size (UPS) resins have unique hydrodynamic properties and exhibit unique properties such as singular and full operational efficiency during the exchange and regeneration of the resin. With outstanding performance for applications in specific industries, they are currently the only choice for producing electronic and nuclear grade ultrapure water. UPS resins are required in the production of ultrapure water used in nuclear power plants. This field has so far been monopolized by a few foreign companies (Dow, LANXESS, Purolite, Mitsubishi).

Sunresin's UPS resin production process has reached an internationally advanced level. At present, most of the resins supplied in the domestic market are made by intermittent kettle suspension polymerization reaction, and their particle sizes are mostly Gaussian distributed with extensive flaws such as wide particle size distribution, low efficiency, fragility, high material consumption. After years of exploration, Sunresin industrialized its proprietary Monojet UPS resin production technology and achieved mass production of UPS spherical resin beads in 2019. With the exception of Zibo Dongda that has mastered the vibration injection gas-liquid phase granulation method (with products mainly used in condensate refining), all other domestic resin manufacturers, including Zhengguang Industrial and Suqing Water Treatment Engineering, adopt the sieving method for UPS resin production. Generally speaking, resins with a uniformity coefficient of less than 1.2 are deemed as UPS resins. Sunresin is capable of producing UPS resins within a uniformity coefficient range of 1.05-1.1, close to the world-leading level of 1.06-1.08 represented by Dow.

Table 10: Comparison of Sunresin and DuPont ultrapure water resin

Brand	DuPont		Sunresin		Comparison
Product brand	AmberTecTMUP6040		Monojet®6040U		
Type	H	OH	H	OH	
Uniformity coefficient	≤1.20	≤1.20	≤1.20	≤1.20	Excellent
Average particle size (μm)	525±50	630±50	600±50	630±50	Flat
Exchange capacity	≥2.0	≥1.10	≥2.1	≥1.10	Flat
Water content (%)	45-51	54-60	43-51	50-60	Flat
Hydrogen form rate (%)	≥299	-	≥99	-	Flat

Brand	DuPont		Sunresin		Comparison
Hydrogen-oxygen form rate (%)	-	≥95	-	≥95	Flat
Delta TOC (ppb)	≤3 (at 2h rinse)		≤1.0 (after 80 bv rinse)		Excellent

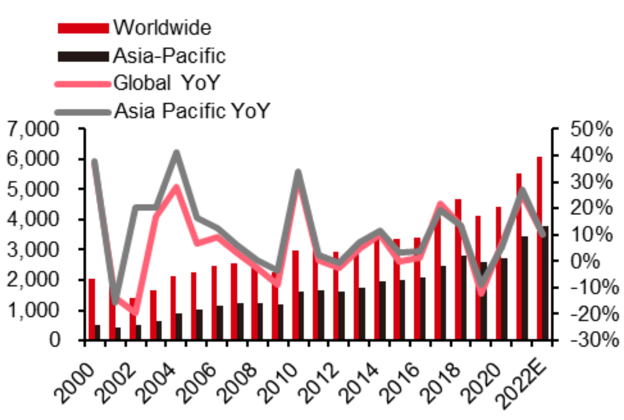
Source: Each company announcement, CITICS Research Cation resin = H; Anion resin = OH

Electronic grade resins for ultrapure water production are set to boom with the semiconductor industry

Electronic grade ultrapure water is mainly for semiconductor applications. Ultrapure water is required in many steps of electronic component manufacturing, such as cleansing and solution and slurry preparation. The manufacturing of integrated circuits involves repeated etching and cleaning, with each integrated circuit consuming 3-5 liters of ultrapure water and a 6-inch wafer consuming an average of 1.2t of ultrapure water. The purity of ultrapure water directly affects the quality and yield rate of electronic components. With the development of semiconductor technology, the reduction of component size and the increase in precision, the requirements for ultrapure water are becoming increasingly stringent.

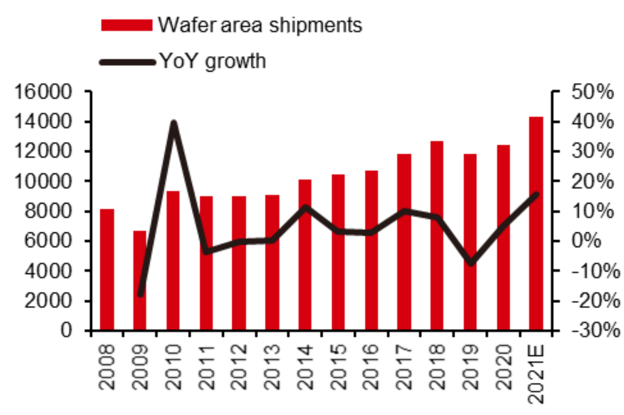
The pandemic has brought a rapid growth in demand for semiconductors. The semiconductor industry is a cyclical industry, which generally expands production capacity during the upward cycle with a view to maximizing savings on production line construction capital and increasing concentration. Following the booming upward cycle in 2014-2018, the year 2021 would have been in a downcycle for the semiconductor industry; however, due to the Covid-19 outbreak and the ensuing control measures which spurred a surge in demand for electronic devices, the industry entered a new upward cycle in the year. According to the Semiconductor Equipment and Materials International (SEMI), the global semiconductor market is expected to reach US$550.8bn in 2021, up 25% YoY, and global wafer shipments to reach 14,350mn square inches, up 15.7% YoY.

Fig. 15: Global semiconductor market size (US$100mn)



Source: SEMI (with forecasts), CITICS Research

Fig. 16: Global wafer shipping area (mn square inches)



Source: SEMI (with forecasts), CITICS Research

The global electronic grade ultrapure water resin market is expected to reach nearly US$500mn by 2030. Referring to the assumptions in our previously published report, *Sunresin New Materials (300487.SZ) In-depth Tracking Report: R&D-driven rapid growth across resin segments (4 Jun 2020)*, we expect the global semiconductor resin market to reach US$160mn in 2021 thanks to strong semiconductor demand. Based on a conservative 10% CAGR estimate, we expect the global electronic grade resin market to reach US$384mn by 2030. Considering that the display market's output value is basically 1/4 of that of the semiconductor industry chain, that display and semiconductor resins are close in process and cost, and that the display industry is also in the eve of a big boom of mini-LED and micro-LED displays, we expect resin demand from the display industry to reach Rmb100mn by 2030. In other words, the entire electronic grade resin market size will reach c. US$400mn. **Electronic grade resin is one of the most difficult types to produce among all adsorbent resins, and its supply follows a standard procedure. Sunresin is already working with enterprises including BOE Technology on product verification, and if things go well, it is expected to quickly achieve import substitution and gain an immense headroom for growth.**

Table 11: Ultrapure water and ion exchange resin demand from semiconductor industry, 2017-2030E

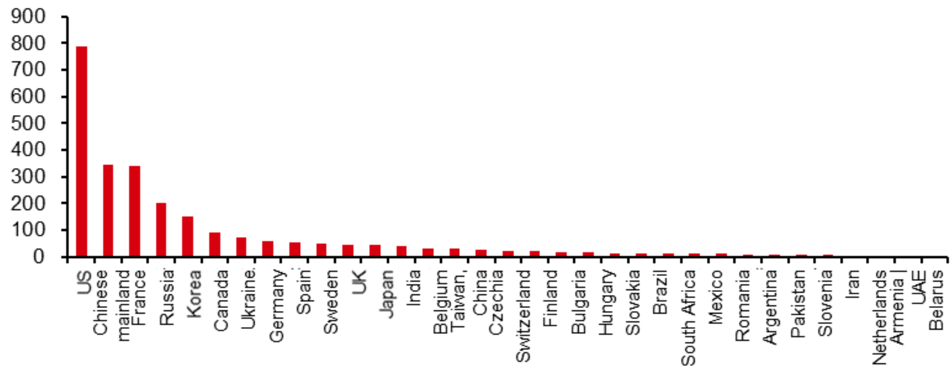
Item	2017	2018	2019	2020	2021E	2022E	2025E	2030E
Global wafer shipping area (mn square inches)	11,810	12,732	11,810	12,407	14,350	15,758	21,174	33,837
Ultrapure water demand per square inch of wafer (m^3)	0.1013	0.1013	0.1013	0.1013	0.1013	0.1013	0.1013	0.1013
Semiconductor industry ultrapure water demand (mn m^3)	1,196.35	1,289.75	1,196.35	1,256.83	1,453.66	1,599.02	2,144.93	3,427.64
Resin demand per tonne of water (10-6 m^3)	7.716	7.716	7.716	7.716	7.716	7.716	7.716	7.716
Global resin demand (m^3/year)	9,231.06	9,951.72	9,231.06	9,697.69	11,216.40	12,338.04	16,550.25	26,447.69
Global resin market (US$100mn/year)	1.35	1.45	1.35	1.41	1.63	1.79	2.41	3.84

Source: SEMI, SUMCO, CITICS Research forecast

Nuclear grade resins for ultrapure water production will benefit from nuclear power growth

Nuclear power is a zero-emission, clean energy source, and is an essential alternative energy source on the road to carbon neutrality. For China to achieve its carbon neutrality goal, it is necessary to substantially increase its clean energy share, which currently stands at only 15.3%. Nuclear power, as a stable zero-carbon energy source, is a viable alternative to coal-fired power. China has shown strong momentum in nuclear power development, with its nuclear power production exceeding France's in 2020, though there is still a long way to go to catch up with the US, which produced 800bn kWh of nuclear power in the year.

