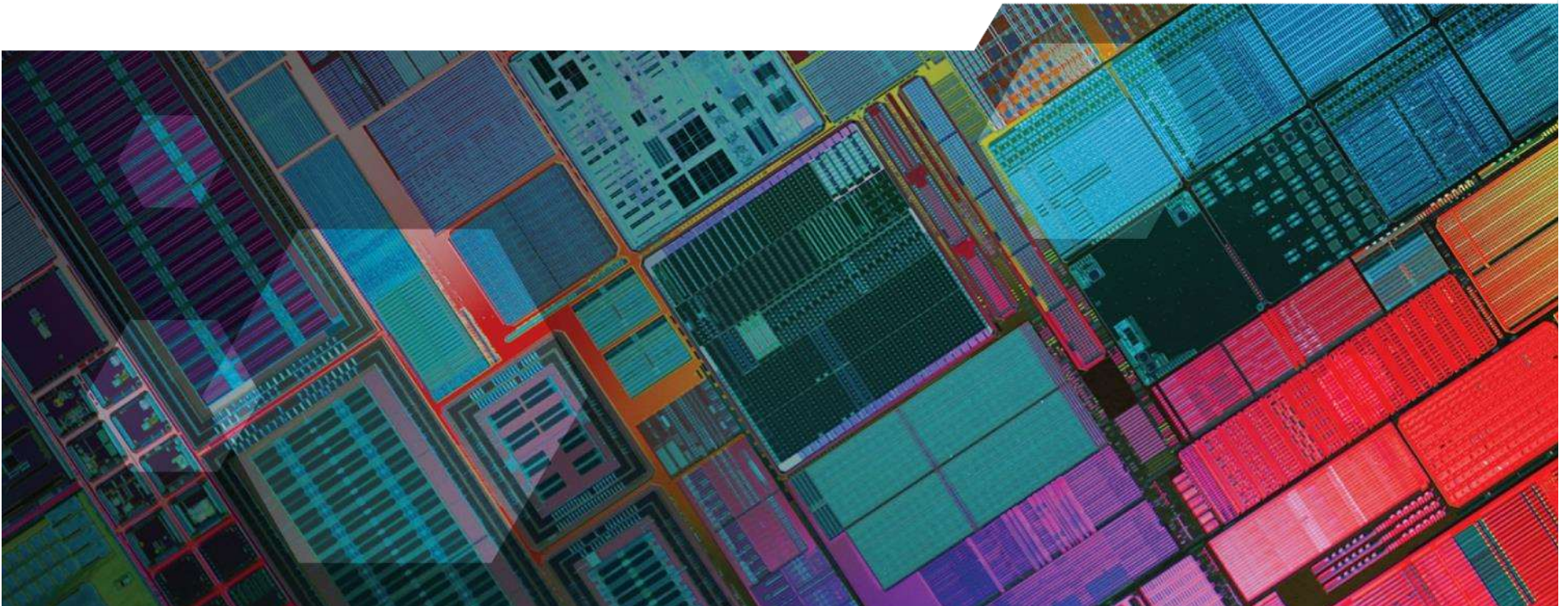




Fab Investment and The Surge of China

Clark Tseng
Sr. Research Manager
SEMI
September 22, 2017



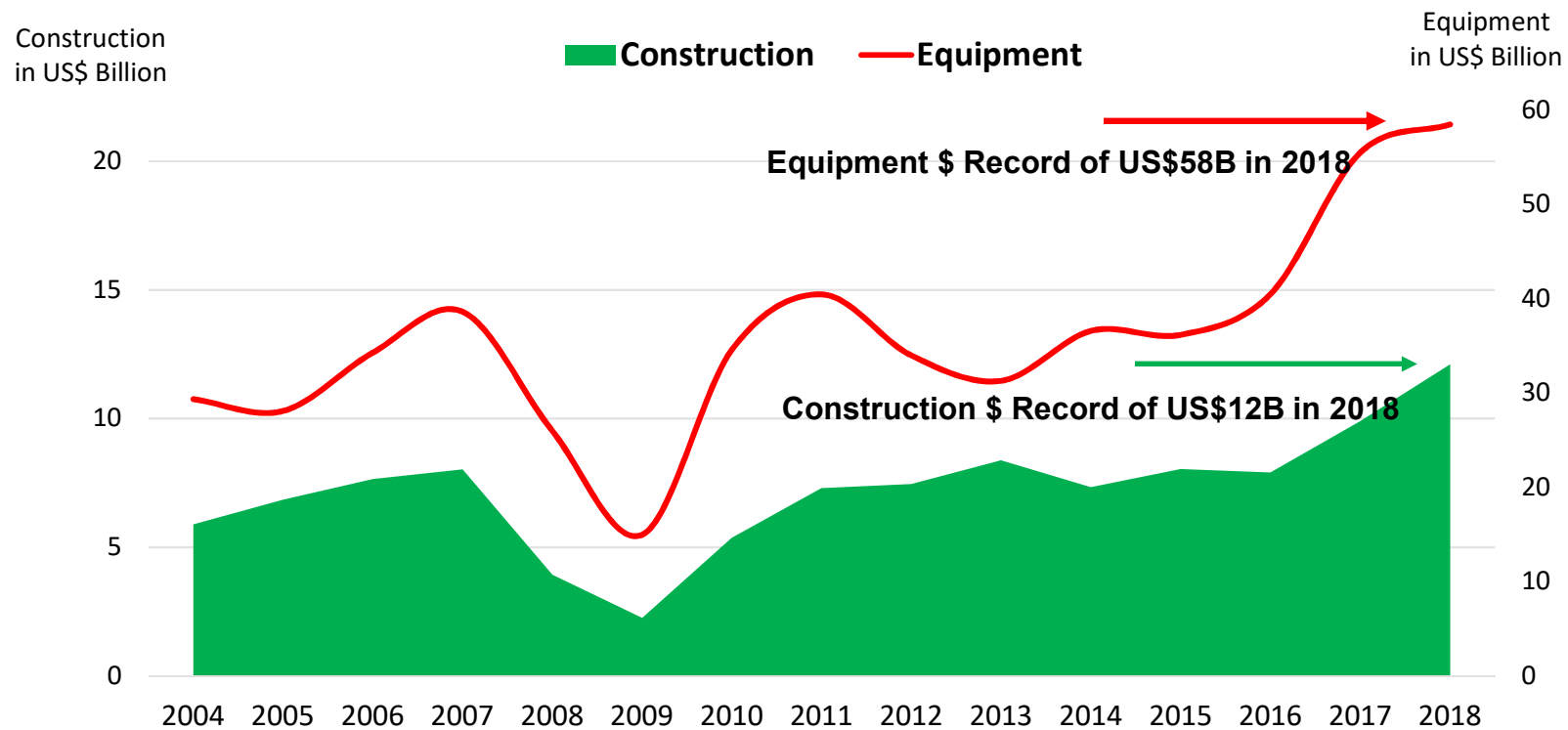
Outline

- Fab Investment Outlook
- Taiwan Outlook
- The Surge of China Investment
 - New fab projects
 - Capacity projection
 - Memory and Foundry
- Summary

Fab Investment Outlook

2017 and 2018 Record Fab Investment

Record Fab Spending !!



Source: World Fab Forecast Report, September 2017, SEMI

Key Fab Projects – driven by Foundry and NAND

NAND

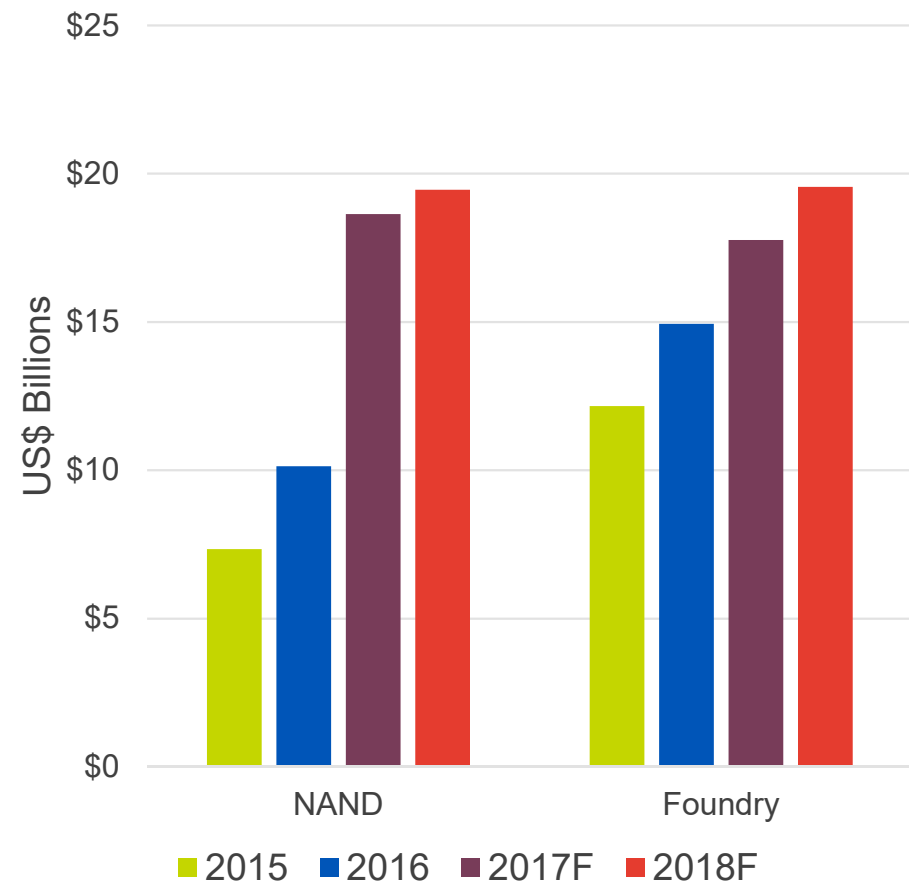
- Samsung NAND fab in Xian and Line 18
- SK Hynix M14 3D NAND line
- Micron Fab 10X in Singapore
- Toshiba/Flash Alliance Fab 2, Fab 6 and new R&D Center
- Intel Fab 68 in China
- YMTC (XMC) 3D NAND fab in China

Foundry

- TSMC Fab 12, Fab 14 and Fab 15
- Samsung S2 and S3
- GLOBALFOUNDRIES Fab 1, Fab 8 and Fab 11
- SMIC Beijing B2 and B3, new Shanghai 300mm fab and Shenzhen 300mm fab.
- UMC Fab 12A P5 and Xiamen fab.

