

# PRISMARK PRESENTATION

July 21, 2023

PREPARED FOR:

## 2023 PCB INDUSTRY SUMMIT @ BANGKOK

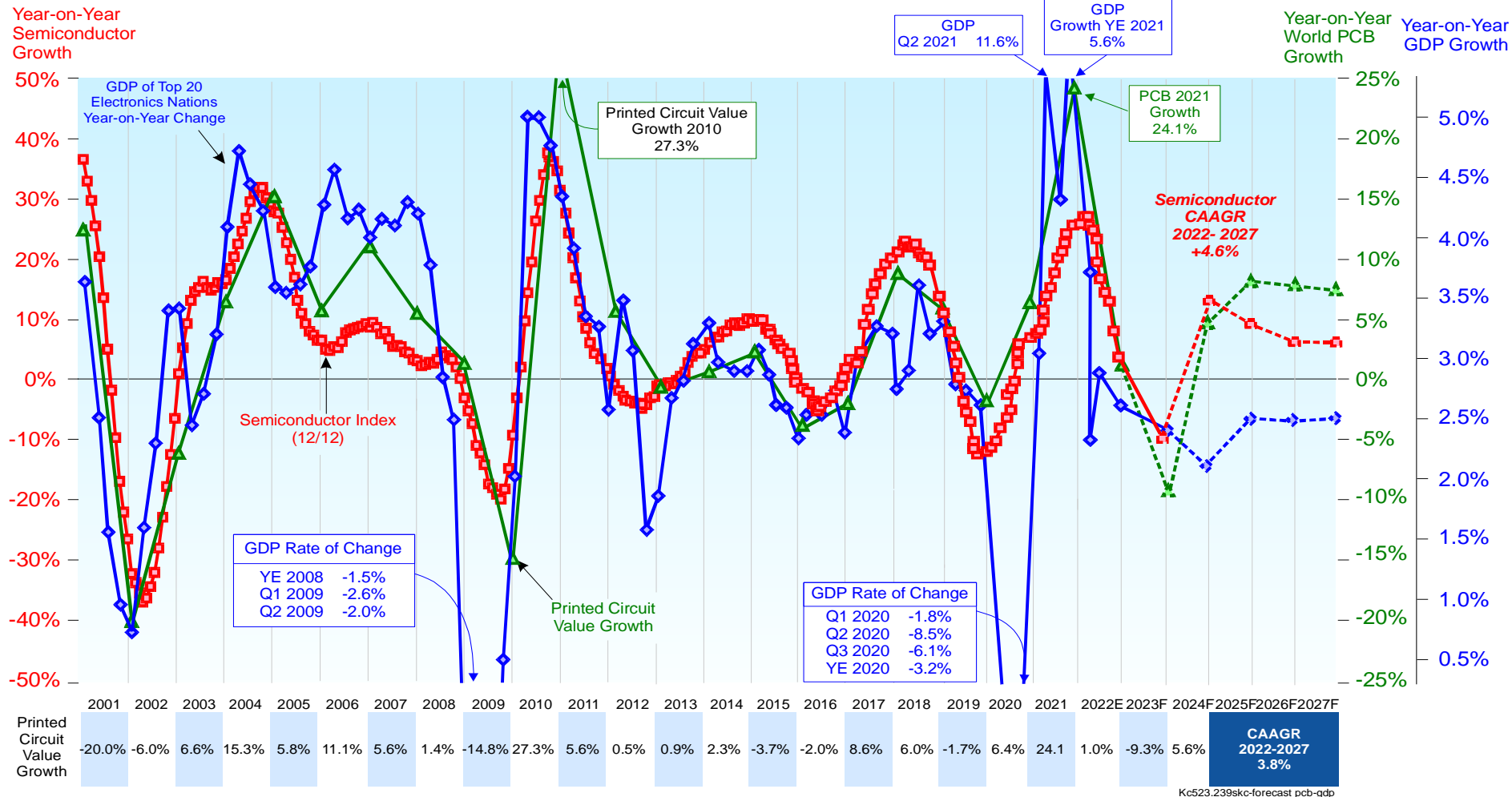
The Transformation and Migration of  
the Global PCB Supply Chain