Fig. 17: Nuclear power production by country in 2020 (TWh)



Source: Wind, CITICS Research

Nuclear power construction during the 13th FYP period missed expectations. According to the *Mid- and Long-term Development Plan for Nuclear Power (2011-2020)*, China aimed to have put into operation 58mn kW of nuclear power capacity in addition to having 30mn kW under construction by the end of 2020, representing a total scale of 88mn kW. However, due to safety and other factors, by the deadline, China had only 48 nuclear power units in operation with a total installed capacity of c. 51.03mn kW and 16 under construction with a total installed capacity of c. 17.38mn, in addition to 3 units with a total installed capacity of 3.61mn kW that were approved but had not started construction; they combine to represent 72.02mn kW, 16mn kW short of the planned target.

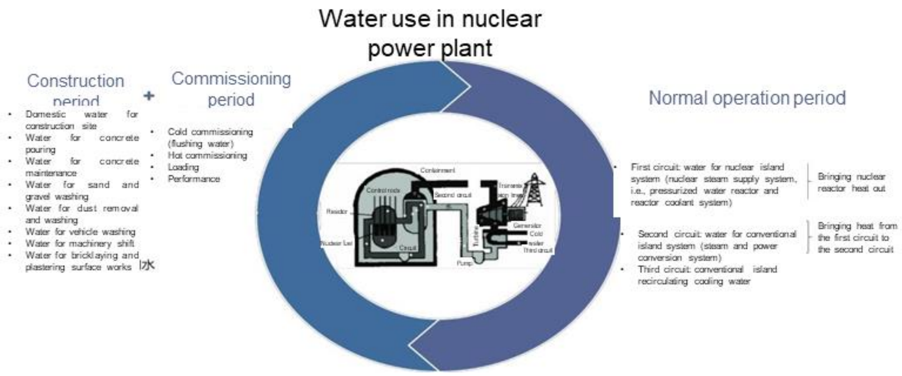
Nuclear power construction will accelerate during the 14th FYP period in order to achieve carbon peaking by 2030. If China is to increase its renewable energy share to 25% by 2030, it will have to replace 1.5bn tonnes of standard coal equivalent (tce) with nuclear power, corresponding to 4.5trn kWh of electricity. China has pledged to increase its installed wind and solar power capacity to more than 1.2bn kW by 2030. We expect it to actually reach 1.5bn KW. However, due to the availability factor for wind and PV solar power generation, we expect electricity from wind and solar to reach 2.3trn kWh by 2030. And add to it 1.4trn kWh of hydropower. Then there is still 800bn kWh yet to be filled by nuclear power. At an annual nuclear availability of 7,300 hours (c. 83% of the year), it will require an installed nuclear capacity of 110mn kW.

Construction of 38 million kW of nuclear power units is expected to start before 2025. Considering the long construction cycle of nuclear power plants, all the new nuclear capacity required by 2030 needs to start construction by 2025, while there are still a 38 million kilowatts installed nuclear power capacity gap, roughly requiring eight nuclear units to be constructed each year before 2025 with an annual capacity addition of c. 8mn kW. This is basically equivalent to 80% of the total capacity of China's current nuclear units in operation.

China currently has 71 nuclear power units, most of which are pressurized water reactors. As of 31 Oct 2021, there were 71 nuclear power units under construction and in operation in the Chinese mainland. Of the 52 in operation, there were one high-temperature gas-cooled reactor, two heavy water reactors, and 49 pressurized water reactors. And all the 19 units under construction were third-generation pressurized water reactors.

Nuclear-grade ultrapure water ion exchange resins play an important role in nuclear power plants. Nuclear grade ultrapure water ion exchange resins are mainly used in the feedwater and water treatment systems of the first and second circuits of reactors. The supply of reliable ultrapure water to the second circuit of the steam generator is a key technology that ensures the generator’s stable operation and its ability to provide steam of acceptable quality. Nuclear grade ultrapure water can reduce fouling on the second circuit, reduce thermal resistance to heat transfer from the first circuit to the second circuit, and increase steam production, in addition to reducing fouling deposits on the generator turbine blades. Moreover, nuclear grade resins that are applied to the first circuit water treatment system in nuclear power plants must have a high regeneration and transformation rate, very low impurity content, good resistance to irradiation decomposition, and ability to operate at higher operating flow rates and rather high temperatures, and the reactions of organic or inorganic impurities released from the system during use must be within allowable limits.

Fig. 18: Schematic of the primary pipes of China's homegrown third-generation nuclear reactor



Source: "Failure analysis and modification of desalination water system in Tianwan Nuclear Power Plant" (TAN Mingyu)

The domestic nuclear grade ultrapure water adsorbent resin market is expected to reach Rmb1.8bn by 2030, from which the Company stands well to benefit. Referring to the assumptions in our previously published report, *Sunresin New Materials (300487.SZ) In-depth Tracking Report: R&D-driven rapid growth across resin segments* (4 Jun 2020), we forecast that domestic nuclear power installed power rating will reach 110mn kWh, representing a nuclear grade ultrapure water resin market of c. Rmb1.2bn by 2030, and it will reach Rmb1.8bn if the replacement cycle of resin is taken into account. Sunresin is one of the few domestic nuclear grade ultrapure water resin suppliers and maintains cooperation with multiple nuclear power related enterprises. Compared with leading foreign companies, it has advantages in terms of supply cycle, supply stability and prices and its products are expected to rapidly replace their imported counterparts.

Table 12: Domestic nuclear grade resin market size, 2018-2030E

Item	2018	2019	2020	2030E
Number of nuclear power units	45	47	51	110
Installed nuclear power capacity (10^8 W)	459	487	510	1,100
Demand for desalinated water per GW of nuclear power capacity (m^3/s*GW)	0.0037	0.0037	0.0037	0.0037
Nuclear power sector’s demand for ultrapure water (106 m^3/year)	5.35	5.69	5.94	12.82

Item	2018	2019	2020	2030E
Resin demand per tonne of ultrapure water (m^3)	0.012	0.012	0.012	0.012
Resin demand (m^3/cycle)	64,200	68,280	71,333	153,856
Replacement cycle (year)	3	3	3	3
Resin market size (Rmb10^8/year)	7.55	8.0	8.38	18.09

Source: National Nuclear Safety Administration, CITICS Research forecast

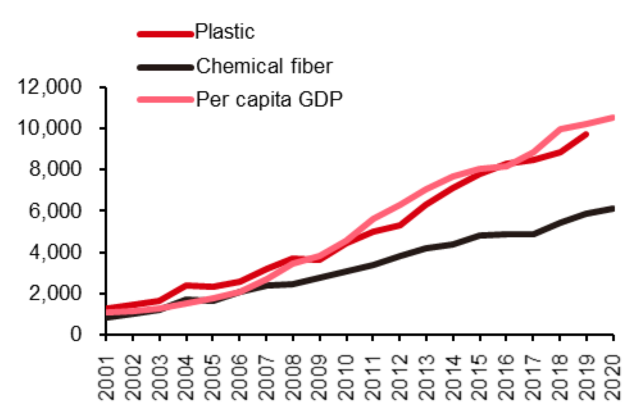
Resins for separation and purification applications help reduce carbon emissions

Resins for biodegradable plastics usher in a period of rapid development thanks to favorable policy

The Company has a solid presence in resins for the purification of upstream raw materials of degradable plastics. The Company started in 2001 with a focus on juice treatment and has over the 20 years since then accumulated profound knowhow in the purification of food ingredients such as juice, pectin, pigment, sugar alcohol and fructose syrup. With the introduction of plastic restrictions and the rise of biodegradable plastics, the Company found through research that ion exchange resins have extensive application scenarios for the purification of upstream raw materials of biodegradable plastics such as lactic acid and BDO, and forayed into the production of biodegradable plastics.

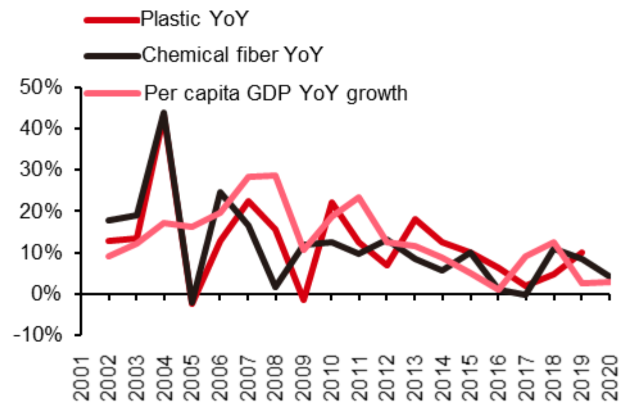
There is a stable growth driver for domestic plastic consumption. According to the National Bureau of Statistics, the growth of plastic and chemical fiber consumption has a strong positive correlation with the growth of per capita GDP. The growth rate of plastic and chemical fiber consumption basically fluctuates above and below the growth rate of GDP per capita. Despite slower domestic economic growth, we expect the growth rate to maintain the pace of 5-6% in the next decade.