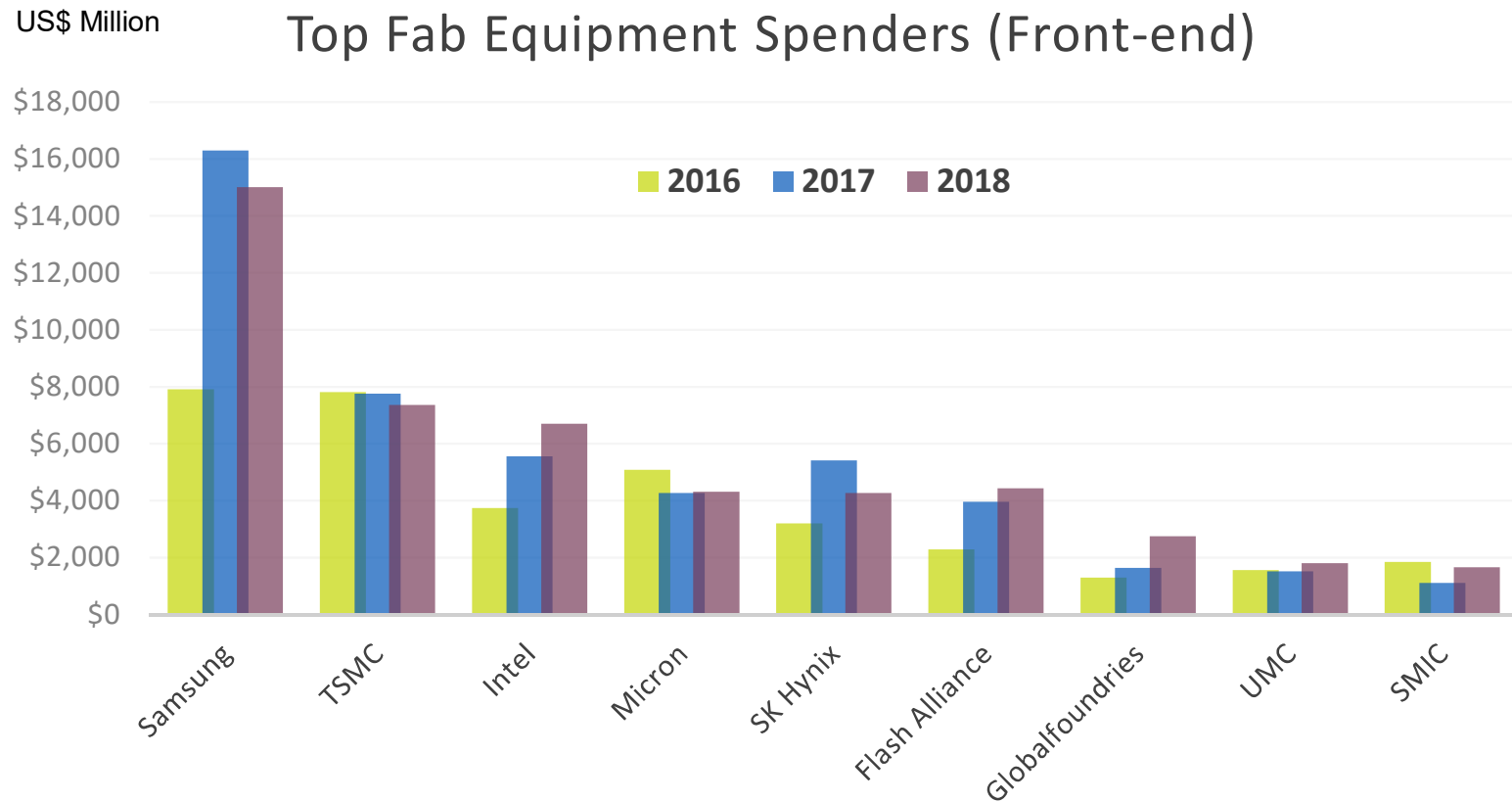
Source: SEMI World Fab Forecast, September 2017

Fab Equipment Spending



Fab Equipment Spending

The Billion Dollar Club



Source: World Fab Forecast, September 2017, SEMI

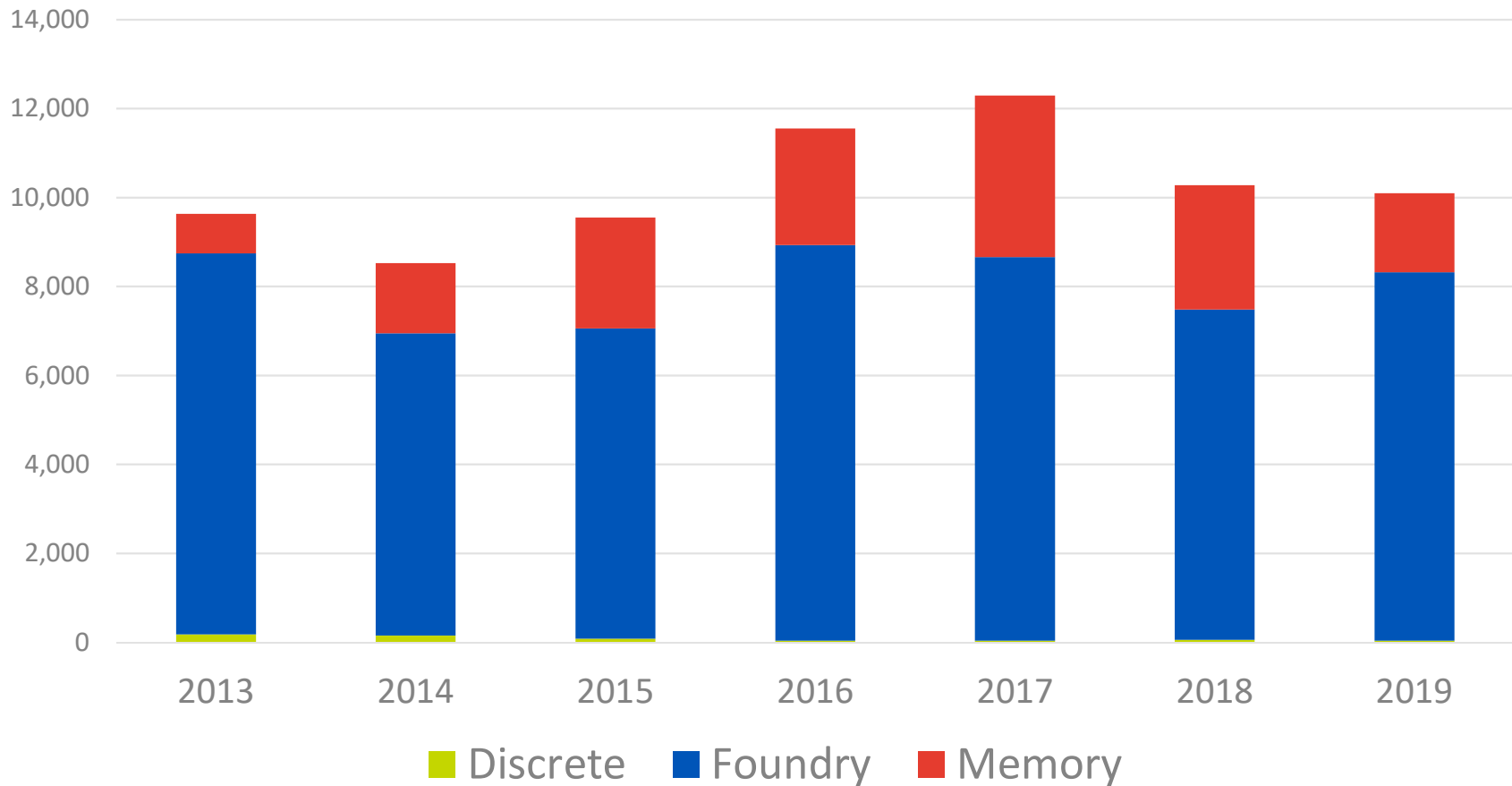
Taiwan Outlook

Taiwan Fab Equipment Spending

Foundry and Memory driven

US\$
Million

Taiwan Fab Equipment Spending by Segments

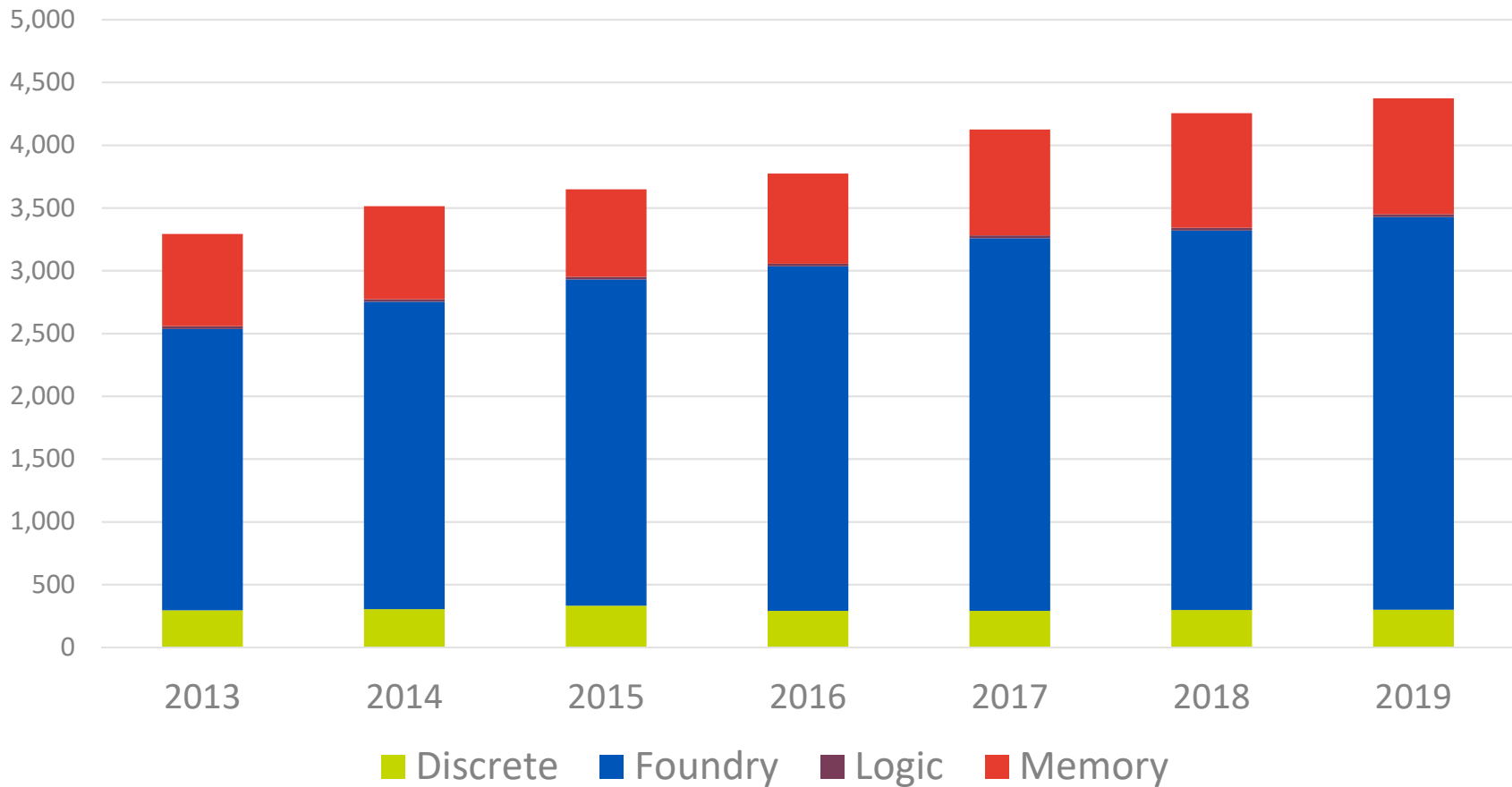


Taiwan Capacity Outlook

Primarily foundry driven

8" WPM (Thousand)

