StarPower Semiconductor Ltd. | Asia Pacific

The domestic IGBT leader in steady progress, Initial OW

Stock Rating	Target Price
Over-Weight	CNY 437.00

Key Positive

StarPower's IGBT Products have tremendous potential in the New Energy Vehicles Market and Photovoltaic Market

New Energy Vehicles Market

According to the StarPower's semi-annual report disclosure, during the first-half year, **the revenue from the new energy industry reached a new high to CNY 547 mn, with an YoY increase of 197.9%**, approaching the size of the industrial controls and power supply industry in terms of revenue. Also, it accounted for 47.4% of the total revenue, increased by 21.9% compared to last year.

StarPower's products support more than 500,000 new energy vehicles, including more than 200,000 Class-A vehicles. On the other hand, **StarPower's 7th-generation micro-trench Trench Field Stop technology of the automotive-grade 650V/750V IGBT chips passed verification**. It has already been used in large volumes in various downstream industries. The new product is expected to further release the company's 12-inch wafer capacity in automotive-grade products, therefore reducing costs and increasing competitiveness.

StarPower also has a layout to produce SiC MOS modules. **Automotive-grade SiC MOS modules for passenger car main electric control have been installed in large quantities, and 1200V IGBT/SiC MOS modules have also been applied in projects of main motor controllers for several systems.** Under the trend of high-voltage fast-charging drive, the new energy vehicles above the A-class are anticipating an upgrade in power semiconductor. Since StarPower has advanced layout in 800V-related models, it is expected to further optimize the product structure and enhance the value of the product per vehicle, and the company's self-built production capacity in 2023 is also expected to bring long-term supply chain security and profitability level optimization.

Photovoltaic Market

StarPower is the major supplier of IGBTs for photovoltaic power generation and energy storage. StarPower's 650V/1200V single-tube IGBTs and modules with its own chips provide comprehensive support for household, commercial and industrial ground power plants, and are being installed in large quantities by domestic mainstream PV inverter customers. The demand for PV IGBTs, especially single-tube products, is very strong with the continuous promotion of distributed PV projects in China.

StarPower is also a major supplier of household and commercial grid-connected inverters and energy storage converters. Meanwhile, the company's product of 1200V IGBT modules are being used in 1500V system ground-mounted photovoltaic power plants and energy storage systems, and the volume is expected to gradually increase.

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StarPower (603290.SH)

Stock Rating	**Over-weight**
Target Price (CNY)	CNY 437
Shr price (15/12/22)	CNY 331
Up/downside (%)	32%
52-Week Range (CNY)	CNY 283.5-450.0
Shares Out. (CNY mn)	171
Mkt Cap (CNY Bn)	56.20
EV (CNY bn)	56.95
50 Days Mov AVG (CNY)	343.3
200 Days Mov AVG (CNY)	366.4

Fiscal year (12/31 End)

(CNY mn)	2021A	2022E	2023E
Revenue	**1,707**	**2,668**	**3,924**
YoY (%)	77%	56%	47%
Gross Profit	**627**	**934**	**1,373**
GPM	37%	35%	35%
EBIT	**444**	**652**	**953**
OPM (%)	26%	25%	24%
Pretax Income	454	551	881
Net Income	**398**	**485**	**775**
NPM	23%	18%	20%
Basic EPS	**2.5**	**2.8**	**4.5**

(Source: Online Research, Bloomberg News, Sifive Announcement, Company Data, CUIRS)

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Key Positive (cont.)
Policy promotes domestic substitution and StarPower's own technological advantages have been formed

External Level: Policy promotion drives supply and demand
The 20th National Congress pointed out that the strengthening of national strategic science and technology forces, optimistic about the development of the national system to accelerate the process of localization of semiconductor replacement. Also, China is accelerating the goal of carbon peak and carbon neutral, and the core components of IGBT division electrical energy conversion can effectively help carbon neutral through clean energy generation and utilization, and traditional energy consumption reduction.

External Level: The rise of domestic substitution broaden the market
IGBT market size is expected to exceed CNY 52.2Bn in 2025 in China. (link) Among them, new energy vehicles, photovoltaic and energy storage contribute a large increment, and the industrial control industry is a solid foundation for growth. However, at present, the localization rate of the industry is low, still less than 20%. However, due to the shortage of price hikes, **the industry localization rate is expected to reach 38% in 2022**. The delivery period of overseas IGBT manufacturers is still around 40-52 weeks and there is a serious trend of delivery period extension and price increase in the future, so there is a serious imbalance between supply and demand. Overseas manufacturers are generally more cautious in expanding production capacity, and the incremental capacity is limited.

Therefore, the localization process depends on the growth rate of domestic manufacturers' production capacity. According to forecast, **IGBT production in China's industry is expected to reach 78.2 mn units in 2024, with demand reaching 195.5 mn units. This leaves a huge supply and demand gap.** (Exhibit 1)

Internal Level: Fast growth with R&D advantage, clients certification advantage, and foundry resources advantage
The cost to enter the semiconductor market is very high, discouraging potential competitors. In China, the vehicle-grade IGBT certification cycle can take up to 2-3 years. The investment in an 8-inch wafer line with an annual capacity of 250,000 wafers is over CNY 2Bn. StarPower has been focusing on the design, development and production process of IGBT-based power semiconductor chips and modules for more than 10 years. **StarPower has been catching up with advanced overseas manufacturers in terms of technology.** (Exhibit 2)

Exhibit 1: 2015-2024 China IGBT Market Supply and Demand, by mn units (Intelligence Research Group, 2021)

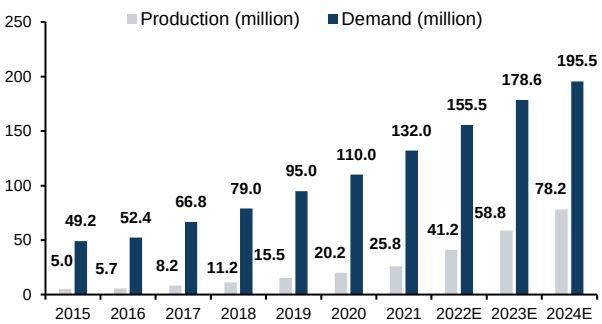

Exhibit 2: Since 2012, StarPower has benchmarked its products against international manufacturers (Zhong Lun Law Firm, 2021)

Year	StarPower	Compare to Infineon
2012	NPT IGBT Chip	2nd Generation
2015	Trench Gate + Field Stop IGBT Chip	4th Generation
2021	Microgroove + Field Cut-Off Automotive IGBT Chip	7th Generation

(Source: Online Research, Bloomberg News, Sifive Announcement, Company Data, CUIRS)

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Key Positive (cont.)
Achieving new growth by entering the SiC, and high-voltage IGBT market as a new growth point

SiC's advantages
SiC material is a high-voltage, high-frequency, and high-temperature material. For the new energy vehicle industry, SiC MOSFET solutions based on SiC materials have **3 major advantages compared to IGBT, including high voltage resistance (greater than 800V), loss resistance, and higher efficiency of the vehicle system**. Since SiC contributes more value to medium and large vehicles than small vehicles, however, with a higher cost of adoption of SiC MOSFET solutions(Exhibit 3), it is mainly used for the high-end new energy vehicle market. At present, some of the mid-to-high-end vehicles represented by Tesla have already started to use SiC MOSFET solutions.