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# 全球電路板產業鏈的移轉與重塑

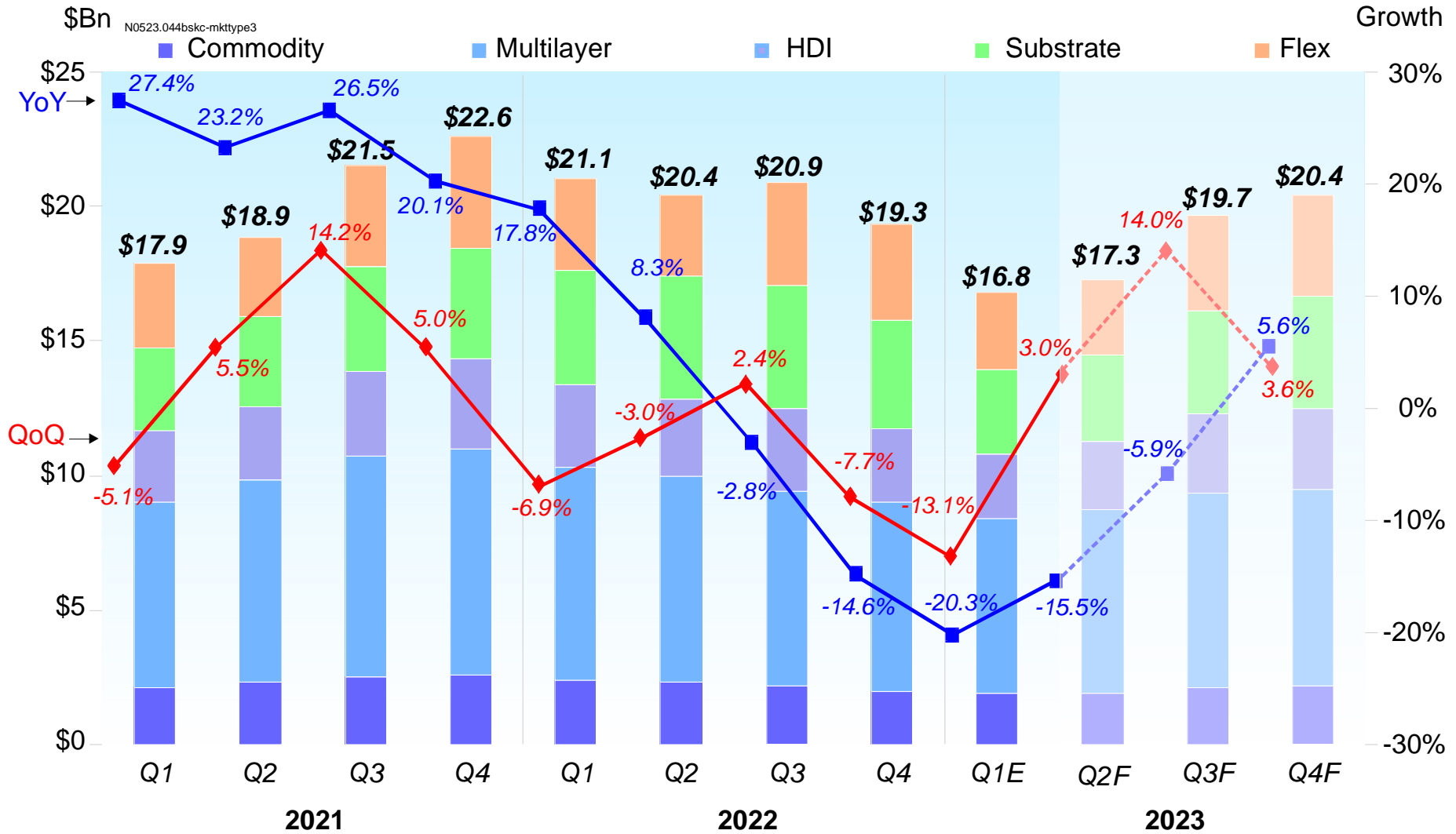
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# WORLD SEMICONDUCTOR, PCB, AND GDP FORECAST



\$M	2000	2010	2017	2022	2027F	2000-2010	2010-2022	2022-2027F
Electronics	\$1,131	\$1,558	\$2,019	\$2,426	\$2,920	3.3%	3.8%	3.8%
Semiconductor	\$204	\$291	\$412	\$573	\$716	3.6%	5.8%	4.6%
PCB	\$42	\$52	\$59	\$82	\$98	2.4%	3.8%	3.8%

# PCB MARKET Q/Q GROWTH



# 2023 PCB MARKET CHALLENGES AND OPPORTUNITIES

- Macro economic and electronics market **challenges in post-pandemic era**:
  - **Weak demand** due to ailing purchasing power, high inflation, and high interest rates
  - **High inventory**, especially in 1H 2023
  - **Oversupply capacities and low utilization**
  - **ASP** decline due to intense competition
  - **Geopolitical conflicts**. US semiconductor export control, supply-chain re-alignment
- 2023 PCB Market Assessment
  - Consumer electronics demand remains weak
  - Non-consumer demand momentum, including HPC, networking, and automotive, EV and ADAS, was decelerating in 1H 2023
  - Semiconductor, advanced packaging, and substrate market has reached an inflection point
  - Seasonal recovery in 2H 2023 is anticipated
- Outlook: Electronics market recovery will arrive sooner or later
  - PCB market growth drivers and opportunities
    - Computing and communications infrastructure – AI (ChatGPT), data center, cloud services
    - Automotive revolutionary changes – ADAS and electrification
  - **Transformation and migration of PCB supply chain (China + N Strategy)**

# SERVER/STORAGE/AI PCB MARKET

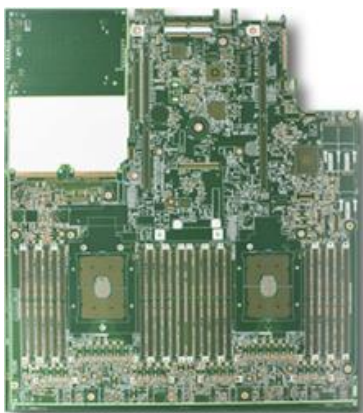
## NVIDIA H100



### Server/Storage/AI PCB Market

Server PCB Market 2022	\$9.9Bn
2022 - 2027 CAAGR	7.5%
Growth Drivers	Data centers, high-performance computing and AI
Leading Customers	Dell, HP, Inspur, ODM, CSP, Nvidia
Products	High layercount MLB, HDI, FCBGA substrates
Technologies	High-speed laminates, SAP FCBGA

## ChatGPT

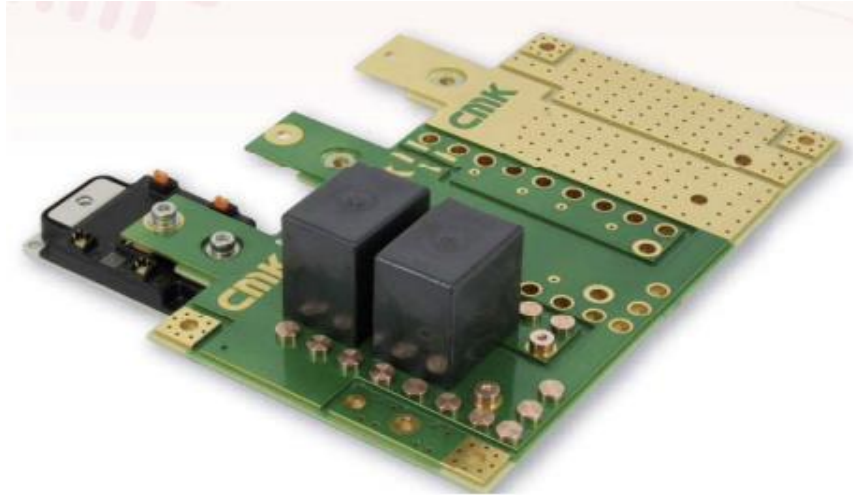


Attribute	Range	Trend for Next 5 years
Layercount	8L for lower end 12-16L higher end rack >22L for Highest complexity	No change in the range, but more pressure to higher layercount
Max Layercount	24 to 28	Modest growth to 30-34
Trace to trace	4 mil → 3.5 mil	
Material Selection	Mid-loss to very-loss laminate Low profile copper required	Higher requirement on electric performance, ultra low-loss, extreme low-loss laminate needed, very-low-profile copper