Taiwan Capacity by Segments

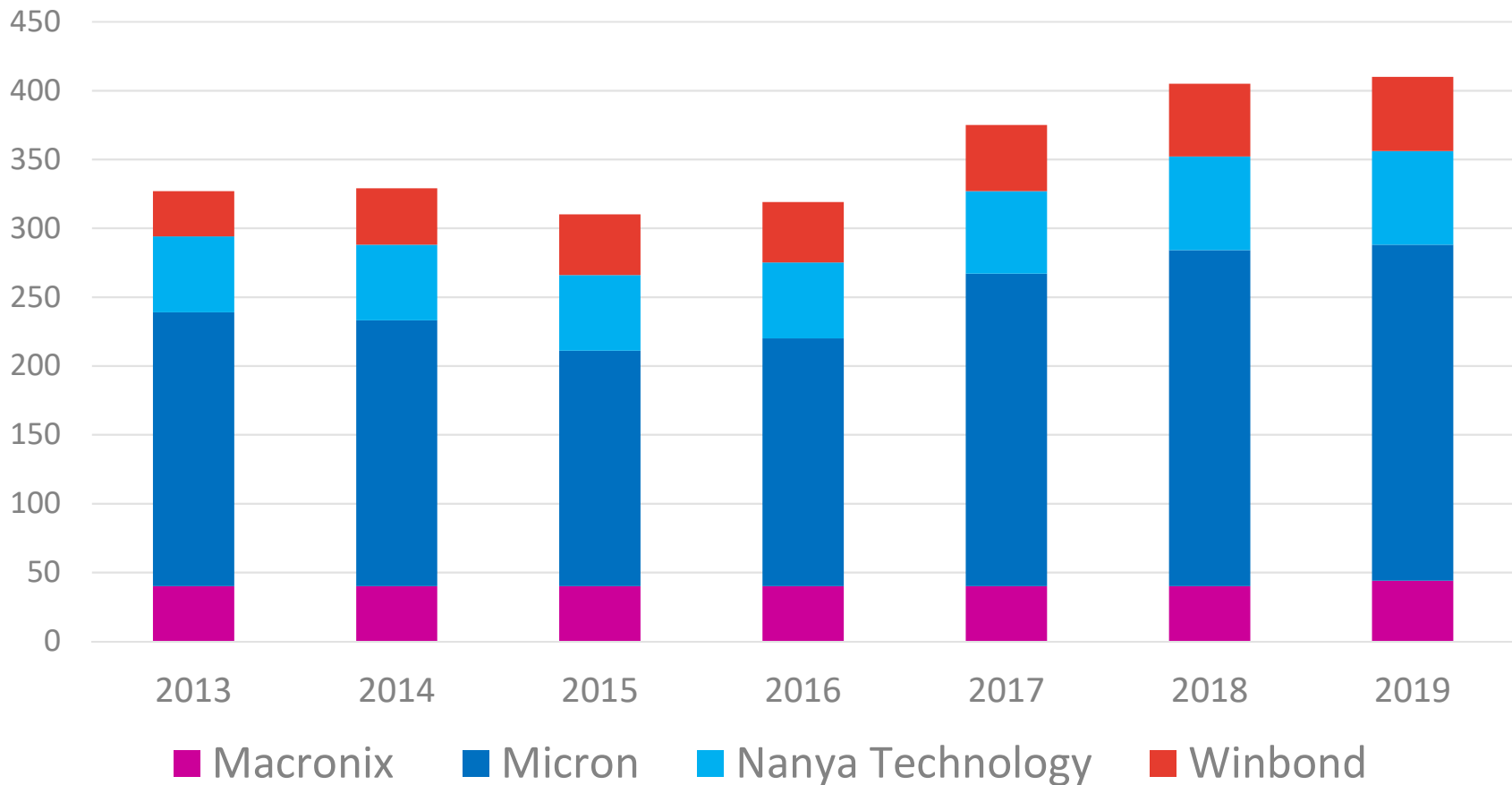


Taiwan Memory Capacity Outlook

Majority DRAM production

300mm WPM
Thousand

Taiwan Memory Capacity by Manufacturers



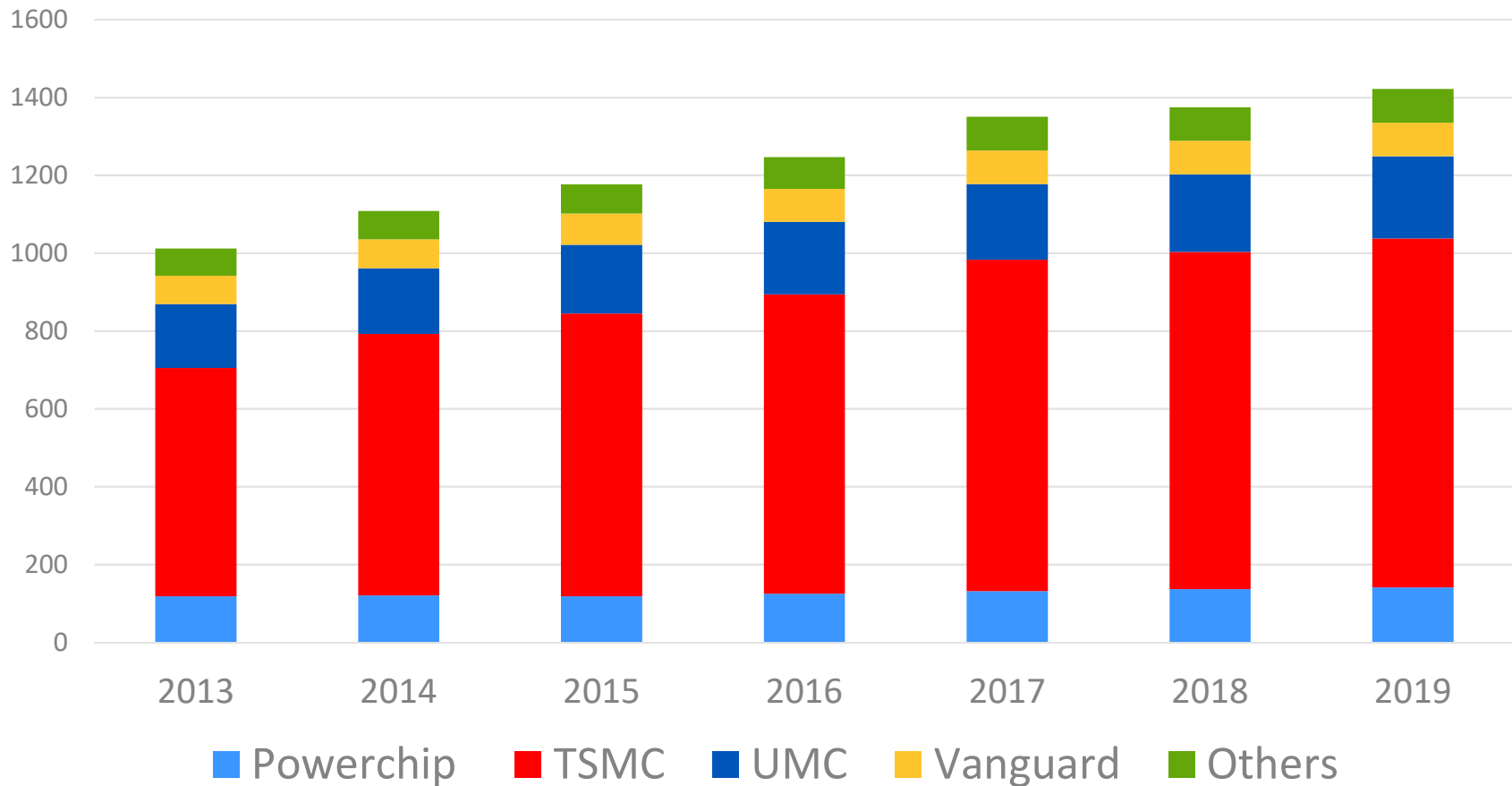
Source: SEMI World Fab Forecast, September 2017

Taiwan Foundry Capacity Outlook

New capacity coming from leading-edge nodes

300mm WPM
Thousand

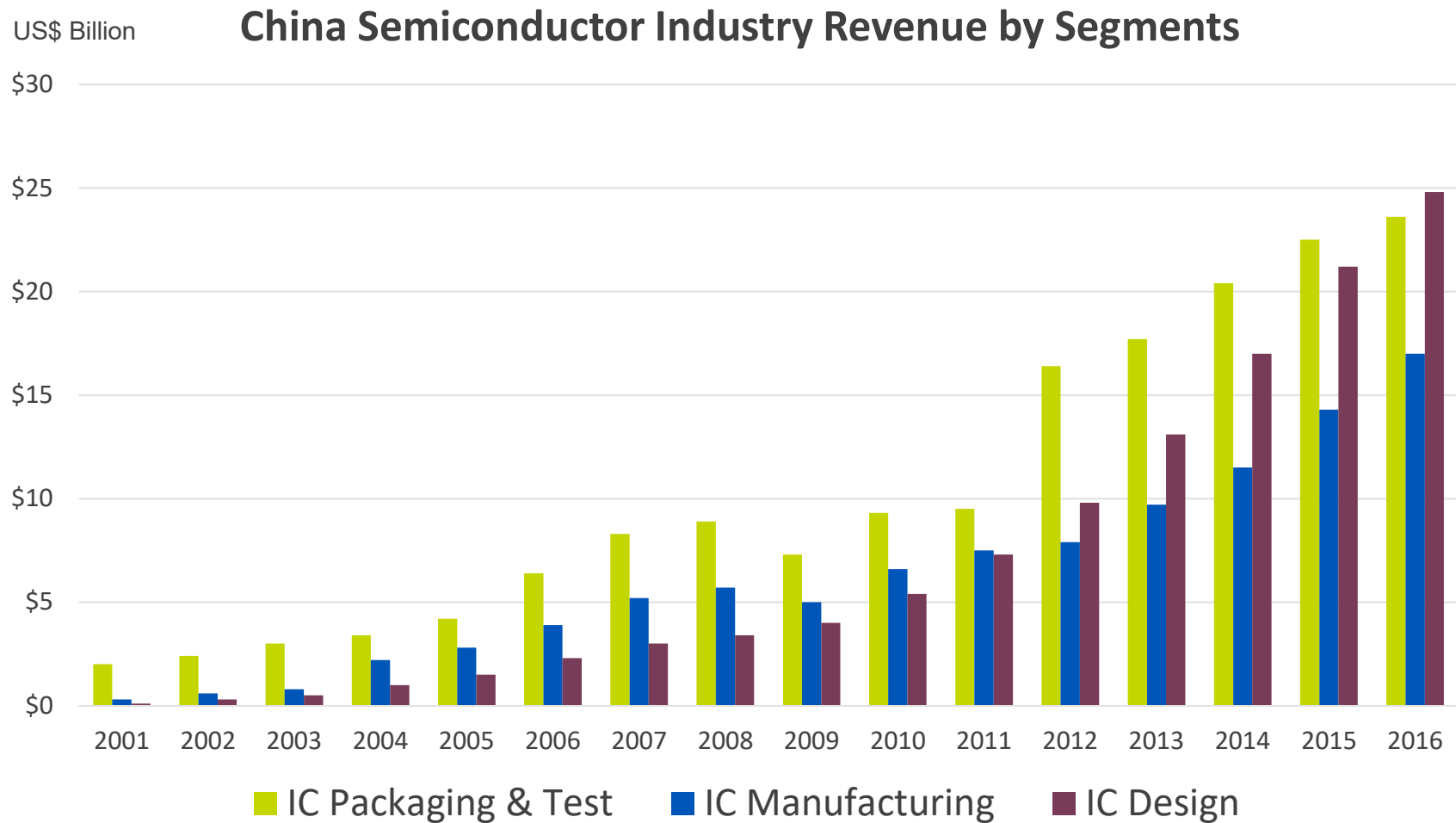
Taiwan Foundry Capacity by Manufacturers