Company growth arising from SiC
With the market demand for faster-charging speed and higher vehicle efficiency, as well as reduced cost of SiC MOSFET solutions thanks to matured technology improvement, SiC MOSFET solutions will be a strong alternative to vehicle-grade IGBT solutions.(Exhibit 4) Presently, the main suppliers of SiC used are foreign companies in the high-end new energy vehicle market. With the trend of domestic replacement, the company that heavily invested in self-research and self-production of SiC modules will expand into the high-end new energy market and gain a larger market share. In the future trend of SiC as a substitute to IGBT, the firm's SiC business would establish solid fundamentals to consolidate its market position.

Exhibit 3: Cost Per kW Comparison For 1500 V PV Inverters (Semiconductor Engineering, 2022)

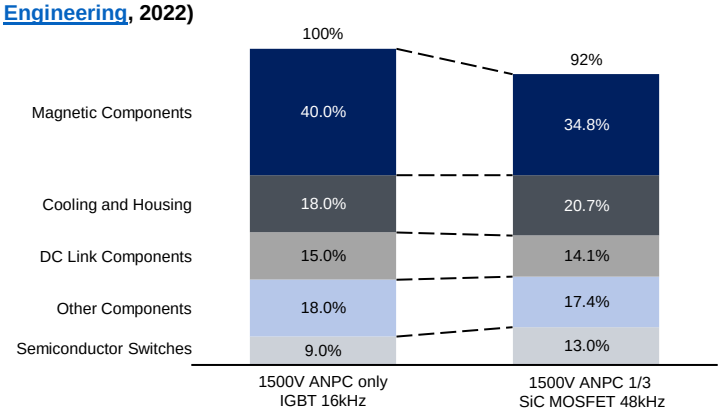
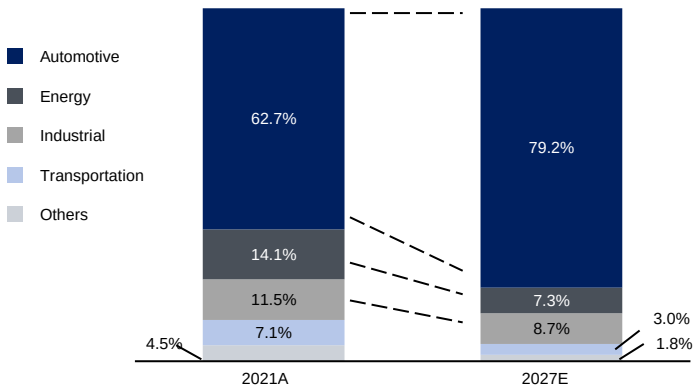


Exhibit 4: SiC Power Semiconductor TAM to Reach CNY 42.15Bn by 2027E With Industry Breakdown (i-Micronews, 2022)



(Source: Online Research, Bloomberg News, Sifive Announcement, Company Data, CUIRS)

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Key Positive (cont.)

High-voltage IGBT's advantage

Compared to IGBTs, high-voltage IGBTs are highly resistant to high voltage that exceeds 1700V. Their applications cover the power generation, transmission, substation, and consumption sides of smart grids, rail transportation, and wind power industries.(Exhibit 5)

Exhibit 5: Application of IGBT in High-voltage Field (Infineon Website, 2022)

6500V	High-Speed Train, Industrial Motors
4500V	High-speed train, Industrial motors, Nation eletronic grid
3300V	Wind power, Photovoltaic industries
1700V	Photovoltaic industries, Charging Piles, Frequency converter, EV
1200V	

Company growth arising from high-voltage IGBTs

China is actively promoting the development of smart grid, rail transportation, and wind power industries, driving the market demand for high-voltage IGBTs. However, China over-relies on foreign supply of high-voltage IGBTs, which hinders the growth rate of the infrastructure industry. Hence, the country has urgent demand for domestic high-voltage IGBTs at present. With a large investment in R&D of high-voltage IGBT modules, the company's products will meet the large demand for high-voltage IGBTs in smart grid, rail transportation, and wind power industries, which not only enriches the company's product line but also gains a larger and solid market share.(Exhibit 6)

Exhibit 6: StarPower Raises a Huge Amount of Capital For Investment Projects Through Non-public Offerings (StarPower 2021 Annual Report, 2021)

Project Name	Investment (CNY mn)
High-Voltage Special-Process Power Chip R&D And Industrialization Project	1,500
SiC Chip R&D And Industrialization Project	500
Power Semiconductor Module Production Line Automation Transformation Project	700
Adding Working Capital	800
Total	**3,500**

(Source: Online Research, Bloomberg News, Sifive Announcement, Company Data, CUIRS)

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Key Risks

StarPower faces short term fluctuations due to the macro trends of the market

World Semiconductor Trade Statistics believes that the semiconductor market might face a serious fluctuation in its growth rate in the second half of this year. The recent global economic slowdown might influence the current trend of the market and send the semiconductor industry into a period of rebalancing of its assets. Meanwhile SOX has seen the most severe decline in its history of 27.4% since the start of the year.

The global slowdown also implies a certain amount of supply chain disruption risk for StarPower, as the company relies heavily on importing materials for its manufacturing.

Semiconductor market is sensitive towards change in government policies

The IGBT sector in China has enjoyed major benefits from the current government policies in recent years, so a change in regulations will have significant effects on StarPower. Globally, as the technology competition between countries is getting fiercer by the day, one may expect future regulations which limit the growth and development of StarPower as it is the leading producer in China's IGBT sector. More specifically, tighter regulations might be implemented upon the importing of raw materials and machineries, intellectual property rights, security and review, etc. Such policies might impede the growth rate of the company.

(Source: Online Research, Bloomberg News, Sifive Announcement, Company Data, CUIRS)

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Valuation

CUIRS CET Initiated StarPower Semiconductor Ltd. with a TP of CNY 437 by discounted cash flow valuation & relative valuation, yielding a 32.0% upside as of the closing price on 15th December, 2022.

Revenue Projection

Net margin expected to increase by 18% and 20% to CNY 485.2mn and CNY 775.4 mn in 22/23 respectively.

We expect the company's revenue to grow 77%/56% to CNY 1,669 mn /CNY 2,654 mn in 2021/22 and net profit to grow 23%/18% to CNY 398.4 mn/ CNY 485.2 mn, respectively. The company achieved revenue of CNY 1.867 bn by 22 Q3, up 56.57% YoY, and net profit of CNY 590 mn, up 121.43% year-on-year, in line with our expectations. The company's gross profit margin improved significantly to 40.84%, mainly due to the rapid increase in the proportion of self-produced IGBT chips and the accelerated domestic replacement.

Throughout the year, from the revenue side – We believe that the growth of new energy business will be an important support for revenue growth in 2022, mainly due to the pull of the downstream demand of the new energy vehicle industry, as well as alternative demand, driving the company's share of the rapid increase. It is expected to become the main driving force of the company by 2023. At the same time, the company's self-research module packaging technology (early entry into the SiC 800V market), which start in 2023 will achieve sustained volume. On the profit side, we believe that in 2021/22, the company's net profit growth rate is expected to be faster than revenue growth, mainly from 1) the company's IGBT chip self-sufficiency rate continues to improve, driving the effective reduction of costs; 2) high-end 1200V IGBT product sales accounted for a continuous increase, nearly 73%, which will drive the comprehensive gross margin improvement.