Fig. 19: Domestic plastic and chemical fiber production and GDP per capita (10kt, US$)



Source: Wind, CITICS Research

Fig. 20: Domestic plastic and chemical fiber production and per capita GDP growth



Source: Wind, CITICS Research

The policy promotes degradable plastics. China has introduced three phases of restrictions on the production, sale and use of disposable plastics by 2020, 2022 and 2025, respectively. Currently, the production and sale of ultra-thin plastic shopping bags less than 0.025 mm thick and polyethylene agricultural film less than 0.01 mm thick have been banned. Increased prohibitions will be imposed on plastic express delivery packaging materials by 2022 and disposable tableware by 2025.

Table 13: China's laws and regulations on single-use plastics

Laws and regulations	Type	Stipulations
Solid Waste Pollution Prevention and Control Law of the People's Republic of China	Restriction	Article 69 The state shall prohibit and restrict the production, sale, and use of non-degradable plastic bags and other disposable plastic products according to the law. The owners of goods retail sites, e-commerce platform enterprises, express delivery enterprises, and food delivery enterprises shall report the use and recovery of disposable plastic products such as plastic bags to the commerce, post and other departments in accordance with the relevant provisions issued by the state. The state shall encourage and guide the reduced use and active recovery of plastic bags and other disposable plastic products and promote the application of recyclable, easily recyclable and degradable alternative products.
	Punishment	Article 106 Where, in violation of the provisions of this Law, the provisions on the prohibition or restriction of the use of non-degradable plastic bags and other disposable plastic products fail to be complied with, or the use of plastic bags and other disposable plastic products fails to be reported in accordance with the relevant provisions issued by the state, the commerce, post, and other departments of local people's governments at or above the county level shall order the taking of corrective action and impose a fine of not less than Rmb10,000 nor more than Rmb100,000.
Opinions on Further Strengthening the Treatment of Plastic Pollution	Prohibition	Plastic products prohibited from production and sale. It is prohibited to produce and sell ultra-thin plastic shopping bags less than 0.025 mm thick and polyethylene agricultural plastic films less than 0.01 mm thick. It is prohibited to use medical waste as raw materials to manufacture plastic products. The import of waste plastics is comprehensively banned. By the end of 2020, the production and sale of disposable foaming plastic tableware and disposable plastic cotton swabs should be prohibited; the

Laws and regulations	Type	Stipulations
		Production of daily chemical products containing plastic microbeads should be prohibited. By the end of 2022, the sale of daily chemical products containing plastic microbeads should be banned.
		Non-degradable plastic bags. By the end of 2020, non-biodegradable plastic bags should be prohibited in shopping malls, supermarkets, pharmacies, bookstores and other places in urban built-up areas of centrally-administered municipalities, provincial capitals and cities specifically designated in the state plan, as well as catering packing take-out services and various exhibition activities; and bazaars should regulate and limit the use of non-biodegradable plastic bags. By the end of 2022, the implementation scope should be expanded to all urban built-up areas of cities at and above the prefecture-level and built-up areas of counties in coastal areas. By the end of 2025, trade markets in these areas will ban the use of non-biodegradable plastic bags. Regions, where conditions permit, are encouraged to stop the use of non-degradable plastic bags at trade markets in rural-urban fringe, towns, and rural areas.
		Disposable plastic tableware. By the end of 2020, non-degradable disposable plastic straw should be prohibited from use in the catering industry nationwide; and non-degradable disposable plastic tableware should be prohibited from use in the catering industry in urban built-up areas and scenic spots at prefecture-level or above. By the end of 2022, it is prohibited from using non-biodegradable disposable plastic tableware in the county built-up areas, and for scenic spots catering services. By 2025, the consumption intensity of non-biodegradable disposable plastic tableware will drop by 30% in catering takeaway in cities above the prefecture-level.
		Plastic packaging for express delivery. By the end of 2022, postal and express delivery outlets in provinces and cities such as Beijing, Shanghai, Jiangsu, Zhejiang, Fujian and Guangdong will be prohibited from using non-degradable plastic packaging bags, and disposable plastic woven bags, and should reduce the use of non-degradable plastic tape. By the end of 2025, non-degradable plastic packaging bags, plastic tapes, and disposable plastic woven bags are prohibited from use in postal and express delivery outlets nationwide.
	Restriction	Disposable plastic products for hotels and restaurants. By the end of 2022, star hotels, restaurants and other venues nationwide will no longer provide disposable plastic products on their initiative, and may provide the relevant services by setting up self-service purchasers and providing rechargeable detergents or otherwise. By the end of 2025, the implementation scope will be expanded to all hotels, restaurants, and residential accommodations.
Notice on Solid Promotion of Plastic Pollution Control	Prohibition	Strengthen the supervision and inspection of plastic products prohibited from production and sale. Local market supervision departments shall carry out quality supervision and inspection of plastic products and investigate and persecute the production and sale of ultra-thin plastic shopping bags less than 0.025 mm thick and polyethylene agricultural plastic films less than 0.01 mm thick according to law; and carry out law enforcement of disposable foaming plastic tableware, disposable plastic cotton swabs and daily chemical products containing plastic microbeads that are included in the catalogue of products to be phased out according to the prohibition deadline specified in the Opinions. Local industry and information technology departments shall, in conjunction with relevant departments and in accordance with the requirements of local government deployments, assess local enterprises' capacity of plastic products required to be phased out and guide the relevant enterprises to adjust production in a timely way.

Laws and regulations	Type	Stipulations
		Strengthen the supervision and management of the compliance with the plastic prohibition rules in retail, catering and other sectors. Local commerce and other departments shall, in accordance with the *Solid Waste Pollution Prevention and Control Law* and the local government arrangements, strengthen the supervision and management of the prohibition of non-degradable plastic bags for retail establishments, take-out services and various exhibition activities. Local commerce and market regulation departments shall, in accordance with local government requirements, promote the establishment of a centralized shopping bag purchase and sale system for trade markets and further regulate the sale and use of plastic shopping bags in trade markets. Local departments of culture and tourism shall, in accordance with local government requirements, strengthen the supervision and management of dining services in scenic spots in respect of plastic restriction and prohibition. All areas shall, in light of the actual local situation, clearly identify the departments responsible for supervision of plastic restriction and prohibition in the catering industry and strengthen supervision, and guide and urge relevant enterprises to replace with non-compliant products with compliant ones and stop the use of disposable plastic straws and disposable plastic tableware before the deadline specified in the Opinions.
	Restriction	Promote the governance of agricultural films. Local agricultural and rural affairs departments shall strengthen coordination with local supply and marketing cooperatives to organize and carry out related activities such as replacement of old for new, hand-in by business entities, and recycling by professional organizations, promote the extended producer responsibility system pilot scheme for agricultural films, advance the construction of agricultural film recycling demonstration counties, and improve the recycling system of used agricultural films. Local agricultural and rural affairs departments shall, in conjunction with other relevant departments, shall strengthen the random inspection of the sales of agricultural films and include polyethylene agricultural films less than 0.01 mm thick and plastic films that are used as agricultural films in violation of rules in the scope of counterfeit, substandard agricultural supplies for crackdown.

Source: *Solid Waste Pollution Prevention and Control Law*, National Development and Reform Commission, CITICS Research

The domestic demand for biodegradable plastics is expected to reach nearly 7mt by 2030. Referring to the assumptions in our previously published report, *Kingfa Sci & Tech In-depth Tracking Report: Promising new material platform set to drive up market cap* (2020-11-26), we forecast that the penetration rate of domestic biodegradable plastics will reach 50% and 80% in 2025 and 2030 respectively, representing a demand of 3.246mt and 6.821mt respectively.

Table 14: Biodegradable plastics market size, 2017-2030E

Item	2017	2018	2019	2020	Annual growth	2021E	2025E	2030E
Agricultural film (10kt)	143.7	140.9	137.9	140	0%	140	140	140
Number of take-out containers (100mn)	198	308	402	450	10%	495	724	1,167
Average mass (g)	25	25	25	25	-	25	25	25
Take-out container usage (10kt)	49.5	77	100.5	112.5	-	123.75	181	291.75
Shipping plastic usage (10kt)	-	160	170	180	6%	190	240	322
Household plastic bag usage	-	-	-	30	5%	31.5	38.3	48.9

Item	2017	2018	2019	2020	Annual growth	2021E	2025E	2030E
(10kt)								
Other usage (10kt)	50	50	50	50	-	50	50	50
Total (10kt)	-	-	-	512.5	-	535.2	649.3	852.6
Penetration rate of biodegradable plastics	-	-	-	3%	-	5%	50%	80%
Domestic demand for biodegradable plastics (10kt)	-	-	-	15.4	-	26.8	324.6	682.1

Source: China Plastics Processing Industry Association, National Bureau of Statistics, Yuanzhe Information Consulting, CCTV Biz News, CITICS Research forecast

Biodegradable plastics represent an enormous raw material purification market for resins

PLA is the only mainstream bio-based degradable plastic at present, which stands to benefit from the carbon neutrality drive. In response to white pollution and policy restrictions, a variety of biodegradable plastics have been put into use, but biodegradable plastics do not mean that their production has a low carbon footprint as well. Currently, PLA is the only bio-based degradable plastic, whose raw material lactic acid is fermented from biomass, which means that the production process of PLA naturally includes carbon capture, and its carbon footprint is very low. Other degradable plastics are petroleum-based or directly chemically synthesized, meaning that although the plastics can degrade with a reduced environmental impact, their end product of degradation is CO_2 and that, therefore, they will still increase CO_2 emissions and contradict the broad goal of carbon neutrality.