China Investment

China's Domestic IC Industry

Undergoing Dramatic Growth



Source: CSIA, SEMI China, March 2017

China IC Market

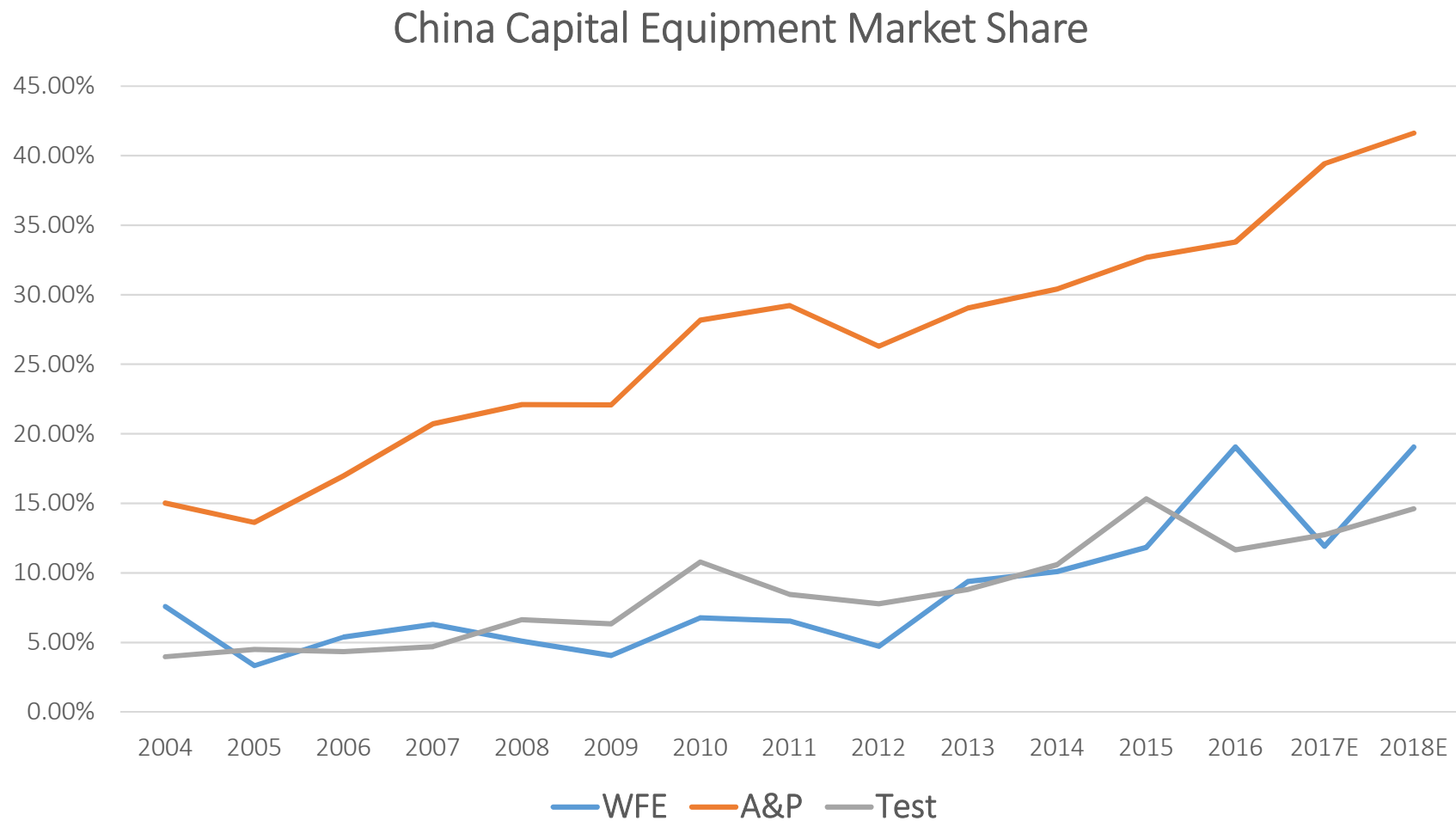
Semiconductors are the No. 1 Import and Trade Deficit



Source: China Customs, SEMI April 2017

- Per customs data reported in China, semiconductors are the #1 imported product.
- Electronics makers in China, including domestic companies, are dependent on the supply of imported semiconductors for their products.
- Government officials view this trade imbalance as a critical issue impacting China's strategic position with respect to the global economy and geopolitical/security standing.