# AUTOMOTIVE PCB MARKET

## High Current PCB



## Automotive PCB Market

Automotive PCB Market 2022 \$9.5Bn

2022 - 2027 CAAGR 6.2%

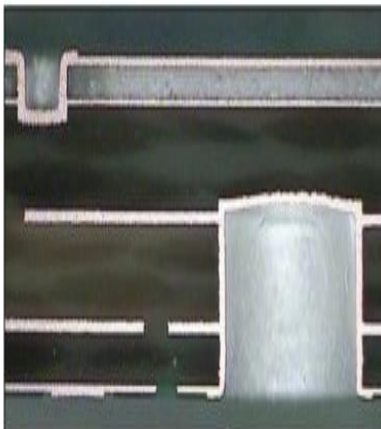
Growth Drivers EV, ADAS

Leading Customers Tesla, BYD, Bosch, Denso, Aptiv, etc.

Products HDI, FPC, Thick Cu and RF ML boards

Technologies High reliability, special materials

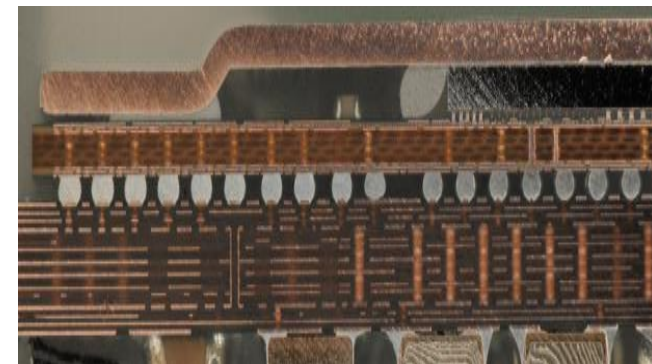
## RF PCB



## Battery Pack FPC



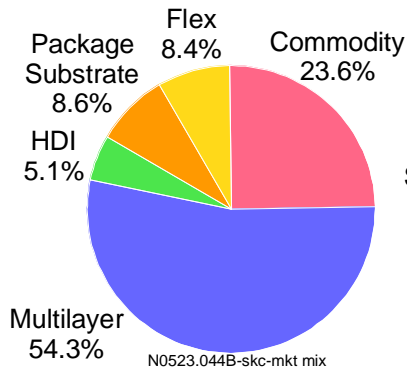
## ADAS Control HDI Board



Photos sources: Prismark/Binghamton University

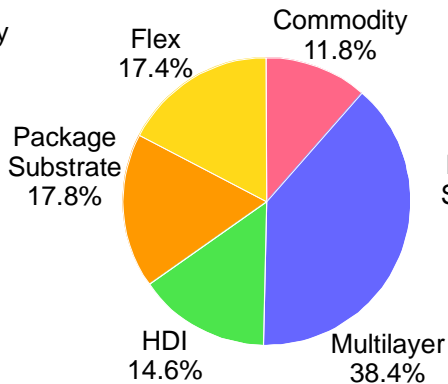
# CHANGES IN PCB MARKET PRODUCT MIX

**2000**



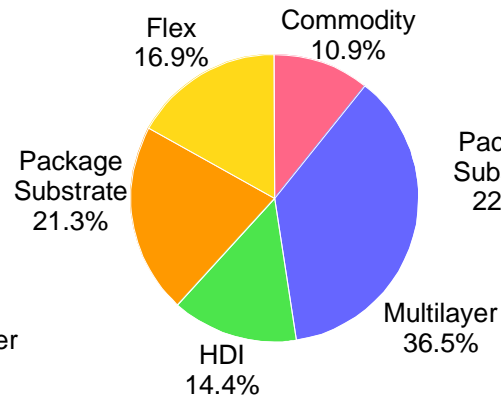
**Total: \$41,570M**

**2021**



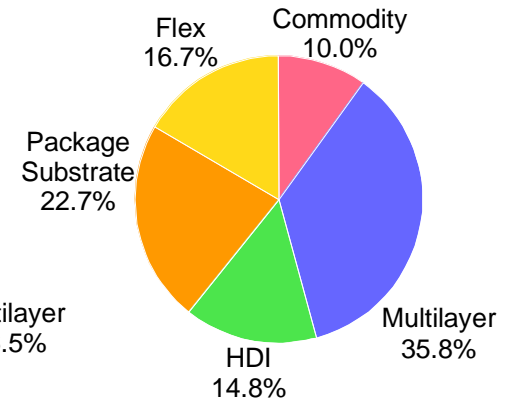
**Total: \$80,920M**

**2022**



**Total: \$81,740M**

**2027F**



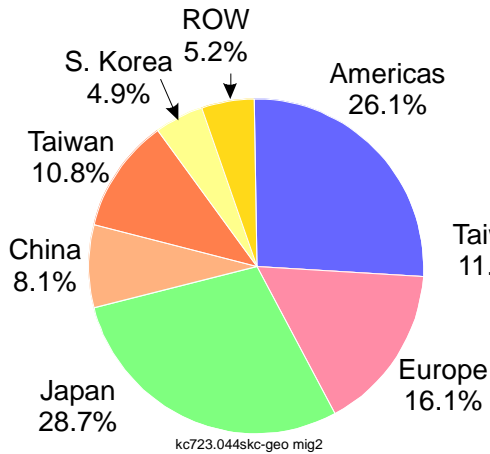
**Total: \$98,388M**

	2000	2020	2021	2021/2020	2022	2022/ 2021	2027F	2022-2027 CAAGR
Commodity	\$10,324	\$7,911	\$9,589	21.2%	\$8,875	-7.4%	\$9,813	2.0%
Multilayer	\$22,217	\$24,763	\$31,053	25.4%	\$29,846	-3.9%	\$35,235	3.4%
HDI	\$2,074	\$9,874	\$11,811	19.6%	\$11,763	-0.4%	\$14,581	4.4%
Package Substrate	\$3,505	\$10,188	\$14,410	41.4%	\$17,415	20.9%	\$22,286	5.1%
Flex	\$3,450	\$12,483	\$14,058	12.6%	\$13,842	-1.5%	\$16,473	3.5%
<b>Total</b>	<b>\$41,570</b>	<b>\$65,219</b>	<b>\$80,920</b>	<b>24.1%</b>	<b>\$81,740</b>	<b>1.0%</b>	<b>\$98,388</b>	<b>3.8%</b>