Exhibit 7: Income Statement and Ratios

	Historical			Fiscal Years Ending December 31				
(CNY in mn)	**12/31/2019**	**12/31/2020**	**12/31/2021**	**12/31/2022**	**12/31/2023**	**12/31/2024**	**12/31/2025**	**12/31/2026**
Total Revenue	779	963	1,707	2,667	3,924	5,462	7,374	9,733
Gross Profit	239	304	627	934	1,373	1,912	2,581	3,407
Operating Income (Loss)	155	197	444	652	953	1,324	1,794	2,364
Net Income	**135**	**181**	**398**	**485**	**775**	**1,126**	**1,572**	**2,112**
EBIT	155	197	444	652	953	1,324	1,794	2,364
D&A	28	33	43	7	7	7	7	7
EBITDA	**183**	**230**	**486**	**659**	**961**	**1,331**	**1,801**	**2,371**
Basic Weighted Avg Shares			161	171	171	171	171	171
Basic EPS			**2.5**	**2.8**	**4.5**	**6.6**	**9.2**	**12.4**
Growth and Margin (%)								
Revenue Growth	-	24%	77%	56%	47%	39%	35%	32%
COGS Growth	-	22%	64%	61%	47%	39%	35%	32%
Gross Margin	31%	32%	37%	35%	35%	35%	35%	35%
EBIT Margin	20%	20%	26%	24%	24%	24%	24%	24%
Net Income Margin	17%	19%	23%	18%	20%	21%	21%	22%
Operating Margin	20%	20%	26%	24%	24%	24%	24%	24%

Exhibit 8: Revenue Breakdown

	Historical			Fiscal Years Ending December 31				
(CNY in mn)	12/31/2019	12/31/2020	12/31/2021	12/31/2022	12/31/2023	12/31/2024	12/31/2025	12/31/2026
Total Revenue	**779**	**963**	**1707**	**2668**	**3924**	**5462**	**7374**	**9733**
Annual Growth	-	*24%*	*77%*	*56%*	*47%*	*39%*	*35%*	*32%*
Industrial Control	581	707	1065	1331	1623	1899	2222	2556
Annual Growth	-	*22%*	*51%*	*25%*	*22%*	*17%*	*17%*	*15%*
% of Total Revenue	*75%*	*73%*	*62%*	50%	41%	35%	30%	26%
New Energy	165	215	571	1231	2147	3347	4850	6756
Annual Growth	-	*30%*	*166%*	*115%*	*74%*	*56%*	*45%*	*39%*
% of Total Revenue	*21%*	*22%*	*33%*	46%	55%	61%	66%	69%
White Goods & Others	33	41	71	106	154	215	301	422
Annual Growth	-	*24%*	*71%*	*50%*	*45%*	*40%*	*40%*	*40%*
% of Total Revenue	*4%*	*4%*	*4%*	4%	4%	4%	4%	4%

(Source: Company Disclosure, Bloomberg Terminal, CUIRS)

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Valuation

Relative Valuation (Discounted P/E)

Target Price: CNY 443 (Forward P/E ratio of 46x for 2026E)

Currently, the market capitalization of StarPower Semiconductor reaches 60.87 bn yuan (as of 18/11/2022), already reaching 19.79% of the market capitalization of global IGBT leader Infineon, but there is still a very large gap between the market share and overseas leaders such as Infineon. The market's expectation of a rapid increase in StarPower's market share and its position as a domestic IGBT leader (compare with average CNY 71.476 bn) remains unchanged. StarPower's high valuation is due to the rising demand for semiconductor substitution.

1) the massive release of module capacity from the 2022 fundraising project will be presented in the future; 2) the company's future revenue volume expansion also relies on the rapid development of the new energy vehicle industry, according to the data from the China Association of Passenger Associations, China's new energy vehicle sales in 2021 will be 3.521mn units, with a penetration rate of only 13.4%. With the further implementation of policies, China's new energy vehicles are expected to continue to grow.

On a 5-year dimension, we expect the company's revenue to reach CNY 9.733 bn, with a 5-year CAGR of 17.84%.We have selected seven semiconductor chip design companies currently listed on the A-share as comparable companies. They all adopt the Fabless model in their business model. Using the remaining relative valuation metrics, the average industry 2022 P/S is currently 14.8x and the average 22-year EV/EBITDA is 82.3x.

Based on StarPower's position as the leading domestic IGBT, we consider the current median for mature international IGBT/IC design houses at 45.9x P/E. Based on market space, we expect the company's EPS to reach CNY 12.4 in 2026, discounted to 2022 at a discount rate of 8.7%, giving us a target price of CNY 443 in 2023.

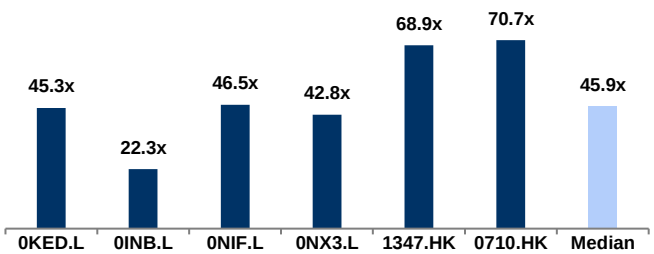
Exhibit 9: Discounted P/E Valuation

Relative Valuation - 26E Based PE (x)								
(CNY in mn)	2019A	2020A	2021A	2022E	2023E	2024E	2025E	2026E
Revenue	**779.4**	**963.0**	**1,706.6**	**2,667.5**	**3,924.1**	**5,462.0**	**7,373.7**	**9,733.3**
YoY Growth (%)	-	24%	77%	56%	47%	39%	35%	32%
Gross Profit	**238.6**	**303.9**	**626.8**	**933.6**	**1,373.4**	**1,911.7**	**2,580.8**	**3,406.7**
Gross Margin (%)	31%	32%	37%	35%	35%	35%	35%	35%
Operating Income (Loss)	**154.8**	**196.9**	**443.9**	**652.3**	**953.4**	**1,324.4**	**1,794.2**	**2,364.4**
Operating Margin (%)	20%	20%	26%	24%	24%	24%	24%	24%
Pretax Income (Loss), GAAP	**144.8**	**208.8**	**454.0**	**551.4**	**881.1**	**1,279.7**	**1,786.7**	**2,400.4**
Net Income, GAAP	**135.3**	**180.8**	**398.4**	**485.2**	**775.4**	**1,126.1**	**1,572.3**	**2,112.3**
Net Margin (%)	17%	19%	23%	18%	20%	21%	21%	22%
Basic EPS, GAAP	-	-	2.5	2.8	4.5	6.6	9.2	12.4
EPS Growth YoY (%)	-	-	-	14.6%	59.8%	45.2%	39.6%	34.3%
*25E Target PE (x)								46.0x
*Endgame Valuation (Target PE x 25E EPS)								CNY 569
Target Price Per Share (TWD, 22E Based)					CNY443			
Implied Upside (%) From Current Price					34.0%			
Implied 22E-26E P/E (x)					97.5x	67.2x	48.1x	35.8x

Cost of Equity Assumptions - Discount From 25E-22E	
Beta	0.46
Risk-Free Rate	3.2%
Market Risk Premium	12.0%
Cost of Equity	**8.7%**

Ticker	22E PE (x)	EPS YoY	Sales YoY
603290.SH	76.8x	40.30%	64.16%
603160.SH	75.6x	120.29%	-22.13%
300661.SZ	64.3x	29.47%	46.71%
688008.SH	58.3x	47.46%	59.17%
688123.SH	44.7x	52.53%	80.47%
603501.SH	25.7x	34.64%	-0.79%
300327.SZ	28.4x	25.00%	28.06%
Correl.	**1.00**	**0.52**	**0.09**
R-Square	**1.00**	**0.27**	**0.01**

Exhibit: 10 Global Mature Peers' 22 E P/E (x)



(Source: Company Disclosure, Bloomberg Terminal, CUIRS)

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Financials

Absolute Valuation – Discounted Cash Flow Valuation

Target Price: CNY 431 Per Share

Followed from previous base case projections on Andes (Net income growth at a 23%, with revenue growth at 56%, CAGR 17.84%, reaching 25E CNY 9733.3 mn revenue scale and CNY 2364.4 mn net profit), our CNY 431 price target is based on a DCF reflecting growth of StarPower with terminal exit year of 2026.