China is now the Top Three Regions of Equipment Market

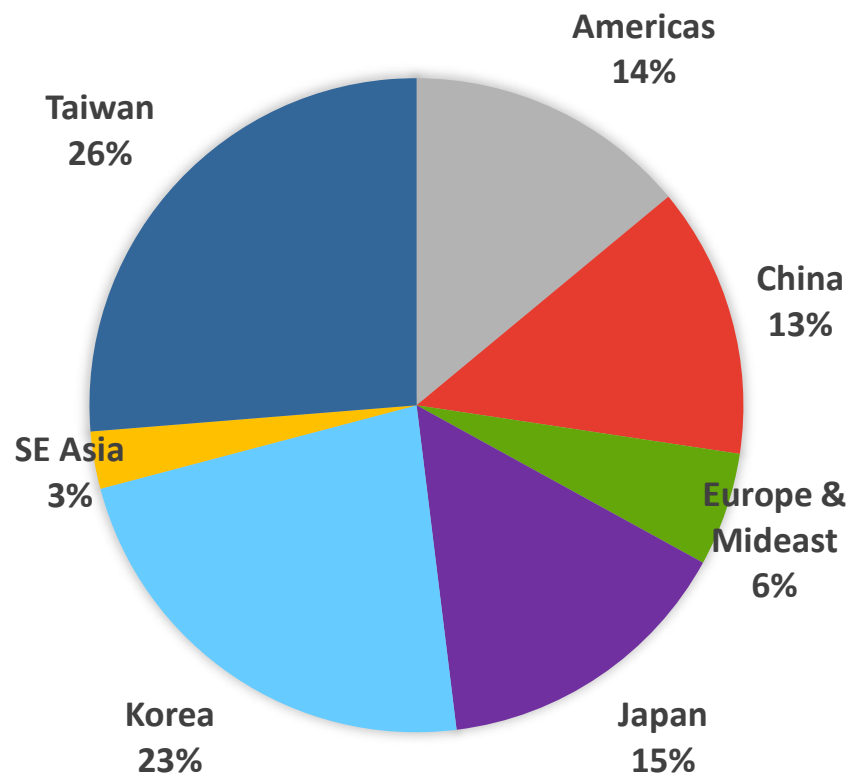


Source: SEMI EMDS, Aug. 2017

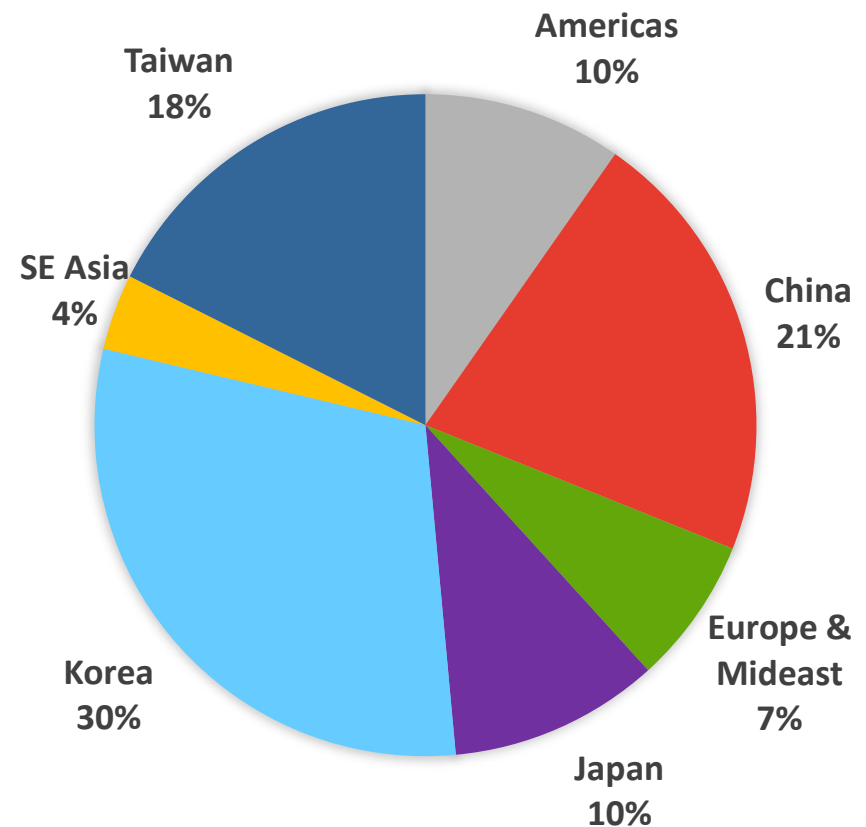
Fab Equipment Spending by Region

China to become Top 2 Spender in 2018/2019

**2015 FAB EQUIPMENT SPENDING
US\$36 BILLION**

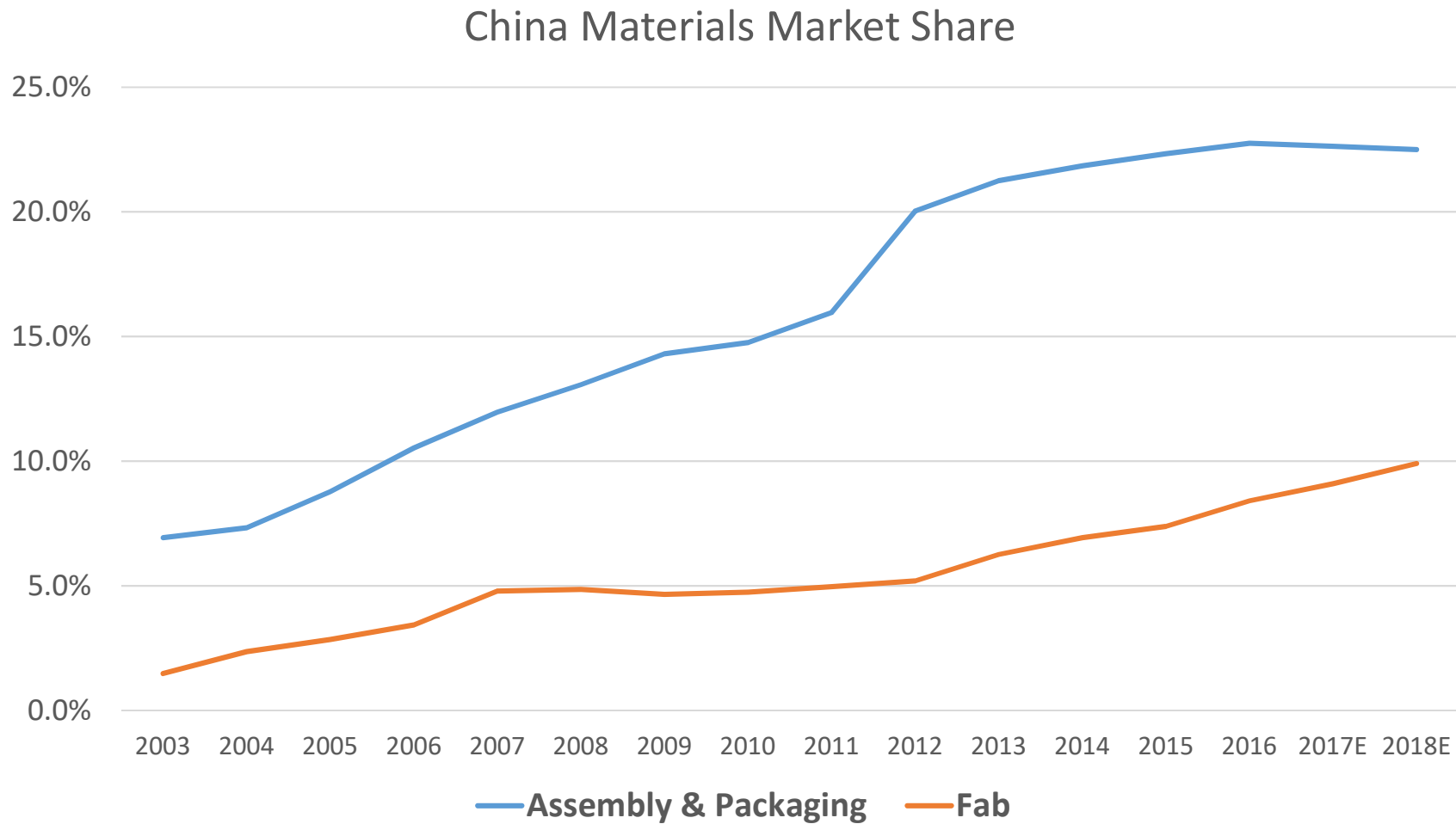


**2018 FAB EQUIPMENT SPENDING
US\$58 BILLION**



Source: SEMI World Fab Forecast, September 2017

China Materials Consumption Set to Soar



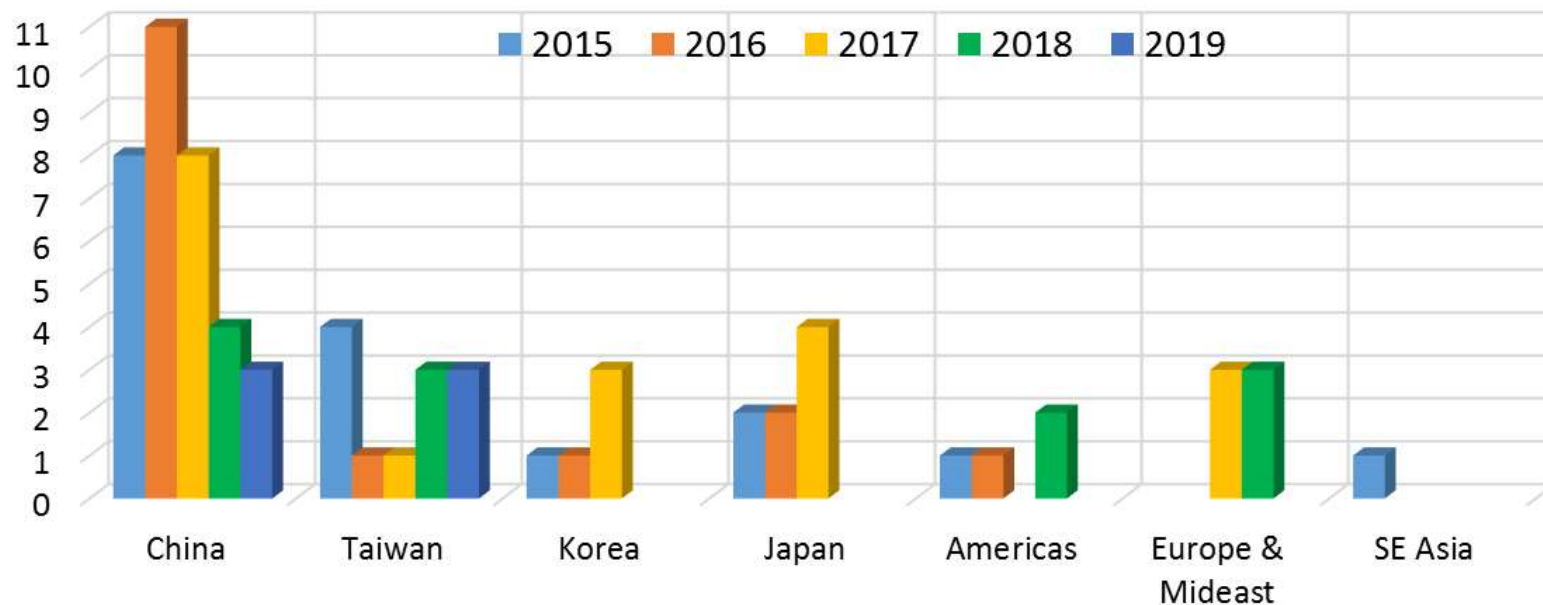
Source: SEMI MMDS, Aug. 2017

New Fab Projects on the Rise

China leads the way

New Facilities & Lines Starting Construction

(Front End, all probabilities, excluding LED, EPI, R&D)

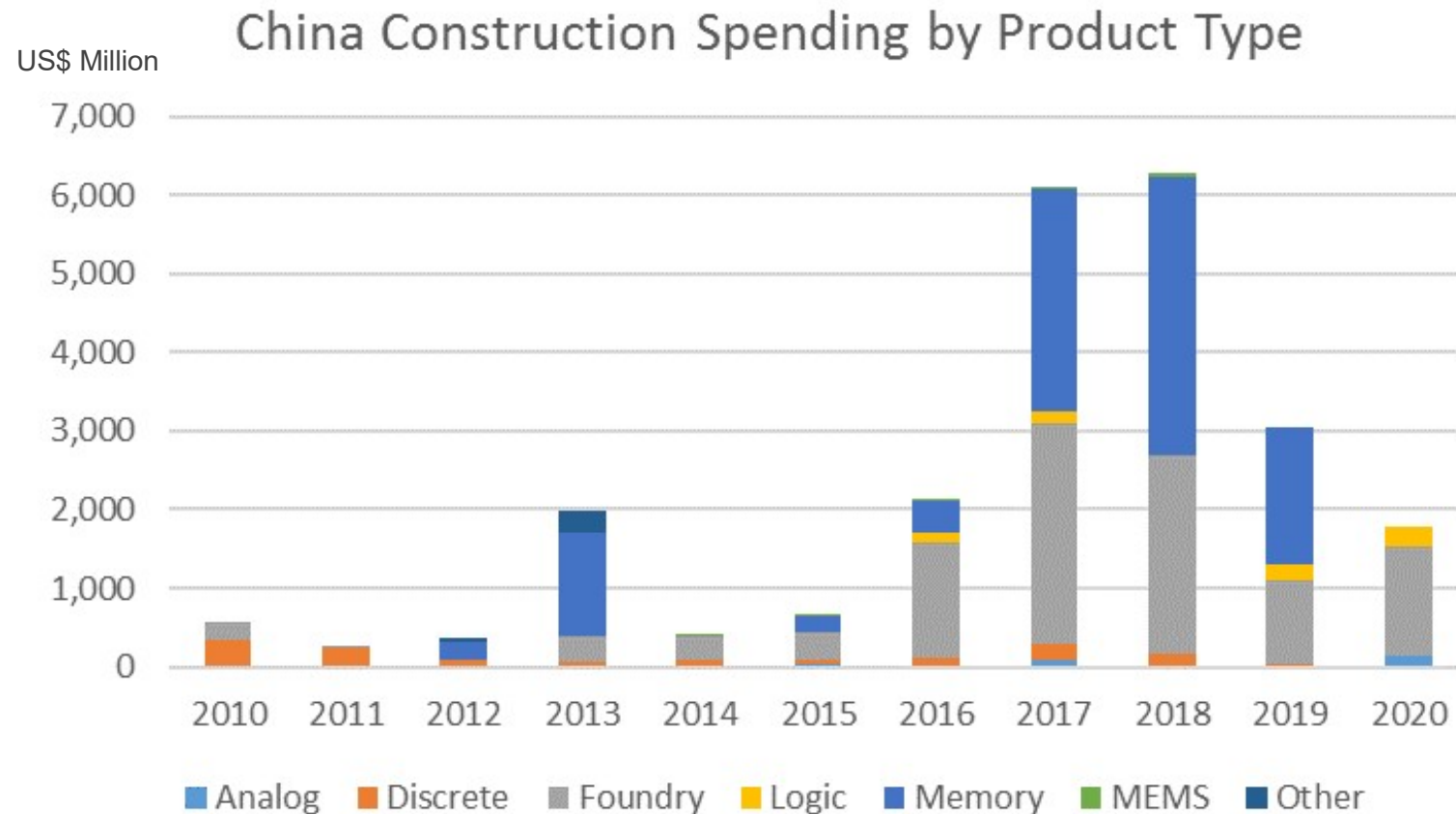


Source: World Fab Forecast report (September 2017, SEMI)

- *15 new fab projects in China from 2017 on*
- *Majority of projects (10) from China-owned entities*

New Fab Projects on the Rise

China Front-end Fab Construction Spending to Surge

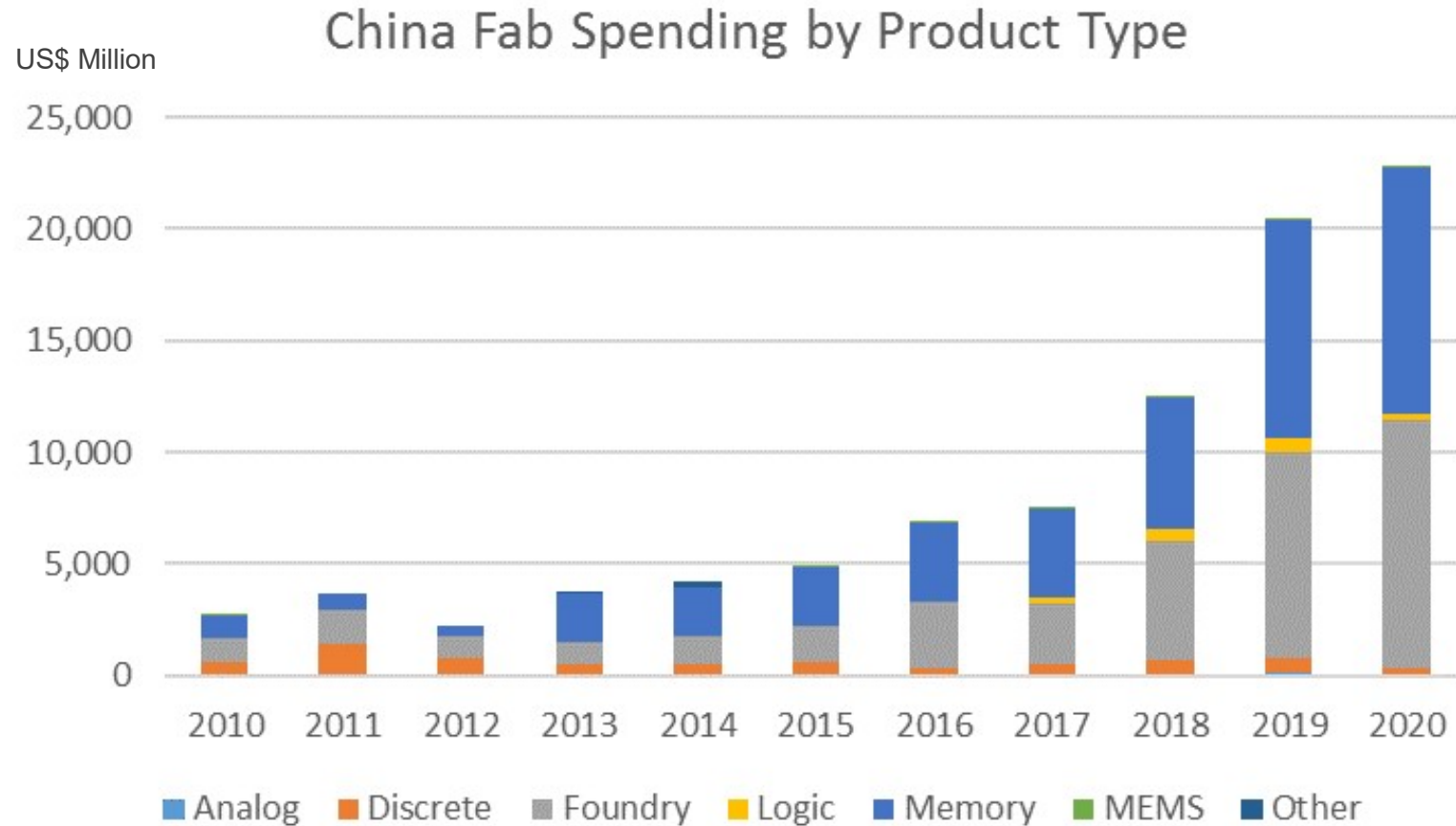


Disclaimer: The forecast is based on current announcement and is subject to change depending on actual execution.