Table 15: Advantages and disadvantages of current mainstream degradable plastics and their raw materials

Plastic	Raw materials	Source of raw materials	Advantages and disadvantages
Polylactic acid (PLA)	Lactic acid or lactide	Mainly biological method	High hardness and rigidity, but low strength and poor toughness, requiring appropriate modification
Polyhydroxyalkanoates (PHAs)	Microbial synthesis	Biological method	Modest mechanical strength, but rather high production costs
Poly(Succinic acid-butanediol) esters (PBS)	Succinic acid, butanediol	Chemical or biological method	Higher strength, but too fast degradation with a short life cycle
Poly(butanedioic acid-adipic acid-butanediol) ester (PBSA)	Succinic acid, butanediol, adipic acid	Chemical or biological method	Better toughness than PBS, but fast degradation
Poly(adipic acid-terephthalic acid-butanediol) ester (PBAT)	Adipic acid, butanediol, terephthalic acid	Chemical synthesis	Combining the advantages of aliphatic and aromatic polyesters, but unable to withstand high temperatures
Polycaprolactone (PCL)	Caprolactone	Chemical synthesis	Good biocompatibility, but low decomposition temperature, mainly used for biomedical materials

Source: "Types of degradable plastics and applications" (CUI Wenjuan), CITICS Research

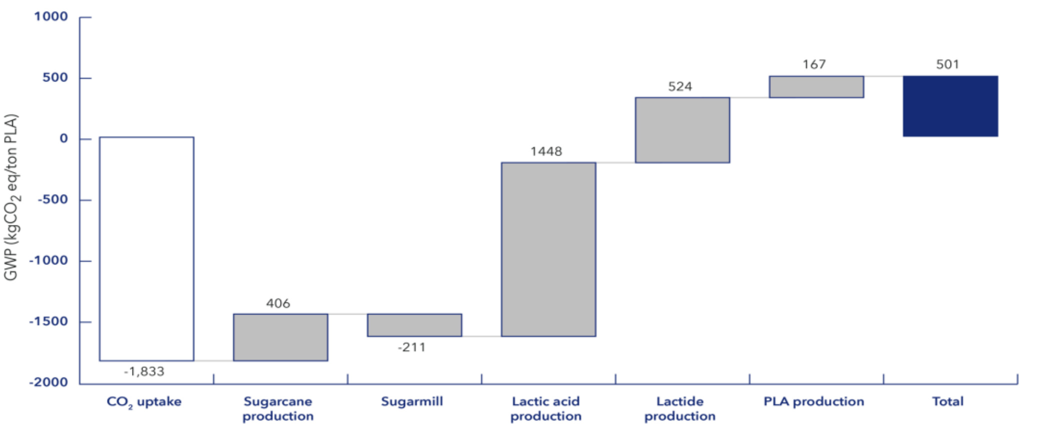
Fig. 21: Routes for recycling PLA biodegradable plastic

Source: Total-Corbion website

Bio-based degradable plastics are highlighted in the Plan for the *Green Development of Industrial Sectors during the 14th Five-Year Plan Period* released by the Ministry of Industry and Information Technology on 3 Dec. The section on "Implementation of industrial carbon peak action" highlights the promotion of green low-carbon materials with efforts outlined to promote green building materials and household products such as low-carbon gelling, energy-saving doors and windows, environmentally friendly coatings and all-aluminum furniture and develop bio-based materials such as **polylactic acid**, polybutylene glycol succinate, polyhydroxyalkanoic acid, polyorganic acid composites and coconut oil acyl amino acids.

The carbon footprint per t of PLA is less than 1/3 of that of polyethylene. According to a study by Ana Morao and Francois de Bie et al., the carbon footprint per t of PLA plastic is only 0.5t, which is mainly attributed to the raw material of PLA, i.e., bio-based sugar, which has up to 1.833t of CO_2 absorption during the production process. The carbon footprint per t of polycarbonate (PC) is a staggering 5t, while other commercial plastics such as polypropylene (PP) and polyethylene (PE) basically have a carbon footprint of c. 2t. It is expected that with the development of PLA production technology, the carbon footprint of PLA can be further reduced for it to play an even greater role in moving towards carbon neutrality.

Fig. 22: Carbon footprint in PLA production (kg CO_2/t of PLA)



Source: "Life Cycle Impact Assessment of Polylactic Acid (PLA) Produced from Sugarcane in Thailand" (Ana Morao, Francois de Bie), CITICS Research

The Company provides resin purification solutions for major PLA producers and stands to benefit from the rapid PLA capacity expansion. According to industrysourcing.cn, China's current PLA production capacity is less than 500ktpa, but the capacity under construction and proposed to be built has reached 1.5mtpa. The refining process is particularly important in the production of lactic acid, which requires the use of resin to remove heavy metals, proteins, pigments and other impurities from the fermentation broth to obtain lactic acid products of different grades, such as food grade, refined grade and high purity grade, of which high purity grade lactic acid is mainly used in the production of PLA. Sunresin has deep expertise in food processing and has secured orders from leading PLA producers such as Jindan Lactic Acid Technology and BBCA Biochemical.

Table 16: Major PLA producers (10ktpa)

Company	Jindan Lactic Acid Technology	Kingfa Sci & Tech	BBCA Biochemical	Hisun Biomaterials	COFCO Biotechnology
Capacity	Lactic acid: 12.8 Lactide: 1 Polylactic acid: 0.1	-	Lactic acid: 15 Polylactic acid: 10	Polylactic acid: 6.5	Polylactic acid: 3
Capacity under construction	High gloss pure lactic acid: 5 Polylactic acid: 1	Polylactic acid: 3	Lactic acid: 50 Polylactic acid: 30	Polylactic acid: 15	Polylactic acid: 10

Source: Company announcement, CITICS Research

Lactic acid purification opens up an adsorbent resin market valued in the hundreds of millions of RMB. We expect that the penetration rate of PLA in degradable plastics will reach 40% and 50% in 2025 and 2030, respectively, corresponding to a PLA demand of 1.3mt and 3.4mt. According to our research, each 10kt of lactic acid production requires c. 40m^3 of adsorbent resin for purification. Assuming the average price of resin at 80 RMB per liter, it will represent a market of Rmb600mn for adsorbent resin by 2025 and Rmb1.6bn by 2030, making adsorbent resin for purification another high-quality business segment of Sunresin.

With performance and other factors considered, PLA+PBAT is the mainstream direction of biodegradable plastics at present. Although PLA has high strength, good thermoplasticity and good biocompatibility and is more in line with the direction of carbon emissions reduction, it is brittle and has poor thermal stability, weaknesses that can be well complemented by PBAT that has good ductility, impact resistance and thermal stability and is often used to toughen other brittle plastics. The current mainstream degradable material solution in the market is to co-extrude PLA and PBAT (to integrate their hardness and brittleness properties). It is expected that the share of degradable plastics will exceed 60% by 2025 and rise further by 2030.

Fig. 23: Price/performance comparison of common biodegradable plastics

Source: "Development and trends of biodegradable plastics" (LU Haixu)

Domestic PBAT capacity expansion drives up demand for upstream raw material BDO. According to industrysourcing.cn, the domestic PBAT production capacity was only 293ktpa in 2020, but the capacity under construction for the period from 2021 to 2023 exceeds 4mt. At present, PBAT is mainly prepared using the direct esterification process in China, with upstream core materials including terephthalic acid (PTA), adipic acid (AA) and 1,4-butanediol (BDO). The BDO consumption per unit of PBAT is between 0.5 and 0.6. Based on the unit consumption of 0.55, it is expected that the new capacity under construction from 2021 to 2023 will have a BDO demand of c. 2.3mt.

Table 17: Domestic PBAT capacity and layout (as of Nov 2021)

Company	Existing capacity	Capacity under construction	Commissioning/planned commissioning	Planned capacity
Xinjiang Blue Ridge Tunhe Chemical Industry Co., Ltd.	13		2020	24
Hengli Petrochemical	3.3	90	2020	90
Mogao Eco-Friendly New Polymer Materials Technology Co., Ltd.	2		2020	
Sinopec Yizheng Chemical Fibre Company Limited (including PBSA)	1		2020	2
Kingfa Sci & Tech	6	6	2021	6
Jinhui Zhaolong High-Tech Co., Ltd.	3	12	2021	
Nantong Longda Bio-Tech New Materials Co., Ltd.	1		2021	
Chongqing Hongda Industrial Co., Ltd.		10	2021	20
Ningbo Changhong Polymer Scientific and Technical Inc.		10	2021	50
Ko Yo Chemical (Group) Limited		10	2021	20
Hainan Rui'an Jiachuang Biotech Co., Ltd.		6	2021	
Shandong Ruifeng Chemical Co., Ltd.		6	2021	30
Shandong Dawn Group Co., Ltd.		12	2022E	
Shandong Siyuan New Material Technology Co., Ltd.		10	2022E	
Wanhua Chemical (Sichuan)		6	2022E	
Yangmei Chemical Co., Ltd.		20	2022E	50
Jindan Lactic Acid Technology		6	2022E	
Yangquan Coal Industry Group Pingding Chemical Co., Ltd.		6	2022E	
Jiyuan Hengtong High-Tech Materials Co., Ltd.		12	2022E	36
Xinjiang Wangjinglong New Materials Co., Ltd.		130	2022E	260
Shanghai Tongcheng New Materials Group Co., Ltd.		6	2022E	
Jilin COFCO Bio-chemical Co., Ltd.		55	2022E	
Zhejiang Huafeng Spandex Co., Ltd.		30	2022E	
Lecron Industrial Development Group Co., Ltd.		6	2022E	
BASF (Guangdong) Verbund Site Project		5	2022E	
Zhejiang Realsun Chemical Co., Ltd.		2.4	2022E	
Anhui Sealong Biotechnology Co., Ltd.		12	2023E	
Inner Mongolia Junzheng Energy & Chemical Group Co., Ltd.		-	2023E	200
Hengli Energy (Yulin) New Materials Co., Ltd.		18		