Starting from cash flow from operations, our improving EBITDA margin 24%, and calculate 5 years' unlevered free cash flow. We further apply 8.4% WACC (Note: Beta since IPO: 0.46, China 20-year treasury yield: 3.2%) to get NPV 10908.6 mn. We implied 37x EV/EBITDA and perpetual growth rate at 3% (Note: company situation and inflation factors). We use the 21A total debt and total cash balance for our valuation in our net debt calculation to reflect the real cash balance.

Exhibit 11: DCF Valuation

Discounted Cash Flow								
(CNY in mn)	12/31/2019	12/31/2020	12/31/2021	12/31/2022	12/31/2023	12/31/2024	12/31/2025	12/31/2026
Cash flow from operations								
Revenue	**779.4**	**963.0**	**1,706.6**	**2,667.5**	**3,924.1**	**5,462.0**	**7,373.7**	**9,733.3**
Revenue growth		*24%*	*77%*	*56%*	*47%*	*39%*	*35%*	*32%*
EBITDA	183.0	229.9	486.4	659.4	960.5	1,331.5	1,801.3	2,371.5
EBITDA margin	23%	24%	28%	25%	24%	24%	24%	24%
EBIT	154.8	196.9	443.9	652.3	953.4	1,324.4	1,794.2	2,364.4
EBIT margin	*20%*	*20%*	*26%*	*24%*	*24%*	*24%*	*24%*	*24%*
Tax rate	(6%)	(13%)	(12%)	(12%)	(12%)	(12%)	(12%)	(12%)
EBIT* (1-Tax)	164.4	223.1	497.2	730.6	1,067.8	1,483.3	2,009.5	2,648.1
(plus) D&A	28.2	33.0	42.5	7.1	7.1	7.1	7.1	7.1
(less) changes in working capital	-	532.8	3,562.4	525.6	708.2	1,019.3	1,483.3	1,989.1
(less) Capex	(49.4)	(228.6)	(987.2)	(52.5)	(55.7)	(59.0)	(62.6)	(66.3)
Unlevered free cash flow	**143.2**	**560.3**	**3,115.0**	**1,210.7**	**1,727.4**	**2,450.6**	**3,437.4**	**4,578.0**
								-
WACC	**8.4%**							
Net Present value	**10,908.6**							

Exhibit 12: EV/WACC Calculation

Enterprise value	
Net Present value	10,908.6
Terminal Value	
Perpetual growth rate	3%
Terminal Value	87,734.3
Implied EV/EBITDA	37.0x
Present value of terminal value	58,685.6
NPV of present value	10,908.6
Enterprise Value	**69,594.2**
Total debt	104.4
Cash	3,721.9
Net Debt/ (Net Cash)	**(3,617.5)**
Minority interest	(0.4)
Equity Value	**73,212.0**
Number of share outstanding	170.0
indicated per share price (CNY)	**431**

WACC Calculation	
Beta	46.0%
Risk free rate	3.2%
Market premium	12.0%
Cost of equity	**8.7%**
Cost of debt	**5.0%**
Debt/(Debt+equity)	8.0%
Effective tax rate	12.0%
WACC	**0.084**

Exhibit 13: Sensitivity Analysis

Sensitivity Analysis - Equity Value (CNY mn)

WACC (%) \ Perpetuity Growth (%)	2.0%	2.5%	3.0%	3.5%	4.0%	4.5%	5.0%
8.2%	65,357	70,083	75,718	82,551	91,012	101,759	115,864
8.7%	60,371	64,318	68,958	74,489	81,198	89,504	100,054
9.2%	56,090	59,427	63,302	**67,857**	73,288	79,875	88,029
9.7%	52,376	55,227	58,503	62,308	66,781	72,113	78,581
10.2%	49,124	51,582	54,382	57,600	61,336	65,728	70,964
10.7%	46,256	48,392	50,806	53,556	56,716	60,385	64,698

Sensitivity Analysis - Share Price (CNY, Per Share)

WACC (%) \ Perpetuity Growth (%)	2.0%	2.5%	3.0%	3.5%	4.0%	4.5%	5.0%
8.2%	384.5	412.3	445.4	485.6	535.4	598.6	681.6
8.7%	355.1	378.3	405.6	438.2	477.6	526.5	588.6
9.2%	329.9	349.6	372.4	**399.2**	431.1	469.9	517.8
9.7%	308.1	324.9	344.1	366.5	392.8	424.2	462.2
10.2%	289.0	303.4	319.9	338.8	360.8	386.6	417.4
10.7%	272.1	284.7	298.9	315.0	333.6	355.2	380.6

(Source: Company Disclosure, Bloomberg Terminal, CUIRS)

StarPower Semiconductor Ltd. | Asia Pacific

Industry Introduction

The Global IGBT Market is expected to reach 16% CAGR and the China IGBT market is expected to reach 21%. Among various industries covered, the New Energy Vehicles Industry and the Photovoltaic & Energy Storage Industry account for the largest portion.

New Energy Vehicles Industry

Industry Summary

IGBT modules play a vital role in new energy vehicles and are core technology components. IGBT for power conversion can improve the efficiency and quality of electricity consumption. Its feature of energy efficiency is a key support technology to solve the energy shortage problem and reduce carbon emissions. Application parts include a motor controller, vehicle air conditioning control system, and charging pile. In terms of commercial value, the total value of a single vehicle IGBT is around CNY 800-CNY 4,000.(Exhibit 14)

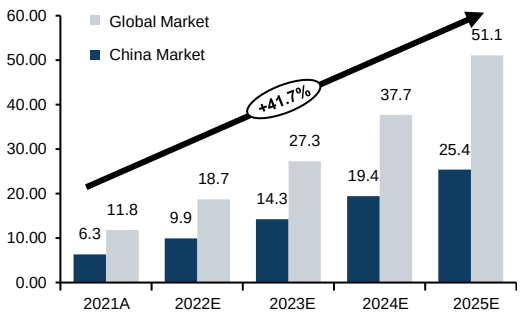
Future Prospect

The electrification trend in the new energy vehicle industry will drive significant growth in IGBT demand. According to CCA and CleanTechnica, the total sales of new energy vehicles in China will exceed 3.5 mn units in 2021, making it the largest market in the world. **As a core component of new energy vehicles, IGBT market is expected to reach 41.7% CAGR in the next five years.**(Exhibit 15)

Exhibit 14: Value Breakdown of IGBT Devices For EV & Supporting Facilities (StarPower 2022 Semi-Annual Report, 2022)

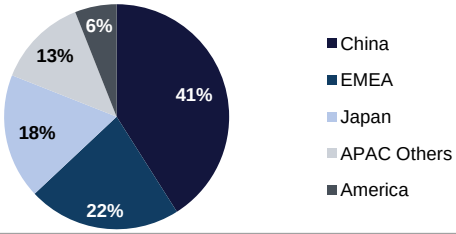
Application	Power (kW)	Average Price per vehicle (CNY)
Drive Motor Controller	100 - 150	1,300
In-vehicle Air Conditioning Controller	1.5 - 5	100
PTC Heater, Water Pump, Oil Pump	-	100

Exhibit 15: Automotive-Grade IGBT Market Size Forecast in China And Global Market, by CNY Bn 21A – 25E (WIND)



With the trend of domestic replacement, domestic IGBT manufacturers have great potential for expansion. **Imported IGBT manufacturers occupy 38% of the domestic market and almost monopolize the high-end product field.** At the same time China still accounts for nearly 41% of global IGBT demand.(Exhibit 16) Domestic manufacturers represented by StarPower are still investing in the R&D of IGBTs for the high-end market to fill the gap in local demand.