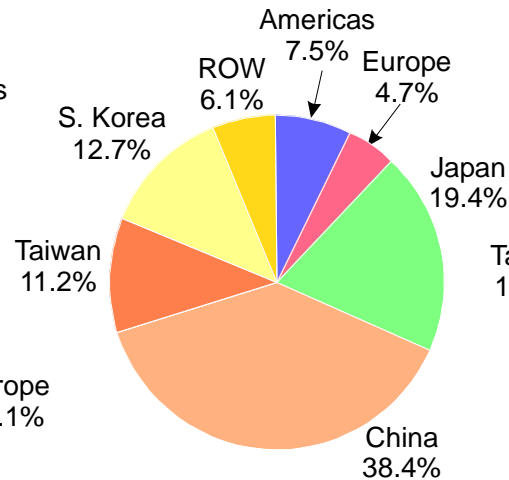
# GEOGRAPHIC MIGRATION OF PCB PRODUCTION

**2000**



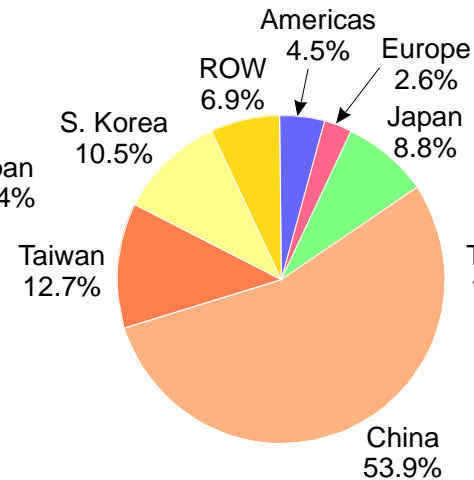
**Total: \$41,570M**

**2010**



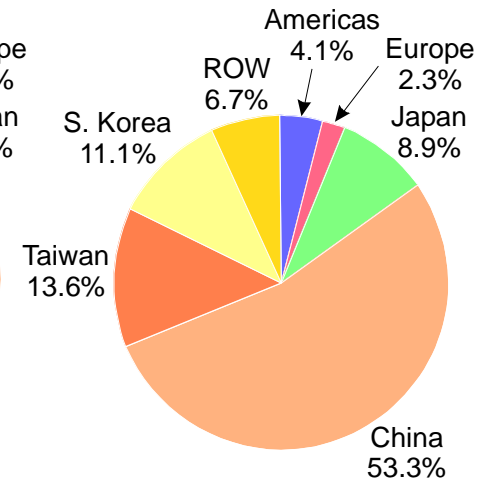
**Total: \$52,468M**

**2020**



**Total: \$65,219M**

**2022**

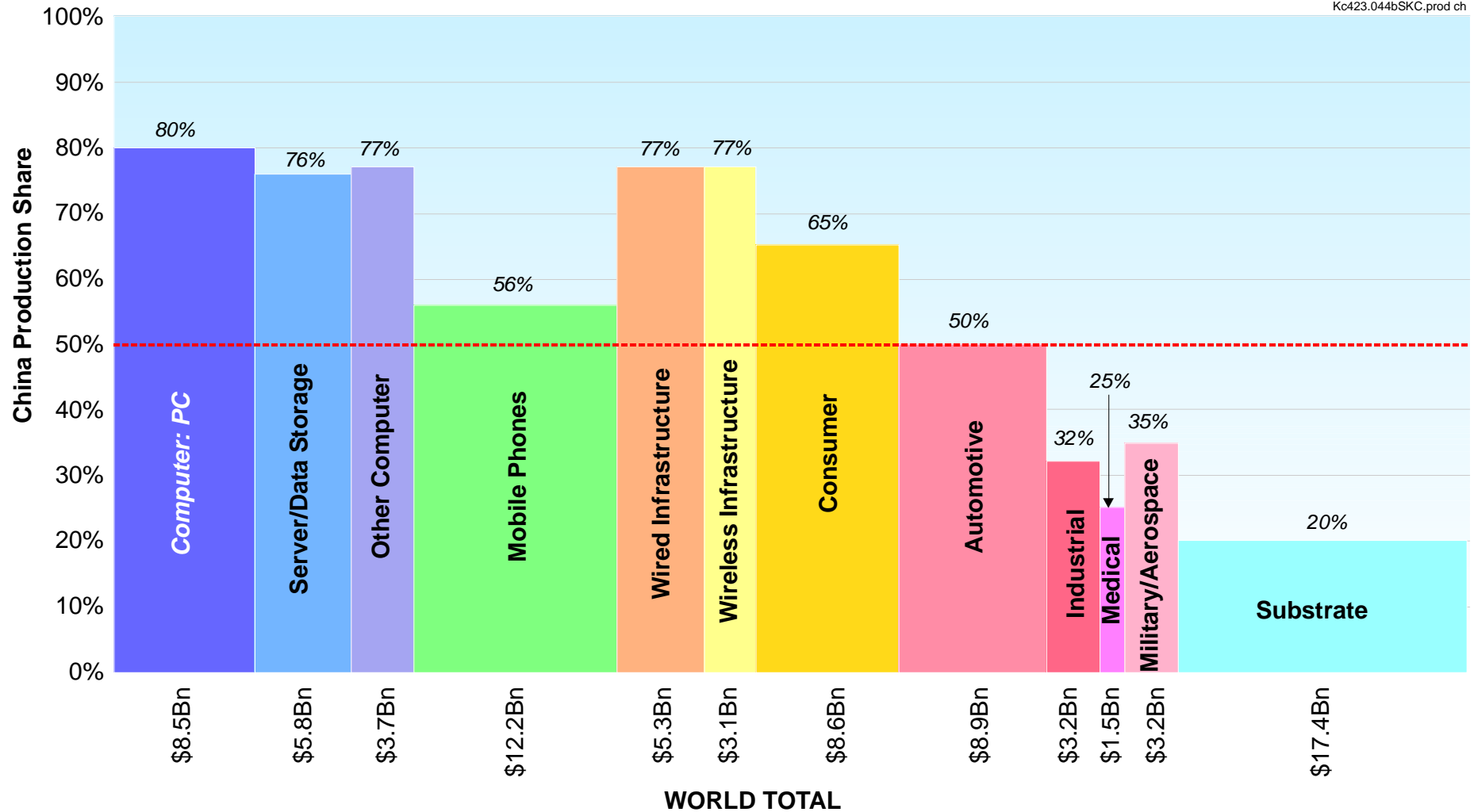


**Total: \$81,740M**

	2000	2005	2010	2015	2020	2022	2000-2010 CAAGR	2010/2022 CAAGR	2000-2022 CAAGR
Americas	\$10,852	\$4,984	\$3,923	\$2,776	\$2,943	\$3,369	-9.7%	-1.3%	-5.2%
Europe	\$6,702	\$3,915	\$2,464	\$1,933	\$1,727	\$1,885	-9.5%	-2.2%	-5.6%
Japan	\$11,924	\$9,651	\$10,165	\$5,655	\$5,771	\$7,280	-1.6%	-2.7%	-2.2%
China	\$3,368	\$9,553	\$20,170	\$26,729	\$35,124	\$43,553	19.6%	6.6%	12.3%
Korea	\$2,053	\$5,446	\$6,640	\$6,652	\$6,881	\$9,052	12.5%	2.6%	7.0%
Taiwan	\$4,510	\$4,399	\$5,888	\$7,204	\$8,266	\$11,121	2.7%	5.4%	4.2%
SEA/ROW	\$2,161	\$2,691	\$3,218	\$4,377	\$4,507	\$5,481	4.1%	4.5%	4.3%
<b>TOTAL</b>	<b>\$41,570</b>	<b>\$40,639</b>	<b>\$52,468</b>	<b>\$55,325</b>	<b>\$65,218</b>	<b>\$81,740</b>	<b>2.4%</b>	<b>3.8%</b>	<b>3.1%</b>

# ASSESSMENT OF 2022 APPLICATION SHARES OF PCB PRODUCTION IN CHINA

Kc423.044bSKC.prod.ch



# THE “CHINA+N” MOVEMENT IS BUILDING MOMENTUM ACROSS THE ELECTRONICS MANUFACTURING SUPPLY CHAIN

- Although **China** remains the dominant hub for global electronics manufacturing, growing US-China tensions, rising Chinese labor costs, and lessons learned from COVID-era supply disruptions are encouraging producers across the supply chain to reduce their China exposure
- **Vietnam, Malaysia, Thailand, India, and Mexico** are particularly well-positioned to benefit from this trend due to their relatively low labor costs and proximity to key markets
- No single country can fully replicate the combination of logistical efficiency, low costs, and abundant manufacturing talent that has made China the most attractive site for electronics production over the past twenty-plus years