Company	Existing capacity	Capacity under construction	Commissioning/planned commissioning	Planned capacity
Jiangsu Sanfame Co., Ltd.		4		12
Hubei Yihua Chemical Industry Co., Ltd.		6		
Xinjiang Tianye Co., Ltd.		10		50
Anhui Anqing Shuguang Chemical Co., Ltd.		6		30
Hunan Yussen Energy Technology Co., Ltd.		6		
Qixiang Tengda Chemical Co., Ltd.				6
Other				125.4
Total	**29.3**	**428.4**		**774.4**

Source: industrysourcing.cn, CITICS Research

BDO enters the expansion period, creating a huge demand for purification resin. According to baiinfo.com, while the current domestic BDO production capacity is only 2.339mtpa, the planned capacity has exceeded 10mtpa since 2021, benefiting from strong downstream demand. At present, BDO is mostly prepared using the Repper process (acetylene-formaldehyde process) in China, which mainly consists of two steps: 1) acetylene and formaldehyde are reacted to form 1,4-butynediol (BYD); 2. BYD is hydrogenated to form BDO. Since metal ions such as Cu will enter the feed solution during BYD generation, which will affect the subsequent hydrogenation, a deionization process is required using a combination of ion exchange resins of strong acid cation resin, weak base anion resin and strong base anion resin. According to our research, each 10kt of BDO requires Rmb400,000-Rmb800,000 worth of adsorption materials. According to existing capacity plans, this will represent a market with a central tendency size of Rmb420mn for purification resin by 2026. Sunresin is expected to become a mainstream supplier in this market by leveraging its resin preparation and modification technology.

Table 18: Domestic BDO capacity under construction and planned capacity (10ktpa, as of Dec 2021)

Company	Project location	Process route	Capacity	Expected start of production
Wanhua Chemical	Meishan, Sichuan	Acetylene production from natural gas by acetylene-formaldehyde process	10	2022
Chongqing Hongqingda	Sichuan, Chongqing	Hong Kong Guanda acetylene-formaldehyde process	20	-
Dongtian Huaye	Shihezi, Xinjiang	Acetylene production from natural gas by acetylene-formaldehyde process	30	-
Guotai Xinhua	Xinjiang Zhundong Economic and Technological Development Zone	Acetylene-formaldehyde process	10	2022
Xinjiang Shuguang Lvhua	Xinjiang Tiemenguan Economic and Technological Development Zone	Acetylene production from natural gas by acetylene-formaldehyde process	30	100ktpa phase 1, with a planned construction period of 26 months
Hengli Hengyuan	Yulin, Shaanxi	Acetylene-formaldehyde process	180	Maleic anhydride process
Hua Heng Energy	Wuhai, Inner Mongolia	Acetylene production from natural gas by acetylene-formaldehyde process	72	-
Tond Chemical	Yuanping City, Yizhou,	-	50	2022

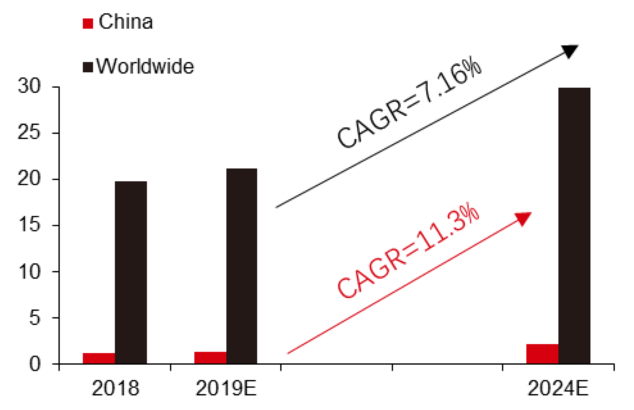
Company	Project location	Process route	Capacity	Expected start of production
	Shanxi			
Yussen Energy	Daya Bay, Huizhou, Guangdong	Maleic anhydride process	12+16	120ktpa, with construction period from Sep 2021 to Aug 2023
Junzheng Chemical	Wuhai, Inner Mongolia	Acetylene-formaldehyde process	2x60	May 2021 - Dec 2023
Sinopec Chongqing SVW Chemical	Sichuan, Chongqing	-	20	-
Zhongjing Petrochemical	Fuqing, Fujian	Maleic anhydride process	60	2024
Henan Energy Hebi	Hebi, Henan	Acetylene-formaldehyde process	40	-
Jurong New Materials	Luntai County, Xinjiang	-	30	-
Xinjiang Markor	Korla, Xinjiang	-	10	Oct 2022
Inner Mongolia Guangju	Wuhai, Inner Mongolia	-	12	-
Hualu Hengsheng Chemical	Dezhou, Shandong	-	18	2021-2023
Sanwei Holding	Wuhai, Inner Mongolia	Acetylene-formaldehyde process	90	Dec 2026
Dongjing Biological	Wuhai, Inner Mongolia	Hong Kong Guanda acetylene-formaldehyde process	20	Jun 2022
Shenghong Petrochemical	Lianyungang, Jiangsu	Maleic anhydride process	30	-
Wuheng Chemical	Ningdong, Ningxia	-	2x11.6	Commissioned in early Jul 2022
Henan Energy Xinjiang	Baicheng County, Xinjiang	-	20	-
Foryou Corporation	Taiyuan, Shanxi	Acetylene-formaldehyde process	30	-
Zhongke Qicheng	Zhumadian, Henan	Acetylene production from natural gas by acetylene-formaldehyde process	20	-
Shandong Tianyi		Maleic anhydride process	5.225	Construction period from 2022 to 2025
Inner Mongolia Jiutai	Hohhot, Inner Mongolia	Acetylene-formaldehyde process	30	-
Zhongguan Petrochemical	Zhuhai, Guangdong	Maleic anhydride process	10	-

Source: www.cheminfo.cn, official announcements, CITICS Research

Resin applications in life sciences accelerate

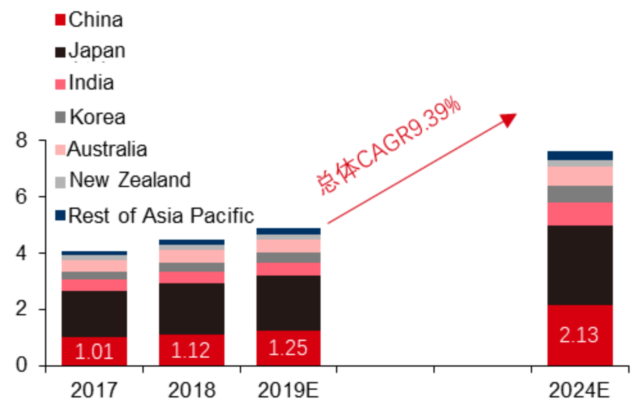
The global chromatography filler market is expected to reach nearly US$3bn by 2024. According to MarketsandMarkets data (as cited in Nanomicro Technology's prospectus), the global chromatography filler industry market size was c. US$1.978bn in 2018 and is expected to grow at a CAGR of 7.16% from 2019 to 2024 to reach US$2.993bn in 2024. Asia-Pacific is expected to lead the global chromatography filler market growth from 2019 to 2024 with a CAGR of 9.39% and see its share in the global market grow from 22.4% in 2018 to 25.39% in 2024.

Fig. 24: Chinese and global chromatography filler market, 2018-2024E



Source: MarketsandMarkets (as cited in Nanomicro Technology prospectus, including forecast), CITICS Research

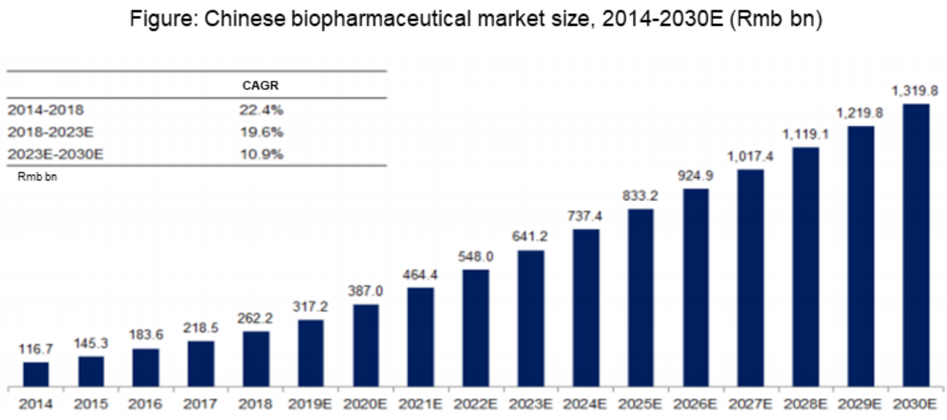
Fig. 25: Asia-Pacific chromatography filler market size (US$100mn), 2017-2024E



Source: MarketsandMarkets (as cited in Nanomicro Technology prospectus, including forecast), CITICS Research

The rapidly expanding domestic biopharmaceutical industry creates a huge demand for import substitution of chromatography fillers. In recent years, the domestic biopharmaceutical industry has achieved significant growth. According to Frost & Sullivan (as cited in Junshi Biosciences' prospectus), China's biopharmaceutical market experienced an annualized growth rate of 22.4% from 2014 to 2018, and the rate is expected to reach 19.6% from 2018 to 2023 and to be maintained at 10.9% from 2023 to 2030, much higher than the expected global market growth rates during the same periods. The Chinese biopharmaceutical market is forecast to reach Rmb1.3trn by 2030. Currently, the global chromatography filler market is mainly dominated by GE Healthcare, Tosoh and Bio-Rad, with a CR3 of 50%. We believe that with the rapid expansion of the domestic biopharmaceutical market and a succession of domestic breakthroughs in key technologies, the penetration rate of domestic chromatography filler products will increase quickly.