Exhibit 16: China is the largest downstream demand market for IGBTs in 2021, by % (Research And Markets, 2022)



(Source: Online Research, Company Annual Report, Deloitte Research, CUIRS)

StarPower Semiconductor Ltd. | Asia Pacific

Industry Introduction

Photovoltaic Industry

Industry Summary

In the PV industry, IGBTs, as the core component, are mainly used in PV inverters, which accounts for 15%-20% of the value of the inverter. Regarding the function of the PV inverter, since the DC power output from PV power generation does not meet the requirements of the grid, the PV inverter can convert DC power into AC power that meets the requirements. Product types are mainly divided into string inverters, centralized inverters, and decentralized inverters. According to the China Photovoltaic Industry Association, string inverters for small and medium-sized PV power plants account for 66.5% of the market share; centralized inverters, which are commonly used in large PV power plants, accounting for 28.5% of the market share. **The global IGBT market for PV inverters will expectedly expand at a growth rate of 17.6% and will reach CNY10.27 bn in 2025. (Exhibit 17)**

Future Prospect

Policies drive the market demand for IGBT modules in PV inverters alongside the development of the photovoltaic industry. In October 2021, the State Council issued the "Action Plan for Carbon Peaking by 2030", emphasizing the vigorous development of new energy and accelerating the construction of photovoltaic power generation bases.

Domestic replacement in the PV industry drives the market room for the expansion of IGBT modules in PV inverters. According to Wood Mackenzie, the top 10 companies in global PV inverter sales in 2021, Huawei and Sunshine Power, have a 23% and 21% market share, respectively, ranking the top two globally. (Exhibit 18) However, according to China Power Network estimates, in 2021, **IGBT modules in PV micro-inverters have a localization rate of 5-8%, showing broad space for domestic replacement.**

Exhibit 17: PV Inverter Market Size Forecast, by CNY Bn (Allied Market Research, 2021)

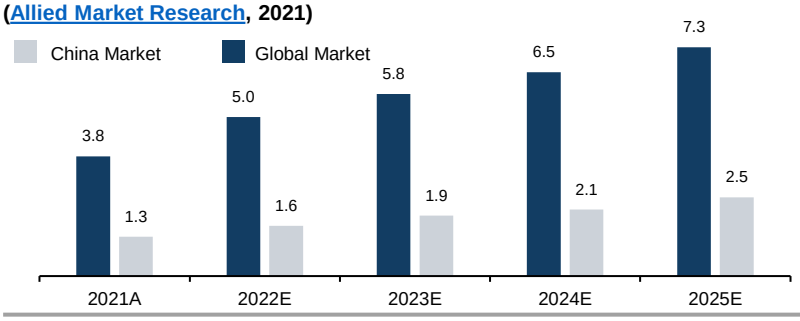
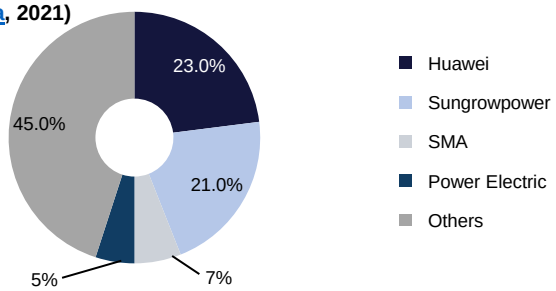


Exhibit 18: Global Inverter Supplier Shipment Share in 2021, by % (Statista, 2021)



(Source: Online Research, Semico Research, Company Report, Deloitte Research, CUIRS)

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Industry Introduction

Industrial Control Application Industry

Industry Summary

As the manufacturing industry continues to upgrade, industrial automation is in high demand for higher-performance motors in which power semiconductor devices, such as IGBT modules, are the core devices. In 2020, 27% of China's IGBT downstream applications are for industrial automation and control. **Globally, industrial automation is the largest market for IGBTs, accounting for 37% of the demand.** In particular, the main IGBT applications in this field include inverters, inverter welders and UPS power supplies.

Future Prospect

The total addressable market of the IGBT industrial control field in China will exceed CNY 16.88Bn in 2025. For the three main IGBT applications, which are inverters, IPM, and UPS power supplies, the market sizes are expected to reach CNY 6.22Bn, CNY 6.76Bn, CNY 3.40Bn in 2025, respectively. (Exhibit 19/20)

Exhibit 19: Inverter IGBT Market Size in CNY mn (Qianzhan Research, 2021)

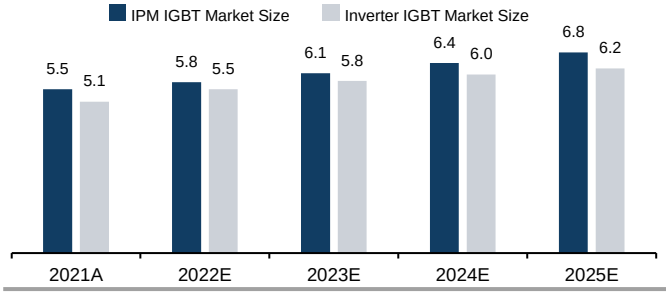
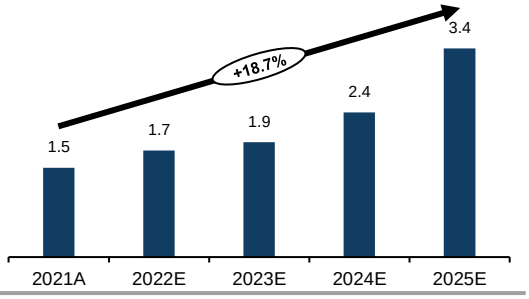


Exhibit 20: UPS IGBT Market Size in CNY Bn (SkyQuest Technology Consulting, 2022)



SiC Industry

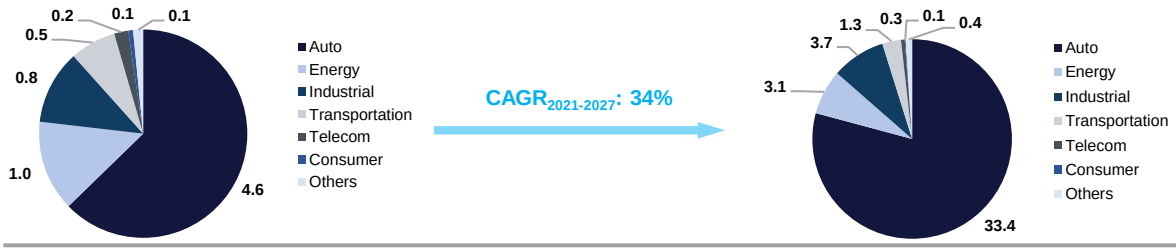
Industry Summary

The SiC industry is characterized by high barriers and competitive landscape, long R&D cycle, high manufacturing difficulty and high capital investment. Compared with Si-based materials, SiC MOSFETS have the advantages of low conduction loss, low switching loss, high switching frequency, high power density. It is more suitable for making high temperature, high frequency, radiation resistant and high-power devices, including new energy vehicles, wind power photovoltaic and other high-voltage fields.