Source: SEMI World Fab Forecast, September 2017

Surging China Investment

US\$20+ billion Forecast led by Foundry and Memory



Disclaimer: The forecast is based on current announcement and is subject to change depending on actual execution.

Source: SEMI World Fab Forecast, September 2017

Foreign vs. Local Investment

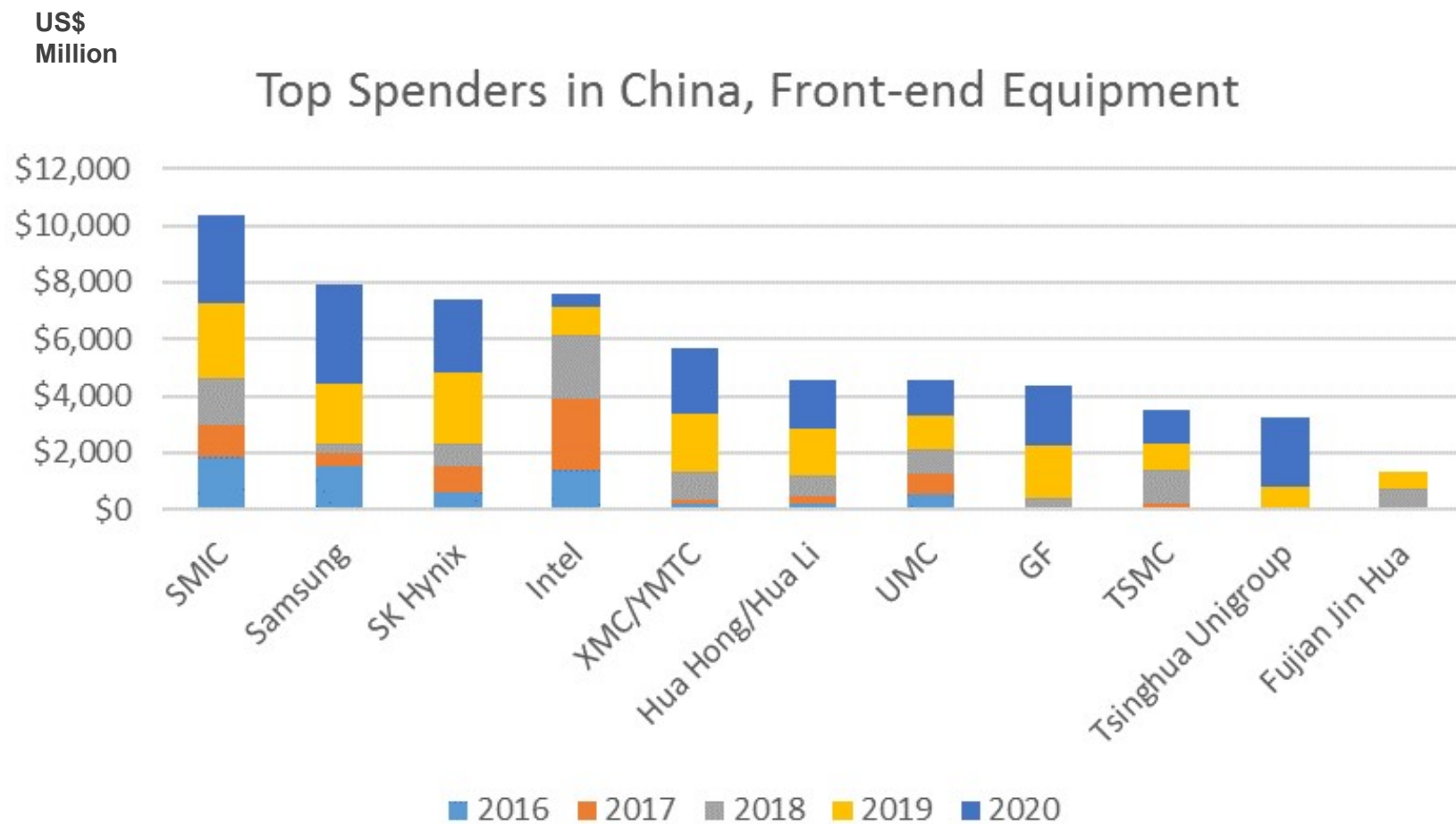
A Tale of Two Communities



Disclaimer: The forecast is based on current announcement and is subject to change depending on actual execution.