Fig. 26: Chinese biopharmaceutical market size, 2014-2030E (Rmb bn)



Source: Frost & Sullivan (including forecast, cited from Junshi Biosciences prospectus)

The Company has extensive resin products for life science applications with multiple domestically leading technologies. Sunresin started to lay out in the biopharmaceutical field very early on. With its main products in this respect including peptide solid phase carriers, enzyme catalytic carriers, biological macromolecule separation and purification resins, resins for small nucleic acid drug separation and purification, microcarriers, resins for purification of plant extracts, pharmaceutical resin microspheres and resins for hemoperfusion, the Company has taken up a rather high share in the domestic market. The Company has multiple domestically leading technologies: 1) extraction of cephalosporin C and enzymatic preparation of 7-aminocephalosporanic acid (7-ACA); 2) extraction of industrial hemp (CBD); 3) purification of biological macromolecules, where it offers a series of first homegrown products, including microcarrier (LX-MC-dex1), butyl 4B filler for hepatitis B vaccine purification, microgel column blood assay Seplife G50SF, and CM Seplife C50 and DAEA Seplife A50 for blood product purification.

Table 19: Sunresin's resin products for life science applications

Resin type	Downstream applications
Resin for western pharmaceuticals	Extraction and separation of western pharmaceutical APIs and intermediates, with the cephalosporin series resin breaking foreign monopoly
Resin for purification of plant extracts	Industrialization of enzymatic preparation of 7-ACA, which is used for the immobilization of glucose isomerase in starch industry, of glycosylase in glycation reaction, and of lipase in oil industry
Immobilized enzyme carrier	Extraction and separation of active ingredients from plants, and removal of pigments and impurities
Solid-phase synthesis carrier	Peptide drug synthesis
Chromatography media	Separation and purification of biological proteins, nucleic acids and viruses such as vaccines, blood products, recombinant proteins and antibodies

Source: Sunresin website, CITICS Research

In the biopharmaceutical segment, the Company continues to push import substitution with products that are both environmentally friendly and cost-effective. Let's take the preparation of 7-ACA as an example:

Enzymatic preparation of 7-ACA is environmentally friendly and cost-effective. 7-ACA is mainly produced by chemical or enzymatic cleavage of CPC, with the chemical process mainly used in China before 2008 and the enzymatic process mostly used overseas. The chemical process is not only complicated with a low yield rate but also involves intensive use of toxic and harmful reagents and the emission of a large amount of organic and metal waste, which is harmful to the environment and human health. In contrast, the enzymatic process is simpler and safer, more environmentally friendly and less costly than the chemical process. Therefore, domestic producers adopting the chemical process lack a competitive advantage compared with overseas.

The Company has successfully achieved the enzymatic preparation of 7-ACA, which increases the global competitiveness of its 7-ACA products. Sunresin Technology has been conducting research on enzyme carrier technology for enzymatic production of 7-ACA since 2005 and has cooperated with domestic 7-ACA producers such as Joincare Pharmaceutical, making the domestic production of 7-ACA using enzymatic process a reality. At present, the Company has maintained a good cooperation relationship with major cephalosporin manufacturers, such as CSPC Pharmaceutical and Kelun Pharmaceutical, helping reduce their production costs significantly.

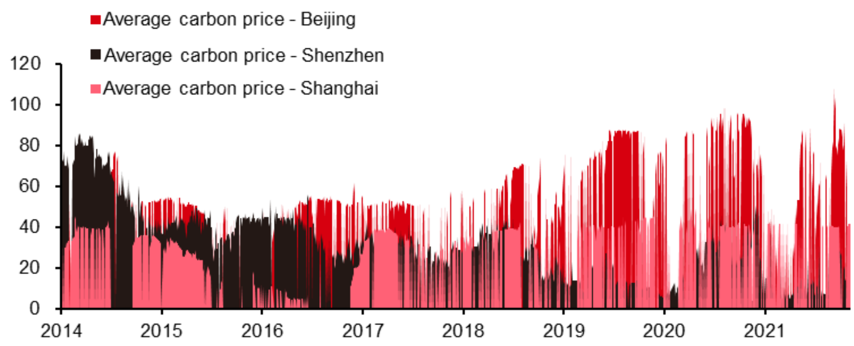
The Company has established a new biotech subsidiary to accelerate penetration in the domestic market. The Company set up a new subsidiary, Suzhou Sunresin Biotechnology Co., Ltd., in Suzhou Industrial Park in Jul 2021, which has a production capacity of 50,000L/year for life science products and a new upstream cell culture laboratory with increased annual R&D expenditure. The life science segment is the Company's prioritized segment for long-term development and is benchmarked against GE. Leveraging the Company's R&D strengths, the subsidiary is expected to achieve rapid penetration in the domestic market.

Adsorbent resins for carbon fixation have a bright outlook with carbon trading

Carbon trading is an important market mechanism to promote carbon neutrality. As a carbon pricing mechanism, carbon trading has significant advantages. Carbon trading refers to the buying and selling of carbon credits to emit greenhouse gases and is designed to reduce carbon emissions. Carbon trading has the following advantages: 1) the government directly determines the total amount of carbon emission allowances within a certain period, i.e. the maximum amount of CO_2 emissions, so there is a certainty of emission reduction; 2) its effective price discovery mechanism greatly enhances the market efficiency; 3) it is conducive to promoting cross-border and cross-regional emission reduction coordination and improving market liquidity.

China has preliminarily established a carbon trading scheme, though there is still significant room for improvement. On 16 Jul 2021, China's national carbon emission trading market was officially launched and received tremendous attention. Before the launch of the national carbon trading market, there had been several regional carbon trading systems in China, with the system in Beijing having higher carbon prices than in other regions because of the higher energy conservation and emission reduction pressure in Beijing, reflecting the market-based price determination mechanism of carbon trading.

Fig. 27: Average carbon prices in Beijing, Shenzhen and Shanghai (Rmb/t)

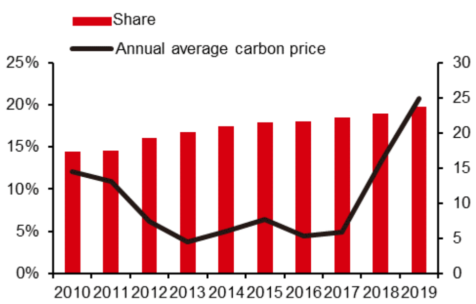


Source: Wind, CITICS Research

Carbon prices in China are far lower than in the EU and have a large upside. The current carbon price on the national carbon emission exchange is only c. Rmb43/t, and that on the Beijing Green Exchange is also no more than Rmb80-100/t, with a significant price upside compared to the current EU carbon price of 60€/t.

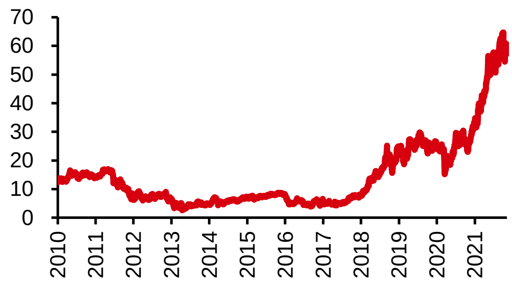
Carbon prices will rise as renewable energy makes headway into the energy mix. The energy transition towards clean energy is inevitably a process that starts with the easy and proceeds to solve the more difficult. For example, in order for coal-fired power to be gradually phased out and replaced by renewable energy sources such as solar and wind power, it requires the construction of large-scale energy storage infrastructure to meet the demand for energy throughout the day. Specifically, carbon prices are higher in the EU than in China because the transition to renewable energy in the EU is faster than in China, which further points to the upward trajectory of carbon prices.