Future Growth

Global SiC power device market is expected to reach CNY 7.31Bn in 2021 and CNY 42.13Bn in 2027, with 6-year CAGR of 34%.(Exhibit 21)

Exhibit 21: 2021-2027 Power SiC Market Devices Split By Segment, by CNY Bn (Yole Development, 2022)



(Source: Online Research, Company Annual Report, Deloitte Research, CUIRS)

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Industry Introduction

Competition Landscape

Infineon is the global IGBT leader, with a certain monopoly strength, in addition to Mitsubishi, Fuji Electric, ON Semiconductor, SEMIKRON and other US, Japanese and European manufacturers also have strong competitiveness.

According to Omdia data, Infineon is the market leader in IGBT modules in 2018, with a market share of 34.5%; Mitsubishi and Fuji Electric are in second and third place, with a market share of 10.4%/9.7% respectively. **StarPower is in the eighth place, with a market share of 2.2%, and is the only domestic company to enter the global top 10.**

Exhibit: 22 Competition Landscape

Company	starpower	Fuji Electric	MITSUBISHI ELECTRIC Changes for the Better	SEMIKRON innovation+service	Vincotech	infineon
Ticker	603290.SS	6504.T	TYO: 6503	Unlisted	Unlisted	IFX
Founding Year	1995	1923	1921	1951	2007	1999
Main Products	1200V IGBT modules, other voltage IGBT modules and other products, which are principally used in industrial control and power industry, new energy industry.	Drives & Inverters. AC Drives. Semiconductors. Power Supply. UPS, Uninterruptible Power System. Sensors & Measurements. Instrumentation. Factory Automation Systems. PLC	Sic-MOSFET, SiC-SBD, Sic Power Modules, IGBT Modules, HVIGBT Modules, Power MOSFET Modules, etc	Integrated circuits, discrete semiconductors, transistor, diode and thyristor power modules power assemblies and systems.	Power module topologies, standard solder-pin connections Press-fit technology, spring connections, innovative thermal interface material (TIM)	Microcontrollers Telecommunications Integrated circuits Power electronics Transient-voltage-suppression diodes
Revenue	$239,400,000	$6,189,564,000	$30,464,000,000	$44,371,000	N/A	$10,949,400,000
Net Income	$55,773,200	$398,888,000	$1,383,664,000	$1,683,000	N/A	$1,158,300,000
Net Profit Margin	23.30%	6.44%	4.54%	0.38%	N/A	10.58%
PE Ratio	102.2x	12.5x	15.9x	N/A	N/A	20.4x
Advantages	Domestic IGBT module industry leader, achieving high revenue and profit growth for many years. The company's SiC modules are starting to be released, and the long-term growth trend in the downstream track of new energy vehicles and new energy power fields is highly certain.	Market Scale Advantage Through extensive technological innovation, power semiconductor IGBT modules have achieved miniaturization, low power consumption and high reliability.	Market scale advantage Strong layout of the different market Unique manufacturing process with applications in MOSFETs to further improve performance and productivity	The combined Semikron-Danfoss will have more than 3,500 experts in the field of power electronics and will shift its future investment and technology development focus to SiC solutions for markets such as industrial applications and automotive applications.	High-quality electronic power components for a wide range of applications in motor control, renewable energy, uninterruptible power supplies (UPS) and switching power supplies.	The world's largest IGBT supplier Cost and scale advantages Years of R&D experience and technical advantages
Market Share	2.80%	11.40%	9.70%	5.80%	3.30%	36.50%
Market Capitalization	$8,629,600,000	$5,888,256,000	$19,108,000,000	N/A	N/A	$33,155,100,000
R&D Expense	$13,528,200	$229,540,800	$1,430,040,000	N/A	N/A	$1,435,500,000
R&D/sales	5.65%	3.71%	4.69%	N/A	N/A	13.11%

(Source: Online Research, Semico Research, Company Report, Deloitte Research, CUIRS)

StarPower Semiconductor Ltd. | Asia Pacific

Company Profile

Company Overview

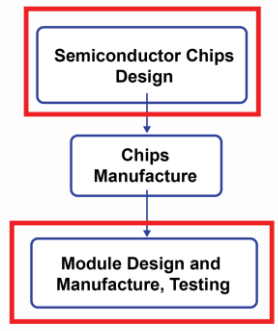
StarPower's main business is the design, development and production of IGBT-based power semiconductor chips and modules. They are a leading supplier of IGBT modules. The core of a IGBT module consists of the IGBT chip and the Fast Recovery Epitaxial Diodes (FREDs). StarPower has independently developed and designed both the IGBT chip and the FREDs, and both are currently two of the company's core competencies. As a new type of power electronic device, IGBT is recognized internationally as the most representative product of the third revolution of power electronic technology, and is a core component in the field of industrial control and automation.

According to the data from the global IGBT modules market of 2020, StarPower's shares ranked 8th globally and 1st domestically, and was the first Chinese company ranked in the world's top ten market shares of IGBT suppliers. The main source of demand for StarPower's products comes from the domestic market. The goal of the company is to eventually replace the imported IGBT modules with its own. StarPower has an oversea establishment, namely the StarPower Europe AG in Germany, but it makes up only a small percentage of the income and is mainly focused on International business expansion along with design and development of semiconductor chips and modules.

Business Model & Services

StarPower dedicates to the design and manufacturing of IGBT modules with 3 main steps: (Exhibit 23)

Exhibit 23: Manufacturing Process



Step 1 – Chip and Module design
The company designs the power module along with the IGBT chips and Fast Recovery Epitaxial Diodes according to the needs of the consumer. The device is designed based on the key parameters provided by the customers to meet the necessary performance requirements, suitable for various industries.

Step 2 – Outsourcing Chip Manufacturing
Being a fabless company, StarPower outsources the manufacturing of chips to third party semiconductor foundries like Hua Hong Semiconductor Ltd., ASMC, etc. Although StarPower provides the designed blueprints and manufacturing process of the microchips to the corresponding third parties, the company is ultimately not responsible for the manufacturing of such parts.

Step 3 – Module Production, Manufacture and Testing
StarPower's production of modules is a process of encapsulating single or multiple power chips such as IGBT chips, Fast Recovery Epitaxial Diodes, etc., in an insulating shell with advanced semiconductor packaging technology. A variety of corresponding microchips, DBCs, heat-dissipating substrates and other raw materials needs to be purchased and applied according to varied requirements from different customers. To produce modules that meet the company's standards, processes such as surface mounting, reflow soldering, aluminium wire bonding, and testing are then used.

Modules not only have a complex internal structure, but they also have to be able to operate under harsh environments such as high voltage, high current, high temperature, and high humidity. These requirements are demanding for the company's design capabilities and production process control.