  - The movement of production lines outside of China will be broadly distributed across countries and regions and will progress slowly over the next five to ten years
- **Vietnam, Malaysia, and Thailand** are the most natural destinations for PCB producers looking to diversify away from China due to their combination of cheap labor, geographic location, favorable trade and business policies, and strong experience in electronics manufacturing
- **India** is becoming an increasingly popular investment destination for major multinational OEMs like Apple, which are keen to gain a foothold in India’s growing consumer market as China’s economic and demographic growth begins to plateau
- **Mexico** offers an attractive combination of cheap labor and preferential trade relations with the US to multinationals looking to expand their share in the US consumer market

# CHINA'S STRENGTH IN STEM TALENT DEVELOPMENT HAS ALLOWED IT TO REMAIN COMPETITIVE DESPITE RISING LABOR COSTS

	China (excl. HK)	Malaysia	Thailand	Vietnam	India	Mexico
<b>Average Monthly Base Salary: Manufacturing, Worker<sup>1</sup></b>	\$607	\$430	\$385	\$277	\$330	\$480 (est.)
<b>Average Monthly Base Salary: Manufacturing, Engineer<sup>1</sup></b>	\$933	\$818	\$663	\$540	\$556	\$720 (est.)
<b>Population (M)</b>	1,412	33	70	100	1420	130
<b>Tertiary enrollment (% of eligible population enrolled in BA or graduate programs, 2021)</b>	64%	43%	44%	35%	31%	45%
<b>Government expenditure on R&amp;D as a percentage of GDP</b>	2.41%	0.95%	1.33%	0.42% <sup>†</sup>	0.66% <sup>†</sup>	0.30%
<b>Mean scores of 15-year-olds on PISA mathematics assessment scale (score, rank)<sup>2</sup></b>	591, #1	440, #45	419, #55	N/A	N/A	409, #59
<b>Mean scores of 15-year-olds on PISA science assessment scale (score, rank)</b>	590, #1	438, #48	426, #53	N/A	N/A	419, #57
<b># of universities ranked in top 500 (100) globally in engineering &amp; technology (2023)</b>	32 (9)	9 (2)	1 (0)	4 (0)	14 (5)	3 (2)