Fig. 28: EU renewable energy share and carbon price (€/t)



Source: Wind, Eruostat, CITICS Research

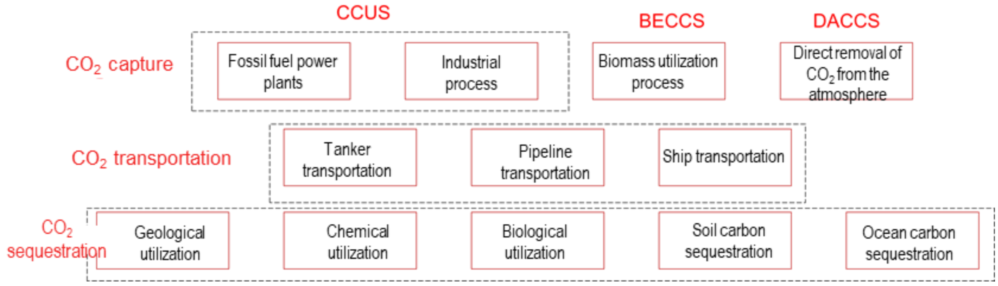
Fig. 29: EU carbon price (€/t)



Source: Wind, CITICS Research

CCUS technology is the most promising means to reduce emissions. CCUS, short for carbon capture, utilization and storage, is currently recognized as the most promising and effective means of carbon stock management and emission reduction. According to a study of the International Energy Agency (IEA), CCUS will contribute 14% of the cumulative global emissions reduction by 2060. It is also the most feasible low-carbon technology that allows the continued use of fossil energy while reducing emissions on a large scale. CCUS services are now fairly mature in overseas markets but still in their infancy in China. The Department of Science and Technology for Social Development, Ministry of Science and Technology predicts that China's CCUS market will reach an annual value of more than Rmb330bn by 2050, pointing to the huge potential of CCUS technology.

Fig. 30: Schematic diagram of CCUS technology

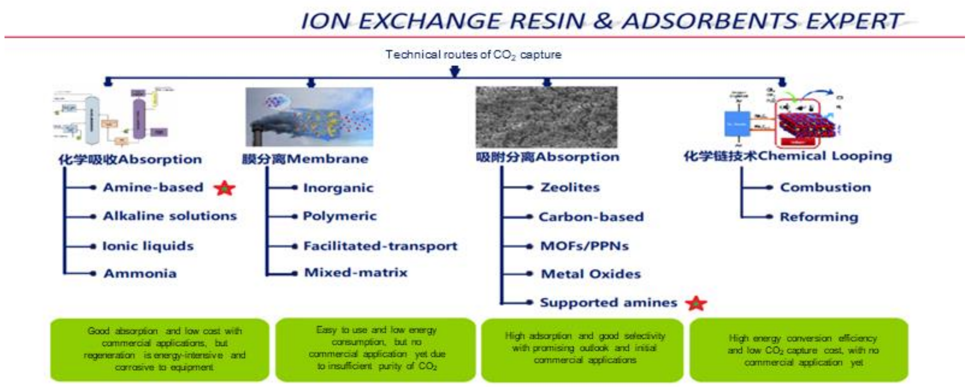


Source: *2021 Annual Report on Carbon Dioxide Capture, Utilization and Storage (CCUS) in China* (Chinese Academy of Environmental Planning, Ministry of Ecology and Environment), CITICS Research

CCUS will become increasingly economically productive as carbon prices gradually increase. The current average price per t of CO_2 treated by CCUS is US$150/t, which is not attractive even in the EU, where carbon prices are high. We expect CCUS to be increasingly widely promoted as it becomes more economically efficient, driven by the economies of scale, technological advances, and rising carbon prices.

The Company's Spelite-CT series carbon capture resin products have been sold to Europe. The traditional CO_2 capture technology is based on solvent absorption, with the core absorption material being liquid amine compounds. Liquid amines are highly adsorptive and cheap, but their regeneration is energy-intensive and is corrosive to equipment. Sunresin's proprietary Seplite-CT polymeric adsorbent resin, which has a macroreticular pore structure, boasts extensive advantages over traditional amine adsorbents, including large specific surface area, high adsorption efficiency, designed pore size distribution, controllable regeneration, less corrosion on equipment and ease of use. The product has wide application scenarios, such as thermal power generation, natural gas processing, steel production, coal chemical industry, chemical production, cement production and direct removal of CO_2 from the atmosphere.

Fig. 31: Main technical routes of CO_2 capture



Source: Sunresin website, CITICS Research

The underlying technology of the Company's Seplite series of resins is included on a national platform for technology transformation. In addition to CO_2 capture, the Company's "adsorption technology for efficient treatment of Volatile organic compounds (VOCs)" is listed in the first batch of technologies in the National Integrated Service Platform for the Transformation of Ecological and Environmental Science and

Technology Achievements. The Company's Seplite®LXQ resin and Sepsolut® integrated VOC treatment system has been validated by multiple enterprises to deliver an adsorption and removal rate of more than 99.9% for chlorinated volatile organic compounds. Boasting higher safety, greater stability, high precision, long life, high recovery rate, and the ability to recover lost raw materials and solvents while meeting emissions standards, the technology has become a powerful tool in the field of VOC treatment.

New plants will solve the capacity bottleneck

New capacity construction makes steady advances. As the Company's downstream application scenarios mushroom, the existing production capacity can no longer meet the demand in domestic and overseas markets, with under-capacity limiting its further development. In Jun 2019, the Company raised Rmb340mn via a convertible bond issue to fund its new materials industrial park project in Gaoling, which the Company expects will have produce 25kt of various types of resin annually after reaching design capacity; at the same time, the Company invested Rmb400mn in a 15ktpa resin project in Pucheng. With the existing 40ktpa production capacity for various types of adsorptive materials and the gradual release of new capacity from the above-mentioned two projects, the Company is expected to have a total capacity of 50ktpa, which will effectively resolve its under-capacity issue.

Table 20: Sunresin's production capacity under construction (10ktpa)

Projects under construction	Planned capacity	Progress (as of end-2020)	Planned completion	Product applications
Gaoling Sunresin New Materials Industrial Park Project	2.5	92.24%	Jun 2022	Including adsorption, ion exchange and chelating series of resins
Pucheng Materials Park Project	1.5	44.34%		The products are mainly adsorptive separation products with large-scale applications, especially in the field of electronic and nuclear grade ultrapure water.
Hebi Suncycle Project	10	85.09%		Waste resin treatment and reutilization

Source: Company announcement, CITICS Research

Two new green plants are put into operation. The Company's two new plants in Gaoling and Pucheng are constructed according to the highest environmental standards for the petrochemical industry and features multiple industry-first emission treatment units, leading the Company's own efforts of green development.

The Hebi Suncycle project is launched to form an industrial closed loop. With its subsidiary Hebi Suncycle having obtained the license for its 100ktpa resin resourcification plant, the Company is the only company in the industry to have presence across the entire industrial chain, encompassing resin R&D, production, sales, and recycling and delivering lifecycle services for adsorptive separation materials, which further reduces the environmental impact of resin production and waste and is in line with China's sustainable development strategy.

To sum up, Sunresin's adsorptive separation technology has diversified application scenarios and is expected to play an important role in advancing carbon neutrality in China and across the world. With the continued release of

new production capacity and increasing penetration in downstream markets, the Company offers high growth potential over the long term.

Potential risks

1) Significant price volatility of raw materials; 2) intensified industry competition; 3) progress in various business segments missing expectations.

Earnings forecast and valuation rating

Earnings forecast

Key assumptions:

1) **Ion exchange resin:** As the new Gaoling and Pucheng plants move towards full capacity, the various segments of adsorbent resin are expected to benefit from capacity release in the next 2-3 years and increasing market penetration.

2) **Systems:** The Company's system sales are expected to main stable growth with increasing applications of lithium extraction from salt-lake brines at home and abroad.

3) **Technical services:** The Company's technical services are expected to maintain stable growth with the expansion of adsorption application projects.

Table 21: Sunresin's revenue by segment, 2019-2023E

Unit: Rmb mn	2019	2020	2021E	2022E	2023E	2024E
Adsorbent resin						
Operating revenue	539.26	591.03	856.99	1,114.09	1,448.32	1,810.40
Cost	278.58	320.77	462.78	596.04	767.61	941.41
Gross profit	260.68	270.26	394.22	518.05	680.71	868.99
Gross margin	48.34%	45.73%	46%	47%	47%	48%
System equipment						
Operating revenue	468.83	296.6	311.43	373.72	448.46	538.15
Cost	227.01	158.05	155.72	179.38	215.26	258.31
Gross profit	241.82	138.55	155.72	194.33	233.20	279.84
Gross margin	51.58%	46.71%	50%	52%	52%	52%
Technical services						
Operating revenue	0.52	32.49	38.99	46.79	56.14	67.37
Cost	0.21	12.47	17.54	18.71	16.84	13.47
Gross profit	0.31	20.02	21.44	28.07	39.30	53.90
Gross margin	59.62%	61.62%	55%	60%	70%	80%
Other						
Operating revenue	3.32	2.5	3.25	4.23	5.49	7.14
Cost	1.85	1.24	1.30	1.69	2.20	2.86
Gross profit	1.47	1.26	1.95	2.54	3.30	4.28
Gross margin	44.28%	50.40%	60%	60%	60%	60%

Source: Wind, CITICS Research forecast

Based on the above assumptions, we offer the following forecasts for core financial indicators of the Company in the next three years.