Source: SEMI World Fab Forecast, September 2017

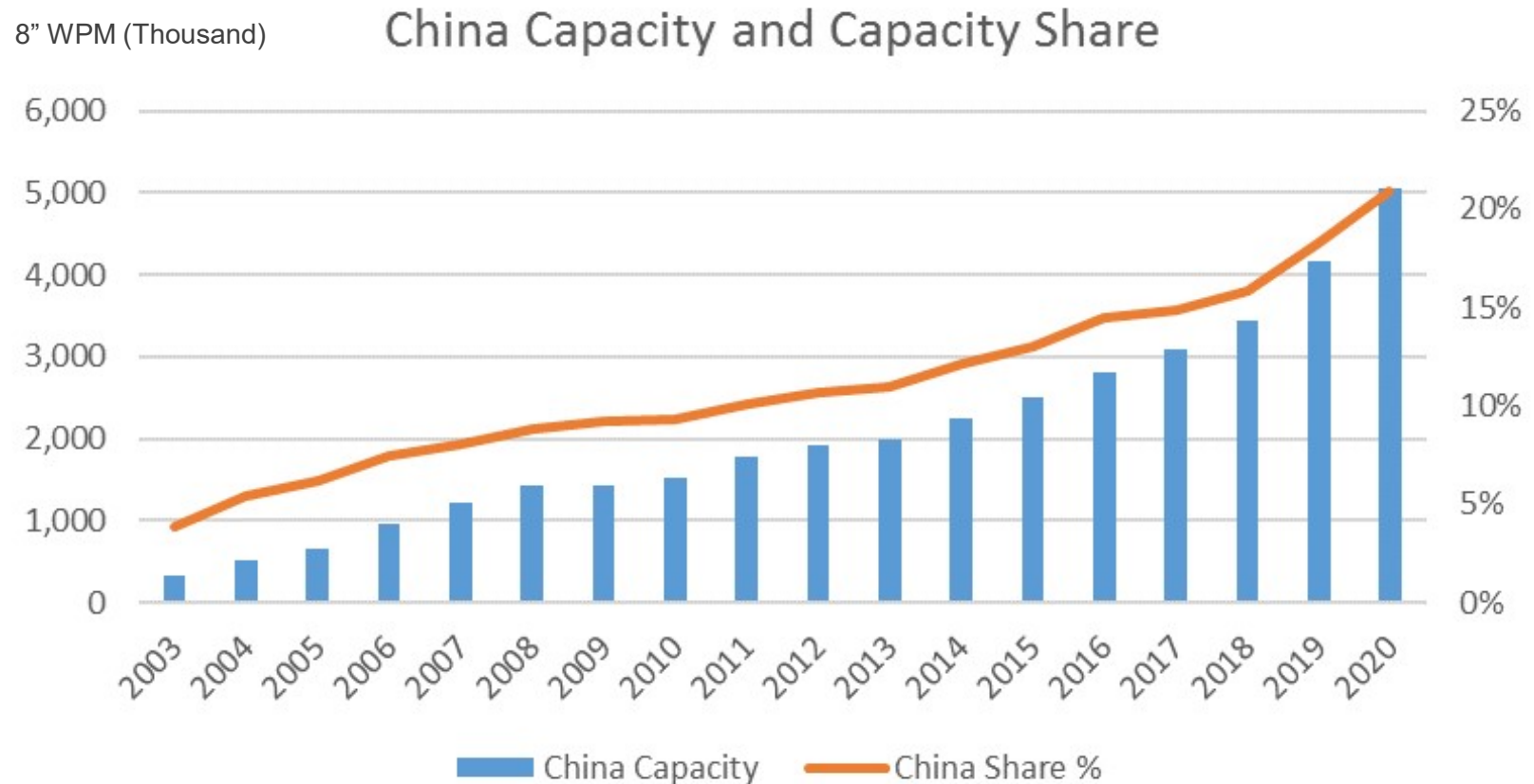
Top Spenders in China 2016 - 2020



Source: SEMI World Fab Forecast, September 2017

The Rising Share of China Capacity

Strong growth from 2015 to 2020

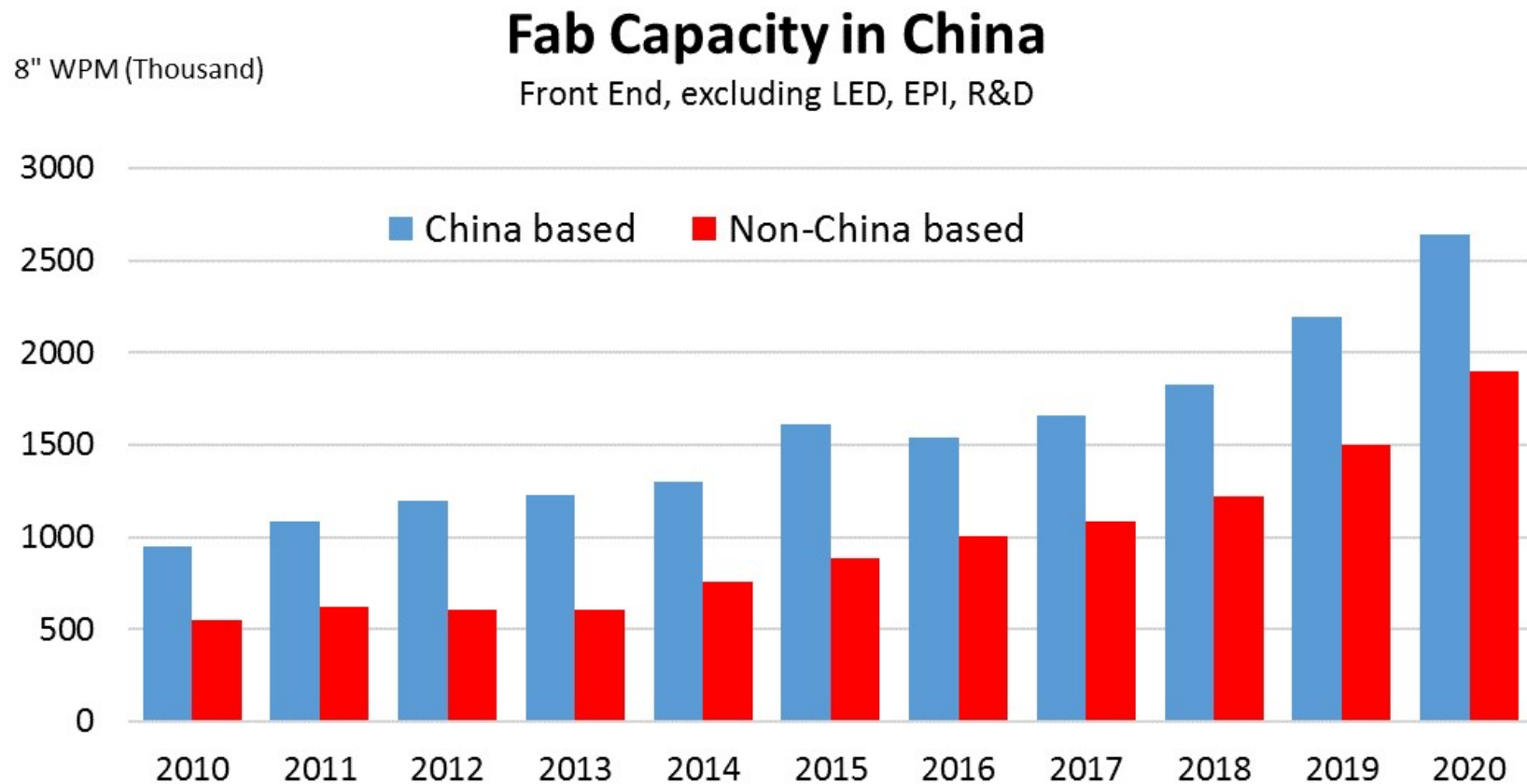


Disclaimer: The forecast is based on current announcement and is subject to change depending on actual execution.

Source: SEMI World Fab Forecast, September 2017

Fab Capacity in China

MNCs grow faster than China companies

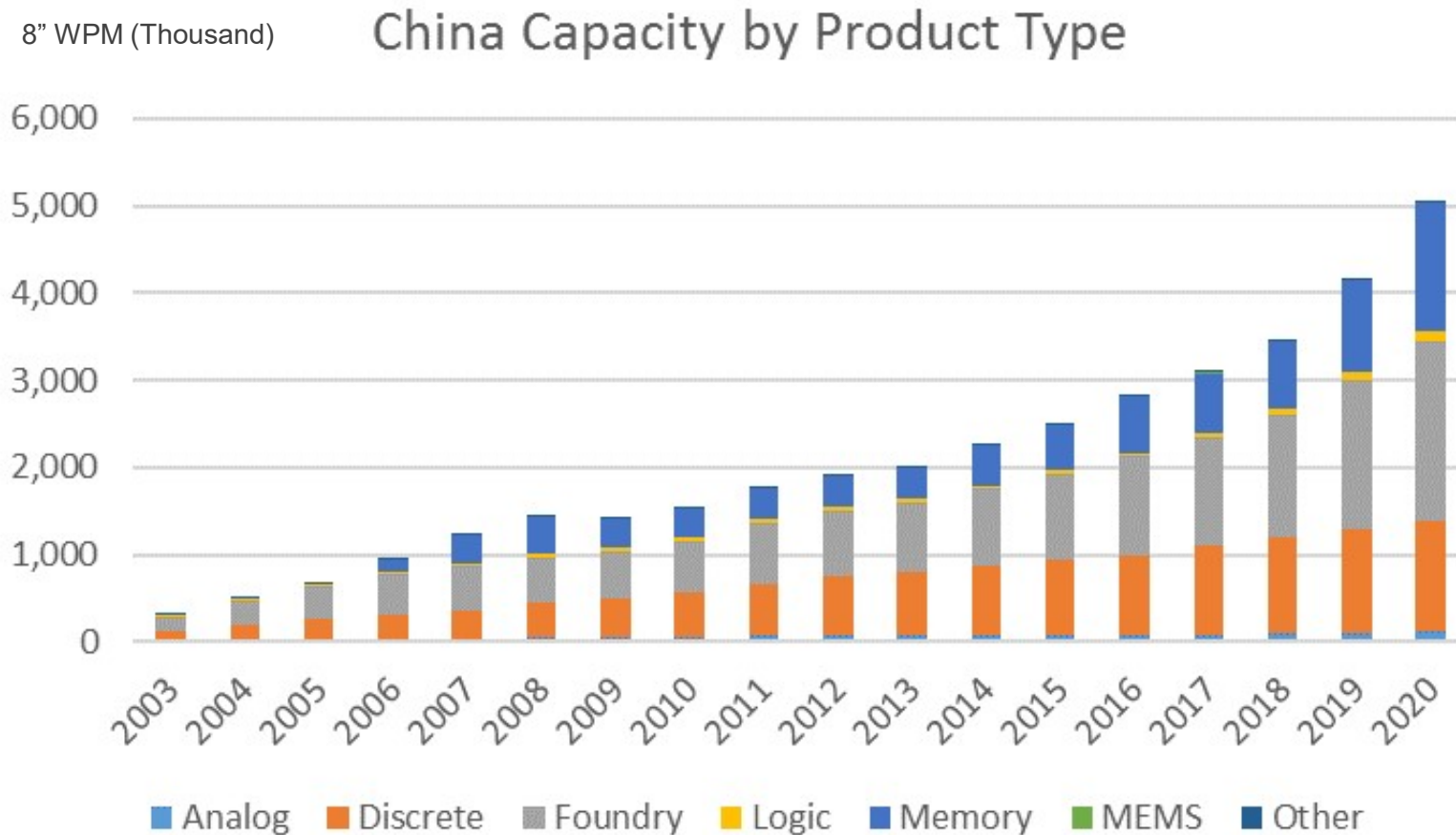


Source: World Fab Forecast report, September 2017, SEMI

www.semi.org/fabs

Capacity Trend in China

Foundry, Memory and Discrete (LED) Fuel the Growth

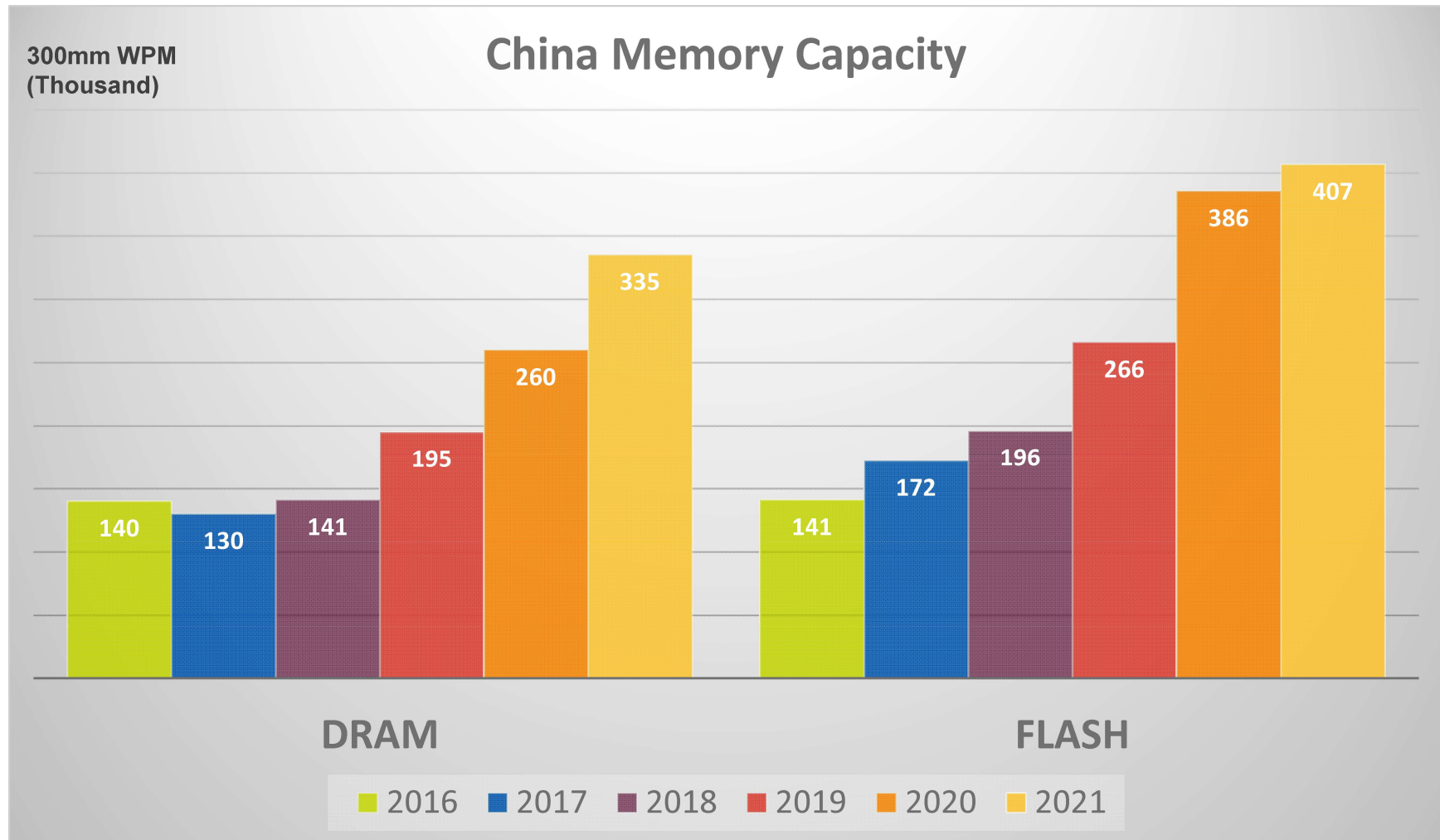


Disclaimer: The forecast is based on current announcement and is subject to change depending on actual execution.