- Worker:** Regular general workers with 3 years of work experience, not including contract based and probationary workers;  
**Engineer:** Regular employees who are core technicians, graduates of a vocational college or university, and have 5 years of experience;  
**Manager:** Regular employees who are section managers in charge of sales, university graduates, and who have 10 years of work experience
- PISA is a test administered by the OECD to measure the average capabilities of 15-year-old students in reading, mathematics, and science; The most recent assessment occurred in 2018 and was administered in 79 high- and middle-income countries. In 2018, the average score for OECD countries was 489 in mathematics and 489 in science;

**Sources: manufacturing wages** - Japan External Trade Organization (JETRO), Prismark estimates; **STEM talent indicators** - Quacquarelli Symonds Global University Rankings, UNESCO, OECD

# TOP 25 PCB SUPPLIERS MANUFACTURING LOCATIONS

Company	2021	2022	2022/ 2021	Factory Locations										
				Americas	Europe	Japan	China	Taiwan	Korea	Thailand	Vietnam	Malaysia	Philip- pines	India
Zhen Ding	\$5,534	\$5,704	3.1%				√	√		●				√
Unimicron	\$3,920	\$4,826	23.1%				√	√		●				
Dongshan Precision	\$3,180	\$3,262	2.6%				√			●				
Nippon Mektron	\$2,795	\$2,591	-7.3%			√	√	√		√	√			
Compeq	\$2,260	\$2,560	13.3%				√	√		●				
TTM	\$2,187	\$2,370	8.4%	√			√					●		
Tripod	\$2,257	\$2,218	-1.7%				√	√			●			
Nan Ya PCB	\$1,871	\$2,167	15.8%				√	√						
AT&S	\$1,712	\$2,033	18.7%		√		√		√			●		√
Ibiden	\$2,055	\$1,933	-5.9%			√	√					√	√	
Young Poong Group	\$1,634	\$1,738	6.3%				√		√		√			
Shennan Circuit	\$1,730	\$1,731	0.0%				√			●				
Kingboard Group	\$1,750	\$1,671	-4.5%				√			√				
SEMCO	\$1,719	\$1,623	-5.6%						√		√●			
Shinko	\$1,531	\$1,562	2.1%			√								
Kinwong	\$1,360	\$1,438	5.7%				√			●				
FLEXium	\$1,275	\$1,340	5.1%				√	√						
WUS Group	\$1,272	\$1,339	5.3%				√	√		●				
HannStar	\$1,566	\$1,316	-16.0%				√	√				√		
Simmtech	\$1,191	\$1,306	9.6%			√	√					√		
BH Co	\$897	\$1,297	44.5%				√		√		√			
Meiko	\$1,307	\$1,274	-2.5%			√	√				√			
Kinsus	\$1,096	\$1,231	12.3%				√	√				●		
Victory Giant	\$1,153	\$1,206	4.6%				√			●	●			
Gold Circuit	\$954	\$1,101	15.5%			√	√			●				

● New facility/ investment either announced recently or still in construction

√ Existing factory that can pivot production or volume production

# THAILAND PCB AND RELATED MATERIALS SUPPLIERS

## Ayutthaya

### Existing Shops

Fujikura, Nippon  
Mektron/Mektec  
KCE, APCB,  
Canon Hi-Tech,  
Elec & Eltek/Pacific  
Insulating Material,  
Panasonic

### New Investment

WUS (Kunshan),  
Aoshikang,  
Huizhou CEE,  
KCE, Techwise,  
Kingboard, ITEQ

## Samut Sakhon

### Existing Shops

Apex, Shye Feng  
Enterprise, Circuit  
Industries (CI)

### New Investment

Apex

## Bangkok/Samut Prakan

### Existing Shops

KCE, Amallion  
Enterprise,  
Sagami Shoko

### New Investment

Compeq

## Pathum Thani

### Existing Shops

Fujikura,  
Elec & Eltek,  
Chin Poon/Draco  
Gravitech Thai

### New Investment

## Prachin Buri

### Existing Shops

Fujikura,  
CMK

### New Investment

CMK, Starteam Global,  
Dynamic, Delton, Huiho,  
Changzhou Aohong,  
Gold Circuit