Table 22: Sunresin's earnings, 2019-2023E

Item/Year	2019	2020	2021E	2022E	2023E
Operating revenue (Rmb mn)	1,012	923	1,211	1,539	1,958
Operating revenue (YoY,%)	60.1%	-8.8%	31.2%	27.1%	27.3%
Net profit (Rmb mn)	251	202	323	448	575
Net profit (YoY,%)	75.4%	-19.6%	59.8%	38.8%	28.4%
EPS (Rmb, Basic)	1.14	0.92	1.47	2.04	2.62
Gross margin	49.8%	46.6%	47.4%	48.3%	48.8%
ROE (%)	19.9%	12.2%	15.1%	17.8%	19.2%
BVPS (Rmb)	5.74	7.51	9.73	11.46	13.65
PE (x)	94.5	104.6	65.4	47.2	36.7
PB (x)	18.8	12.8	9.9	8.4	7.0

Source: Wind, CITICS Research forecast Note: Closing price as of 27 Jan 2022

Valuation and rating

1) PE valuation

Comparable companies in the industry are valued at an average PE of 57x in 2022. We identify Zhengguang Industrial, Jiuwu Hi-Tech and Nanomicro Technology as comparable companies, whose average PE in 2022 is 57x according to Wind consensus estimates.

Table 23: Valuation of Sunresin vs. comparable companies, 2020-2023E

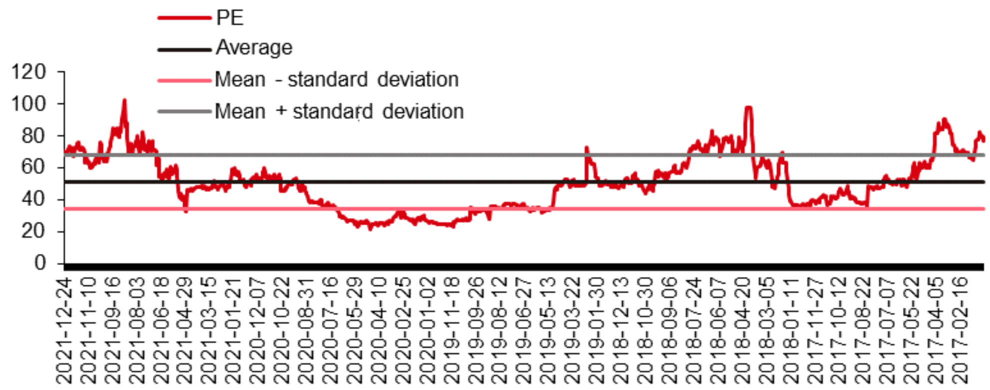
Ticker	Company	Share price	EPS				PE (x)			
			2020	2021E	2022E	2023E	2020	2021E	2022E	2023E
301092	Zhengguang Industrial	34.00	1.27	1.00	1.21	1.58	-	34.0	28.1	21.5
300631	Jiuwu Hi-Tech	33.56	0.76	0.70	1.02	1.36	22.74	49.0	33.7	25.4
688690	Nanomicro Technology	63.55	0.20	0.35	0.57	0.85	-	174.3	110.0	73.7
Average								85.8	57.3	40.2
300487	Sunresin New Materials	96.19	0.94	1.47	2.04	2.62	92.9	65.4	47.2	36.7

Source: Wind, CITICS Research forecast Note: Closing prices as of 27 Jan 2021; EPS forecasts for comparable companies are Wind consensus estimates

2) Vertical PE valuation

The Company's average PE over the past 5 years is 50x. The Company's PE (TTM) from 2016 to the present time is 50x with a mean ±1 standard deviation PE range of 34x-67x. Anticipating high growth of earnings and continued valuation matching in the next 2-3 years thanks to capacity ramp-up and increasing penetration in the downstream markets, and selecting the Company's historical mean PE plus 1 standard deviation as reference, we assign the Company 67x 2022 PE.

Fig. 32: Sunresin's historical PE (TTM) from 2016 to present



Source: Wind, CITICS Research

To sum up, we put the Company's reasonable PE at somewhere between 57x-67x. With carbon neutrality efforts gaining momentum, domestic and overseas NEV markets rapidly expanding, electronic and nuclear grade resins finding increasing applications, and CCUS technology continuing to spread, the Company has entered a phase of rapid growth across segments. We are bullish on the Company's continued rapid earnings growth driven by capacity ramp-up and increasing market penetration and consider its reasonable P/E to be at 60x. We maintain our 2021E-23E earnings forecasts of Rmb323mn/Rmb448mn/Rmb575mn and EPS forecasts of Rmb1.47/2.04/2.62 and reiterate the 2022E target price of Rmb120 (implying 60x 2022E PE) and the "BUY" rating.

Income Statement (RMB mn)

Indicator	2019	2020	2021E	2022E	2023E
Operating revenue	1,012	923	1,211	1,539	1,958
COGS	508	493	637	796	1,002
Gross profit margin	49.8%	46.6%	47.4%	48.3%	48.8%
Taxes and surcharges	9	12	12	14	18
Selling expenses	29	24	29	34	39
Selling expense ratio	2.9%	2.6%	2.4%	2.2%	2.0%
Administrative expenses	84	83	97	123	157
Administrative expense ratio	8.3%	9.0%	8.0%	8.0%	8.0%
Financial expenses	4	41	2	1	0
Financial expense ratio	0.4%	4.4%	0.1%	0.1%	0.0%
R&D expense	62	55	70	86	110
R&D expense ratio	6.2%	5.9%	5.8%	5.6%	5.6%
Investment income	1	1	1	1	1
EBITDA	324	354	430	573	719
Operating profit margin	28.09%	23.28%	29.00%	31.56%	31.74%
Operating profit	284	215	351	486	622
Non-operating revenue	0	3	1	1	2
Non-operating expenses	1	1	1	1	1
Total profit	284	217	351	486	622
Income tax	36	21	34	48	61
Income tax rate	12.6%	9.8%	9.8%	9.8%	9.8%
Non-controlling interest	(3)	(7)	(6)	(10)	(14)
Net profit attributable to shareholders	251	202	323	448	575
Net profit margin	24.8%	21.9%	26.7%	29.1%	29.4%

Balance Sheet (RMB mn)

Indicator	2019	2020	2021E	2022E	2023E
Cash and cash equivalents	401	605	952	1,318	1,657
Inventories	316	332	412	515	657
Accounts receivable	233	286	323	413	551
Other current assets	118	160	218	196	231
Current assets	1,068	1,383	1,905	2,442	3,096
Fixed assets	672	673	649	619	584
Long-term equity investment	2	3	3	3	3
Intangible assets	172	167	164	161	158
Other non-current assets	341	327	329	331	333
Non-current assets	1,186	1,170	1,144	1,114	1,078
Total asset	2,253	2,553	3,049	3,556	4,174
Short-term loans	0	71	0	0	0
Accounts payable	302	200	339	407	484
Other current liabilities	288	423	370	437	510
Current liabilities	590	695	709	844	994
Long-term borrowings	50	23	23	23	23
Other long-term liabilities	333	163	163	163	163
Non-current liabilities	383	186	186	186	186
Total liabilities	973	880	894	1,030	1,180
Share capital	207	215	220	220	220
Capital reserve	366	615	817	817	817
Total owner's equity attributable to parent company	1,261	1,650	2,138	2,519	3,001
Minority interests	19	22	16	7	-7
Total owners' equity	1,280	1,673	2,155	2,526	2,994
Total owners' equity and liabilities	2,253	2,553	3,049	3,556	4,174

Cash Flow Statement (RMB mn)

Indicator	2019	2020	2021E	2022E	2023E
Net profit	248	196	317	439	561
D&A	33	90	71	76	82
Change in working capital	-393	-104	-110	-44	-186
Other operating cash flow	65	79	21	7	19
Net cash flow from operating activities	-47	260	298	478	477
Capex	-236	-53	-43	-43	-43
Investment income	1	1	1	1	1
Other investing cash flow	-31	-6	-1	-1	-2
Net cash flow from investing activities	-265	-58	-43	-44	-44
Change in equity	54	1	208	0	0
Change in liability	32	41	-71	0	0
Dividend payment	-30	-52	-43	-67	-94
Other financing cash flow	242	-40	-2	-1	0
Net cash flow from financing activities	298	-50	92	-69	-94
Net increase in cash and cash equivalents	-14	152	347	366	339

Major financial indicators

Indicator	2019	2020	2021E	2022E	2023E
YOY (%)					
Operating revenue	60.1%	-8.8%	31.2%	27.1%	27.3%
Operating profit	73.0%	-24.4%	63.4%	38.3%	28.0%
Net profit	75.4%	-19.6%	59.8%	38.8%	28.4%
Profit margin (%)					
Gross profit margin	49.8%	46.6%	47.4%	48.3%	48.8%
EBITDA Margin	32.0%	38.4%	35.5%	37.3%	36.7%
Net profit margin	24.8%	21.9%	26.7%	29.1%	29.4%
Return rate(%)					
ROE	19.9%	12.2%	15.1%	17.8%	19.2%
ROA	11.2%	7.9%	10.6%	12.6%	13.8%
Other(%)					
Asset-liability ratio	43.2%	34.5%	29.3%	29.0%	28.3%
Tax rate	12.6%	9.8%	9.8%	9.8%	9.8%
Dividend payout ratio	20.6%	21.2%	20.9%	20.9%	21.0%

Source: Company announcement, CITICS Research forecast

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	Ratings	Description
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	OVERWEIGHT	Increase relative to market representative index between 5% and 20%
	HOLD	Increase relative to market representative index between -10% and 5%
	SELL	Decrease relative to market representative index over 10%
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