(Source: Online Research, Company Annual Report, Deloitte Research, CUIRS)

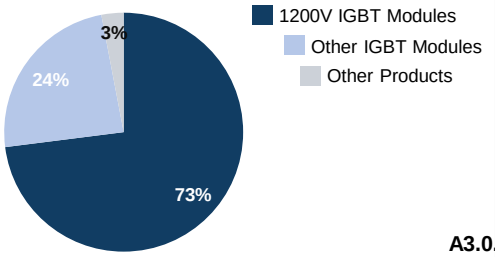
StarPower Semiconductor Ltd. | Asia Pacific

Company Profile

Product & Service Summary

Sales of the modules make up about 94% of StarPower's total revenue in the first half of 2022. Of which (According to data from 2019), sales of 1200V IGBT modules take up about 70% of total sales while other IGBT modules with different voltage capacity take up about 20%. (Exhibit 24)

Exhibit 24: Revenue by Products and the 1200V IGBT Module



A3.0.Single, StarPower's 1200V

IGBT Modules

A IGBT module functions like a human heart in machineries, being able to adjust the voltage, current, frequency, phase, etc. in the circuit according to the signal instructions from the industrial device. With such a module, one can achieve the purpose of precise regulation. Therefore, IGBT is being called the "CPU" in the power electronics industry, and is widely utilized in motor energy saving, rail transit, smart grid, aerospace, household appliances, automotive electronics, new energy power generation, new energy vehicles and other fields.

StarPower standardized the size of the IGBT module's outline and its mount and connected circuits within the module. (Exhibit 25) As such, products made by StarPower, compared to modules with a similar volume, **have the advantages of small size, light weight, compact structure, high reliability, simple external wiring and good interchangeability.**

Exhibit 25: Starpower's Other Voltage Capacity IGBT Modules

B3.2.3-level 600V

A.3.1.Half Bridge 1700V

A.4.0.Single 3300V

Other Products (Account For <5% as of 2021A Revenue)

MOSFET, FRD, Discrete Device

MOSFET function similarly to IGBT, enabling users to precisely control the electronic device. However, they generally have a lower voltage capacity compared to IGBT modules, meaning they cannot be applied to high voltage environments like railway systems, electric cars, etc. (Exhibit 18)

(Source: Online Research, Semico Research, Company Report, Deloitte Research, CUIRS)

StarPower Semiconductor Ltd. | Asia Pacific

Company Profile

Exhibit 26: Starpower's Other Products

MOSFET B7.0.3 Phase Bridge

C8.2.Full Bridge

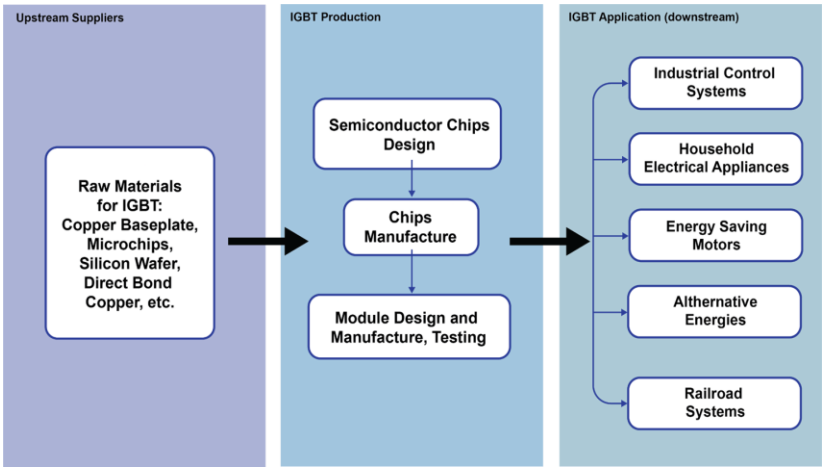
Discrete Device T2.0.Single

FRD, or Fast Recovery Diodes, are applied in areas such as diodes converter and da-ac converters, where high frequency applications are required, ranging from a few kHz up to 100 kHz. Discrete semiconductor devices are applied in many areas with the goal of regulating voltage or reducing heat generation.

Supply Chain Position

As shown in their business model, StarPower is a fabless company. The company is mainly responsible for the design and production of the modules while outsourcing the chip manufacturing to other companies.

Exhibit 27: IGBT Module Industry Chain



Upstream Suppliers:
Chips: Infineon, ADI, etc.
Copper Baseplate: Saiying Electron Co
Silicon Wafer: SUMCO, NSIG, Hangzhou Lion Microelectronics, etc.
DBC: Rogers Germany

Downstream Consumers:
Industrial Control: Shenzhen Inovance Tech, Sichuan Injet Electric Co, etc.
Electric Cars: NIO, BYD, etc.
Alternative Energy: Sungrow Power Supply, GoodWe, etc.

(Source: Online Research, Semico Research, Company Report, Deloitte Research, CUIRS)

StarPower Semiconductor Ltd. | Asia Pacific

Company Profile

Key Consumers

The main demand for StarPower produced IGBT modules comes from the Industrial Control Systems (49.1%) and the Alternative Energy Sector (47.4%).
Major customers from Industrial Control Systems include Shenzhen INVT Electric, Shenzhen Inovance Tech, and ZONCN.

The alternative energy sector mainly consist of wind and solar energy, which are expected to significantly increase in demand in the coming years. The sector is also heavily comprised by electric car manufacturers. Such manufacturers include JEE and Shanghai Edrive Co. The end user for JEE includes CHERY, JAC Motors, YUDO, and several other domestic car manufacturers. The end users for Shanghai Edrive are FAW Group, Changan Automobile, and several domestic car manufacturers along with Groupe Renault, General Motors, and other foreign companies.

Revenue Breakdown As of 2021A

Revenue by End Users

Although Industrial Control Systems has been the main source of demand, there has been a significant increase in proportional demand from Alternative Energy Sector. The amount of revenue generated from the sector is expected to surpass that of the Industrial Control System soon. The revenue stream from frequency conversion in electric compliances has maintained its proportion with a steady growth rate. (Exhibit 28)

Revenue by Region

The main source of income for StarPower is concentrated in the Asia Market. Foreign revenue mainly comes from StarPower Europe AG. The company is working on expanding into foreign markets. (Exhibit 29)

Revenue by Products

Sales of IGBT module makes up the vast majority of StarPower's income. Different voltage capacity of IGBT is available while the most predominant is the 1200V model. Other products include MOSFET, FRD, Discrete Device, totaling about 6% of StarPower's total revenue. (Exhibit 29)

Exhibit 28: End User Proportion Changes in Recent Years, by % (20A – 22E)