## Chon Buri/Chachoengsao

### Existing Shops

Kyoden

### New Investment

Sihui Fuji, TUC,  
Taiflex, Unimicron,  
Shengyi Electronics

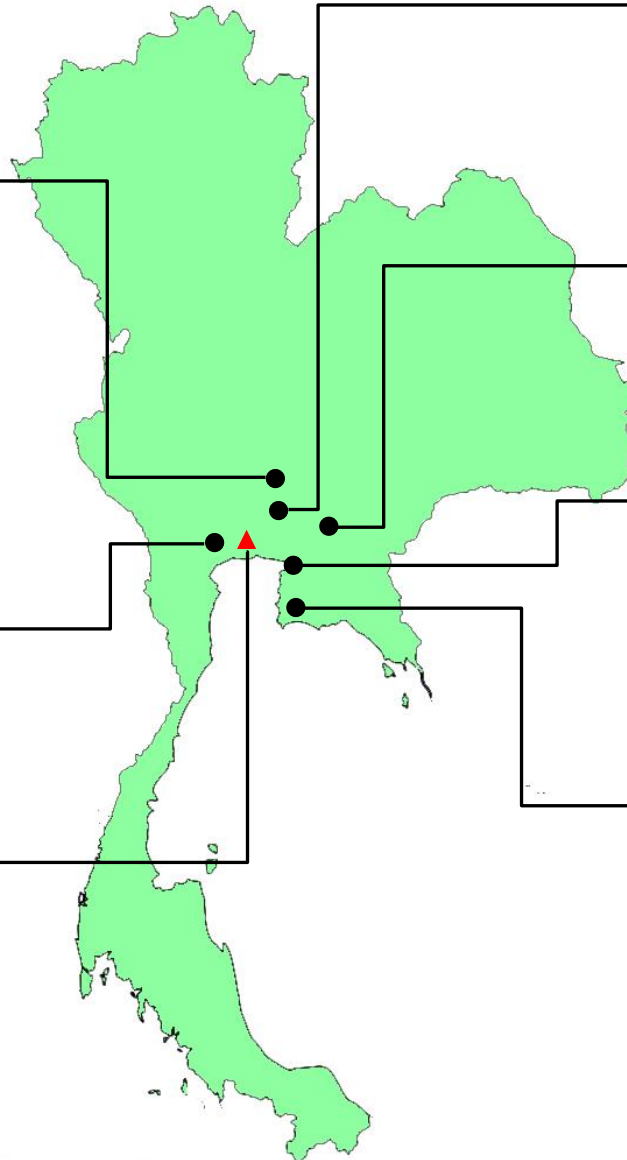
## Rayong

### Existing Shops

MGC

### New Investment

Shenzhen Jove,  
Huazheng New  
Material, MGC

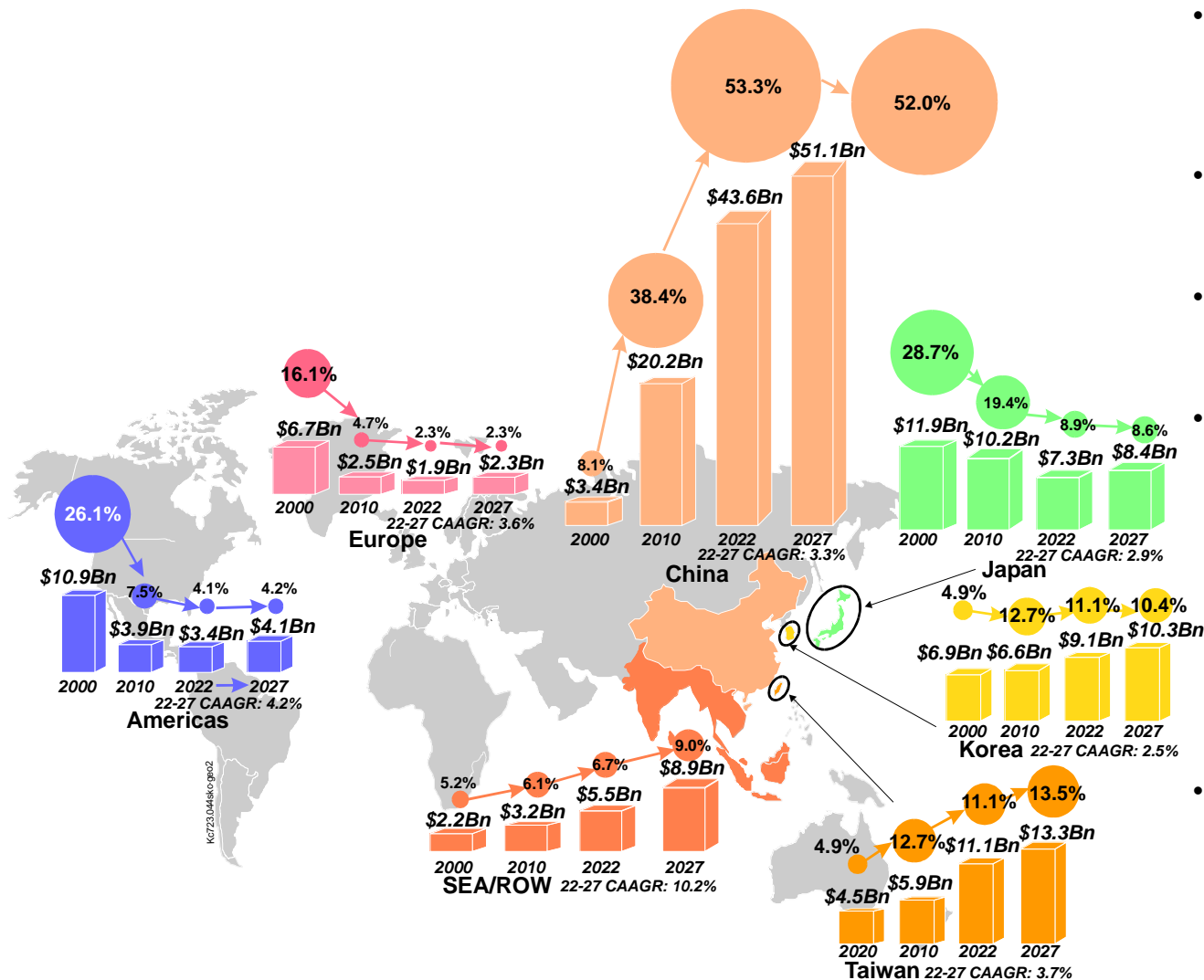




# CRITICAL SUCCESS FACTORS IN PCB MARKET

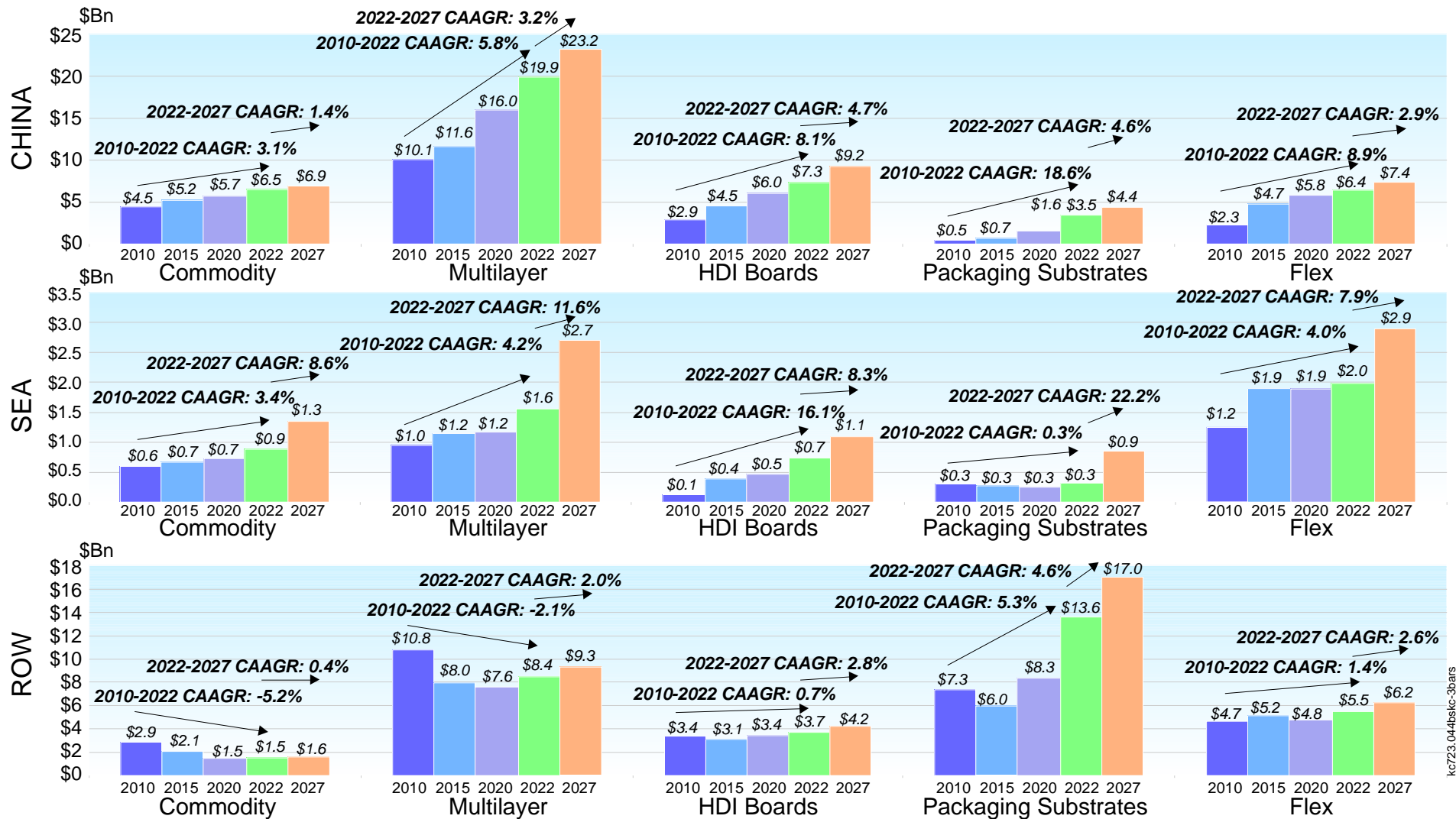
Critical Success Factors	China of 2000	SEA of 2023
Applications	Cell phone, Consumer, PC, Communications, etc.	Server, Automotive, Smartphone (likely)
OEM Customers	Nokia, Motorola, IBM, Sony, Huawei, Cisco, TCL, etc.	Dell, HPE, Google, Amazon, Denso, Aptiv, etc.
Product/Technology	Commodity, ML, HDI, FPC	ML, HDI, Substrate
Human Resources	XXXXXX	XX
Capital Investment	XXXXXX	XXX (>\$6Bn for 40+ investment/expansion plans)
Preferred Locations	Guangdong and Jiangsu, China	Thailand, Vietnam, Malaysia
Cost Structure	Lowest	Competitive
Government Support	Very Strong	Strong

# GEOGRAPHIC MIGRATION OF PCB MANUFACTURING 2000 TO 2027



- China will remain the major PCB production site with 50+% global production share by 2027.
- Japan, Taiwan, and Korea will focus more on substrate production.
- SEA is likely to achieve double-digit CAAGR growth from 2022 to 2027.
- Strong growth in SEA due to:
  - Customer push and demand shift
  - Server, communication, automotive electronics
  - Heavy investments by Taiwanese and Chinese PCB shops. (>\$5Bn from 2022 to 2027)
- Strong growth of PCB production in SEA:
  - High layercount ML