Source: SEMI World Fab Forecast, September 2017

Memory Capacity in China

3D NAND showing stronger momentum

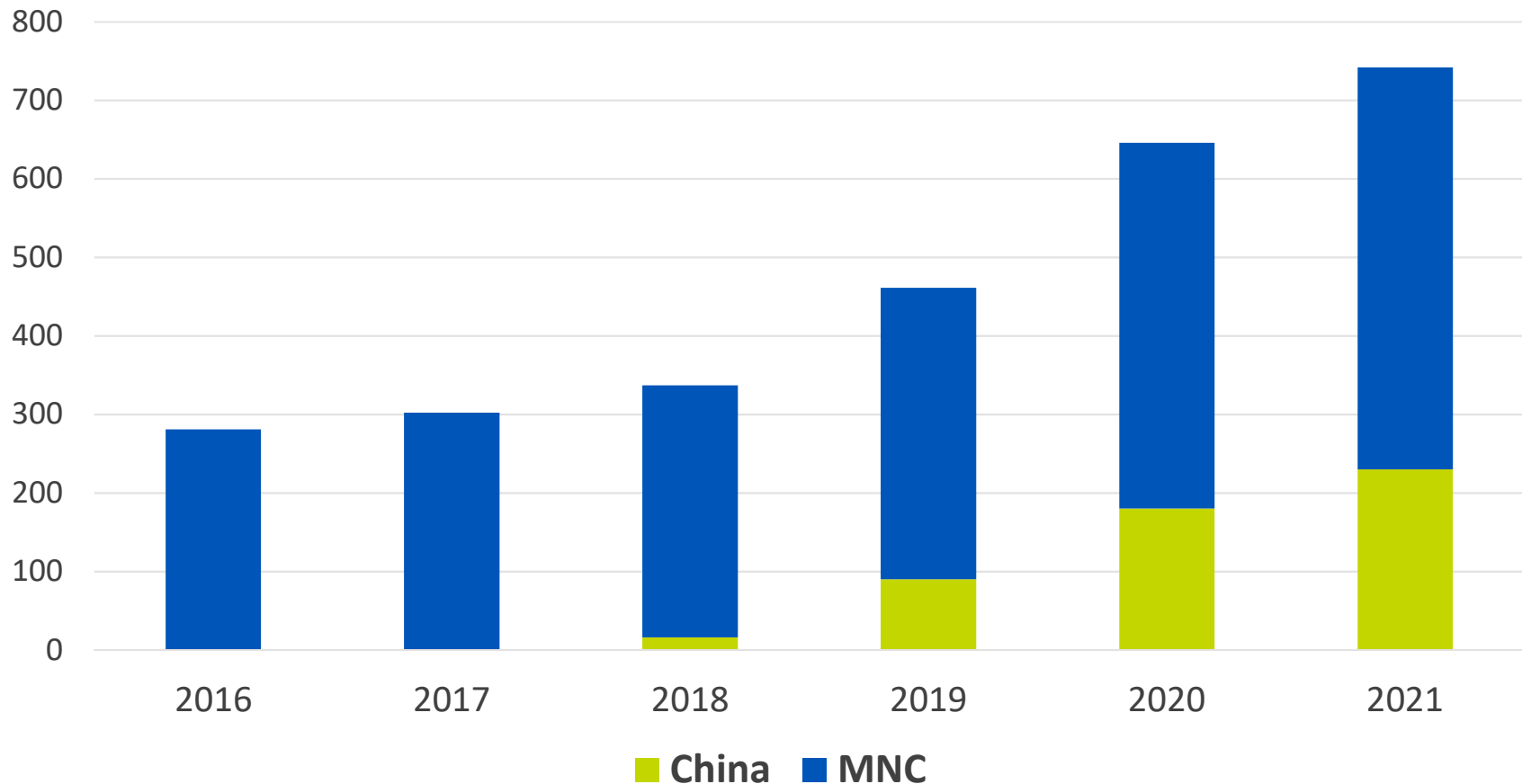


Source: SEMI World Fab Forecast, September 2017

Memory Capacity in China

Domestic players' capacity to surface from 2019

300mm WPM (Thousand) **China Memory Capacity by Communities**

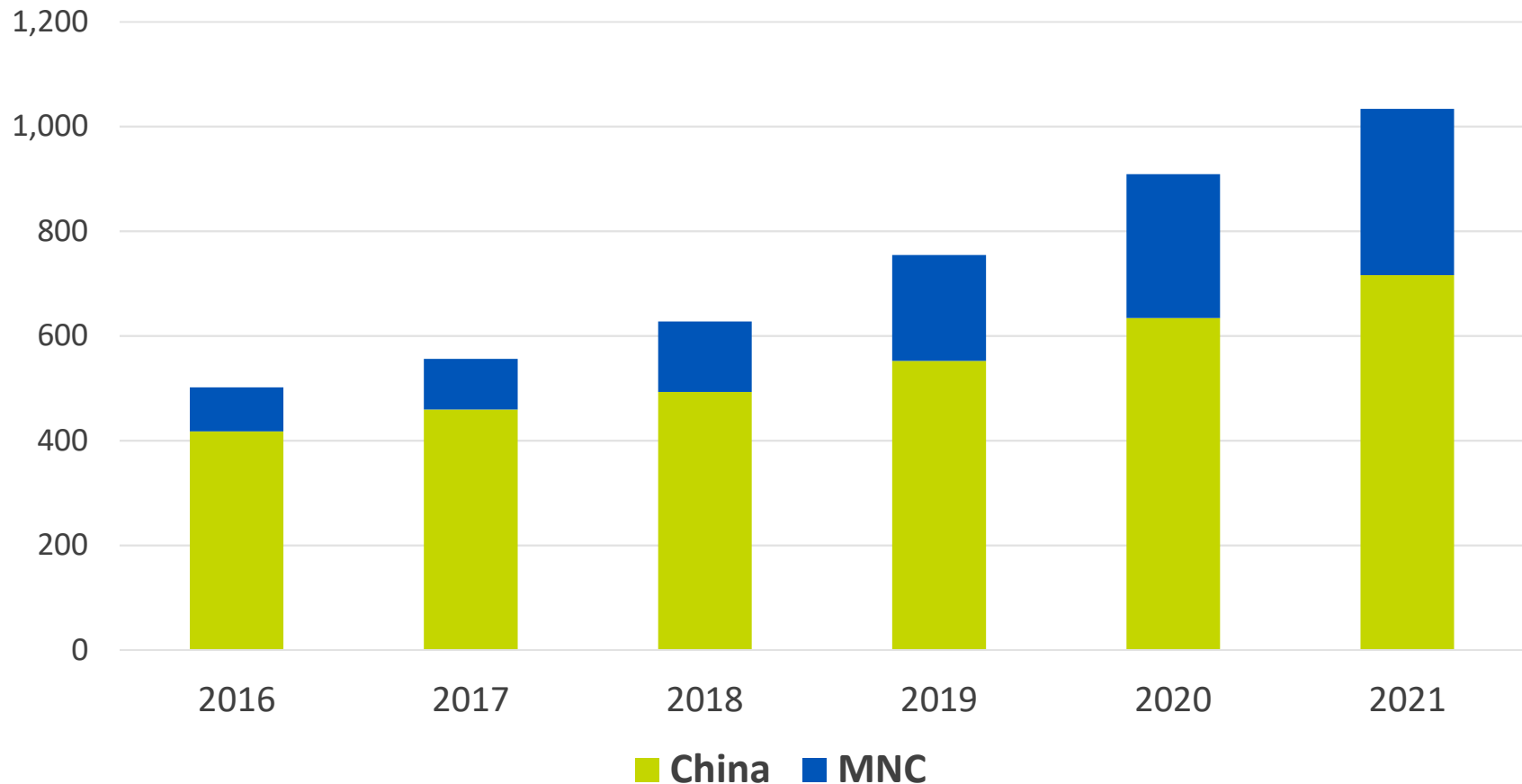


Foundry Capacity in China

MNC foundries are seeing higher capacity growth

300mm WPM (Thousand)

China Foundry Capacity by communities



Major 300mm Foundry Fab Activity in China

| Company | Product | Project | Capacity | Status |
|--------------------|-------------------|---------------------|------------|---|
| SMIC | Foundry 28nm | B3 in Beijing | 35,000 wpm | Constructing. Production to start in 2H18 |
| SMIC | Foundry 14nm/28nm | Fab 8-2 in Shanghai | 35,000 wpm | Constructing. Production to start in 1H19 |
| SMIC | Foundry 55/65nm | Fab 16 in Shenzhen | 40,000 wpm | Equipping. Production to start by end of 2017 |
| Hua Li | Foundry 28nm | Fab 2 in Shanghai | 40,000 wpm | Constructing. Production to start in 2H18 |
| Hua Hong | Foundry 28nm | Fab 7 in Wuxi | 30,000 wpm | Announced. Production to start in 2H19 |
| Tsinghua Unigroup | Foundry 28nm | Chengdu fab | 50,000 wpm | Planned. Production may start in 2020. |
| Tacoma / TowerJazz | Foundry 65nm | Nanjing fab | 20,000 wpm | Planned. Production may start in 2021. |

Source: SEMI World Fab Forecast, September 2017

Major 300mm Foundry Fab Activity in China

| Company | Product | Project | Capacity | Status |
|-----------------|-----------------------------|------------------------|-----------------------|--|
| TSMC | Foundry 16nm | Nanjing fab (3 phases) | 40,000 wpm per phase | Equipping. Production to start in 2Q18 |
| UMC | Foundry 28/40nm | Fab 12X in Xiamen | 50,000 wpm | Production now (2 phases) |
| Globalfoundries | Foundry 22/28nm & 130/180nm | Fab 11 in Chengdu | 83,000 wpm (2 phases) | Constructing. Production to start in 2H18. |
| Powerchip | Foundry 90nm | Nexchip | 40,000 wpm | Production starts in 2H 2017 |

Source: SEMI World Fab Forecast, September 2017

Major 300mm Memory Fab Activity in China

| Company | Product | Project | Capacity | Status |
|--------------------------------|-------------|----------------------|--------------------------|---|
| Samsung | 3D NAND | Xian Module 2 | 100,000 wpm | Announced. Production to start in 2H19 |
| SK Hynix | DRAM | C2F & C3 | 100,000 wpm | Constructing. Production to start in 1H19 |
| XMC/ YMTC | 3D NAND | Wuhan fab (3 phases) | 100,000 wpm per phase | Constructing. Trial production to start in 2H18 |
| Tsinghua Unigroup | DRAM & NAND | Nanjing fab | 100,000 wpm per phase | Announced. Production may start in 2020. |
| Fujian Jin Hua | DRAM | Jinjiang fab | 60,000 wpm (20K in 2018) | Constructing. Trial production to start in 2H18 |
| Hefei Chang Xin / RuiLi Memory | DRAM | Hefei fab | 125,000 wpm (2 phases) | Constructing. Trial production to start in 2H18 |

Source: SEMI World Fab Forecast, September 2017

China Momentum and Challenges

Momentum

- The surge of China investment is both policy-driven and market-driven.
- Policies such as the National IC promotion Guidelines (2014) as well as the 13th five-year plan (2016-2020) are the key drivers of the new fab projects blossoms across the country.
- Majority of these new fab projects are supported or “invested” by National IC fund and various local government funds.
- The huge demand and rising Chinese electronics OEMs also play an important role in attracting foreign semiconductor companies to set up facilities in China.
- MNCs are actually investing as fast as China counterparts in memory and foundry sectors.

China Momentum and Challenges

Challenges

- There is no shortage of capital for semiconductor fab projects in China. Though some local government funds are not really ready yet.
- Two major limiting factors are the availability of talent and the sources of technologies/IP.
- Talent sourcing is happening across Asia especially from Korea, Taiwan and Japan.
- However, talent recruiting raises some concerns about IP infringement especially in memory.
- The concerns of adding massive capacity in certain product categories may trigger oversupply in the long run.
- China faces regulatory challenges to successfully complete outbound M&A in tech sectors.

Summary

Summary

Fab Investment

- 3D NAND, Foundry and China investments key to spending

The Surge of China

- 15 or more new projects on the horizon from 2017 onwards.
- China is forecasted to become the largest capital equipment market by 2020
- MNCs and China device makers are investing equal weighted in China.
- Investment in foundry and memory segments are paving the way for China's place on the global semiconductor stage.