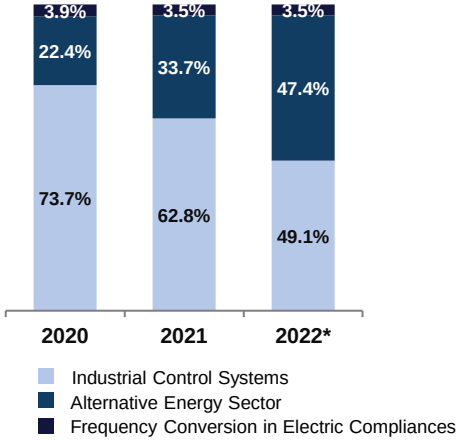
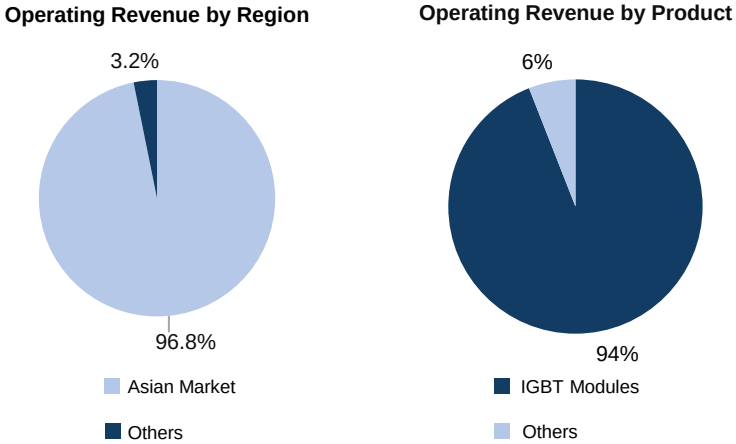


Exhibit 29: Revenue By Region And Products, by % (2022 Q2)



(Source: Online Research, Semico Research, Company Report, Deloitte Research, CUIRS)

Company Profile

Investment Projects

The company's investment projects are at the forefront of the industry, with large application space and value-added space in the future.

a) Continue to increase the expansion project of IGBT modules for new energy vehicles to enhance the core competitiveness of the company.

b) Continuously broaden business, carry out IPM module research and development, value-added white goods revenue.

c) Continuously expand the technology R&D center to dock the technical layer IGBT modules with the application layer IGBT modules.

R&D innovation is the core driver of the Company's business development and a key factor for the Company to gain advantages in the increasingly fierce competition. (Exhibit 30) The expansion of the technology R&D center will greatly enhance the company's R&D innovation capability, and the company will focus on designing and developing a new generation of IGBT chips with lower on-state voltage drop and lower switching loss. On the one hand, the project can support the product performance upgrade of the company's existing IGBT modules, which can be better applied in the industries of motor energy saving, rail transportation, smart grid, aerospace, household appliances, automotive electronics, new energy power generation, new energy vehicles, etc. On the other hand, the company can rely on the new generation of chips to develop IGBT modules with smaller size and better performance, which can improve the overall competitiveness of the company's products.

Exhibit 30: Investment Project of StarPower Listed in 2022 Semi-Annual Report

Items	Total Investment Scale	Proposed Investment of Proceeds
IGBT module expansion project for new energy vehicles	25,000.00	15,949.33
IPM module project (annual production capacity of 7 mn units)	22,000.00	0.00
Technology R&D Center Expansion Project	15,000.00	10,000.00
Supplemental working capital	20,000.00	20,000.00
Total	**82,000.00**	**45,949.33**

(Source: Online Research, Company Annual Report, Deloitte Research, CUIRS)

StarPower Semiconductor Ltd. | Asia Pacific

Company Profile

People – Key Management

The management team of the company has many years of technical and management experience, and the structure is stable.
The quality of the company's management and employees is relatively high, with a reasonable staff structure and the ability to cover business lines and explore new business research and development. Also, the company attaches importance to R&D investment and the introduction of high quality talents to improve its technological innovation capability.

Shen Hua (Chairman)
Responsibilities:
control the strategic development direction of the company.
Work experience:
Many years of experience in IGBT-related technology development and production management

Tang Yi (Vice President and Vice President of Technology,)
Responsibilities:
Develop of the company's IGBT chip technology.
Work experience:
Years of experience in IGBT chip technology development and management.

Dai Zhizhan (Vice President)
Responsibilities:
Control the company‘s product testing and system applications.
Work experience:
Years of experience in semiconductor component design and system applications.

Liu Zhihong (Director of the company's R&D department)
Responsibilities:
Develop the company's module packaging technology.
Work experience:
Has been engaged in module design and development work, has a wealth of module technology development and practical experience.

Hu Shaohua (Director of the company's process department)
Responsibilities:
Sell IP Business related product and service, develop customers, maintain customer relationship and manage sales operation.
Work experience:
Has been engaged in the development of module manufacturing process, and have rich industry experience and technical accumulation in module manufacturing process.

StarPower Semiconductor Ltd. | Asia Pacific

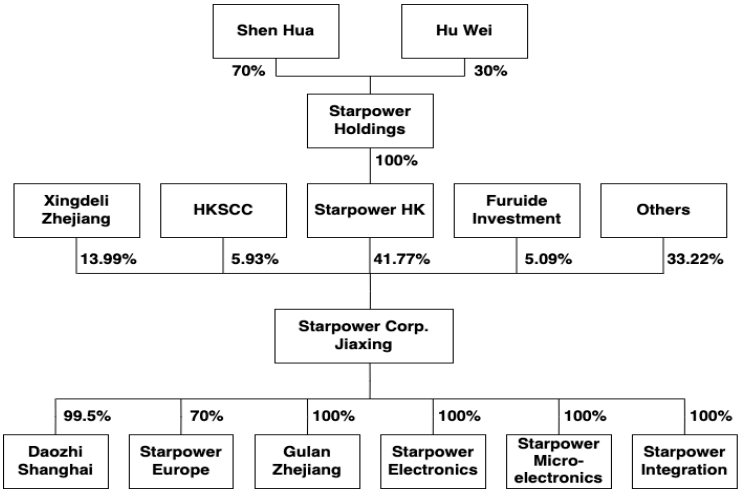
Company Profile

Holding – Key Controlling Factors

The company's holding is stable, and the subsidiary holding has its own duties.

StarPower has established a wholly-owned subsidiary to empower the subsidiary with technology research and development and enhance profitability. StarPower also set up a holding subsidiary for professional operation and management, equity distribution, etc. (Exhibit 31)

Exhibit 31: Shareholding Penetration Chart of StarPower (2022 Q3)



Policy – Key Catalyst towards the company

China vigorously develops strategic emerging industries and supports the development of new materials and advanced manufacturing industries. Also, the development of advanced manufacturing clusters brings common platform construction plan to consolidate the industry status of Starr Semi-conductor. Encouraged by policies such as tax incentives, industrial support, and information technology development, the competitiveness of the semiconductor equipment industry continues to break through, and the localization process is steadily advancing. (Exhibit 32)

Exhibit 32: Policy Catalysts On Semiconductor Industry

Time	Publishing Agency	Name	Summary
2022.06	Ministry of Industry and Information Technology	“Industrial Energy Efficiency Action Plan”	Promote the application of products and technologies such as low-power chips in mobile communication networks
2022.03	Ministry of Finance, Ministry of Commerce, etc	“Notice on the relevant requirements for the formulation of the list of integrated circuit enterprises or projects and software enterprises enjoying preferential tax policies in 2022”	Key integrated circuit design fields: high-performance processors and FPGA chips; memory chips; intelligent sensors; industrial, communication, automotive and security chips
2021.12	Ministry of Industry and Information Technology	“The 14th Five-Year Plan for the Development of Digital Economy”	In terms of the "Digital Technology Innovation Breakthrough Project", it is proposed to take the lead in the layout. Integrate and innovate along technology, promote the construction of cutting-edge disciplines and cross-research platforms
2021.03	Ministry of Industry and Information Technology	“Notice on Import Tax Policies to Support the Development of the Integrated Circuit Industry”	The notice clarifies several situations of exemption from import duties.

(Source: Online Research, Company Report, CUIRS)

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