  - Substrates
  - HDI
- Thailand, Vietnam, and Malaysia

# PCB SUPPLY CHAIN TRANSFORMATION



# PCB MARKET DEVELOPMENT TRENDS

- For the next five years, the PCB market is likely to expand from \$81.8Bn in 2022 to \$98.4 Bn in 2027
- The PCB market will be driven primarily by the following applications:
  - Server/storage/AI systems: large body-size and advanced substrates as well as low-loss specialty motherboards are key growth drivers
  - Automotive electronics: EV and ADAS
  - Communication electronics: switch, 5G, and satellite
- PCB market growth will also come from the following product technologies:
  - Substrates: SAP for FCBGA and mSAP for FCCSP, memory, SiP/module substrates, and SLP
  - High-speed and high-frequency laminate materials for server, AI, wired and wireless infrastructure
  - Low-loss FPCs and PCBs for automotive, wireless, and consumer applications
- PCB supply chain landscape: Globalization and Localization
  - China will remain the leading PCB production site, but will emphasize value-added products. Consolidation and local companies expansion are likely to happen
  - Japan, Taiwan, and Korea will focus more on substrate production
  - Americas and European markets will be supported by military, industrial, and medical PCB production
  - SEA will be the growth leader. Strong demand for rigid ML (server and automotive), substrates (CPU and GPU), HDI, and FPC (smartphone) are likely to accelerate in the next few years.

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