Fab Investment Outlook and The Surge of China

Shanshan Du
Senior Analyst
SEMI China
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Outline

• 2018 Outlook and Drivers

• Fab Investment Outlook
  – Record spending

• The Surge of China
  – New fab projects
  – Capacity projection
  – Memory and Foundry

• Summary
2018 Outlook and Drivers
Semiconductor Industry Outlook
2017 soars past $400 billion

Source: SIA/WSTS historical year end reports, WSTS 2018 Forecast
2018 Semiconductor Forecasts

- **Future Horizons (Jan 18), 21.0%**
- **Cowan LRA (Apr 18), 16.8%**
- **IC Insights (Mar 18), 15.0%**
- **WSTS (Feb 18), 9.5%**
- **VLSI Research (Jan 18), 7.7%**
- **Gartner (Jan 18), 7.5%**
- **IHS Markit (Jan 18), 7.4%**
- **Semico Research (Jan 18), 7.2%**

Source: SEMI April 2018
Industry Trends and Growth Drivers

• Numerous Applications Driving Growth Through 2025

<table>
<thead>
<tr>
<th>Applications</th>
<th>Largest Growth Products in 2017</th>
<th>Long Term Forecast to 2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td>Memory (DRAM due to strong pricing)</td>
<td>IoT * $16B -&gt; $62B</td>
</tr>
<tr>
<td>Industrial</td>
<td>Sensors</td>
<td>Automotive* $32B -&gt; $51B</td>
</tr>
<tr>
<td>Wireless</td>
<td>Opto Electronics</td>
<td>5G ** $0B -&gt; $20B</td>
</tr>
<tr>
<td>Automotive</td>
<td>Analog Devices</td>
<td>AR/VR*** $4B -&gt; $131B</td>
</tr>
<tr>
<td>Consumer</td>
<td>Discretes</td>
<td>AI*** $5B -&gt; $50B</td>
</tr>
</tbody>
</table>

• Robust volume shipments and higher ASPs for Memory are driving strong 2017 revenue growth.
• Storage, industrial, wireless, and automotive applications also contributing to strong 2017 growth.
• Connectivity, data centers, communications, automotive, and advanced software spurs strong demand through 2025.

Source: SEMI Industry Strategy Symposium, 2017

*   Semiconductor value
**  Network/Devices
*** Market Size

Virtual Reality (VR)
Augmented Reality (AR)
AI Artificial Intelligence (AI)
Global Fab Investment Outlook
40% Increase in 2017

**Fab Equipping Spending over Time**
(All Front End facilities. Including new, used, and in-house)

<table>
<thead>
<tr>
<th>Year</th>
<th>$ Billion</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>$29</td>
</tr>
<tr>
<td>2005</td>
<td>$28</td>
</tr>
<tr>
<td>2006</td>
<td>$34</td>
</tr>
<tr>
<td>2007</td>
<td>$39</td>
</tr>
<tr>
<td>2008</td>
<td>$26</td>
</tr>
<tr>
<td>2009</td>
<td>$15</td>
</tr>
<tr>
<td>2010</td>
<td>$35</td>
</tr>
<tr>
<td>2011</td>
<td>$40</td>
</tr>
<tr>
<td>2012</td>
<td>$34</td>
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<td>2013</td>
<td>$31</td>
</tr>
<tr>
<td>2014</td>
<td>$37</td>
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<tr>
<td>2015</td>
<td>$36</td>
</tr>
<tr>
<td>2016</td>
<td>$40</td>
</tr>
<tr>
<td>2017</td>
<td>$57</td>
</tr>
<tr>
<td>2018</td>
<td>$63</td>
</tr>
</tbody>
</table>

World Fab Forecast, December 2017, SEMI
Fab Investments

Growth is likely to continue beyond this year

Source: SEMI World Fab Forecast, March 2018
Fab Spending by Product Types
Led by Memory and Foundry

Fab Equipment Spending by Product Type
(All Front End, including new, used, in-house)

Source: World Fab Forecast reports, December 2017, SEMI
Capacity Trend by Product Types
3D NAND, DRAM, Foundry and MEMS add more new capacity

<table>
<thead>
<tr>
<th>Type</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>3D NAND</td>
<td>46%</td>
<td>20%</td>
</tr>
<tr>
<td>DRAM</td>
<td>5.5%</td>
<td>5.7%</td>
</tr>
<tr>
<td>MEMS</td>
<td>7.8%</td>
<td>3.8%</td>
</tr>
<tr>
<td>Foundry</td>
<td>5.4%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Analog &amp; Power</td>
<td>4.1%</td>
<td>3%</td>
</tr>
<tr>
<td>Logic &amp; MPU</td>
<td>4.5%</td>
<td>3%</td>
</tr>
</tbody>
</table>
China Investment
China’s Domestic IC Industry
Undergoing Dramatic Growth

- Total revenue reached $83.1B
- YtY growth rate is 27%

Source: CSIA, SEMI China, April 2018
Fab Equipment Spending by Region

*China to become Top 2 Spender in 2018/2019*

<table>
<thead>
<tr>
<th>Region</th>
<th>2015 Spending</th>
<th>2018 Spending</th>
</tr>
</thead>
<tbody>
<tr>
<td>Americas</td>
<td>14%</td>
<td>12%</td>
</tr>
<tr>
<td>China</td>
<td>13%</td>
<td>20%</td>
</tr>
<tr>
<td>Europe &amp; Mideast</td>
<td>6%</td>
<td>7%</td>
</tr>
<tr>
<td>Japan</td>
<td>15%</td>
<td>32%</td>
</tr>
<tr>
<td>Korea</td>
<td>23%</td>
<td>32%</td>
</tr>
<tr>
<td>SE Asia</td>
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<td>26%</td>
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<td>16%</td>
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Source: SEMI World Fab Forecast, December 2017
New Fab Projects on the Rise - *China leads the way*

- 19 new fab projects in China from 2017 on
- Out of 10 upcoming 300mm projects in China, Majority (7) are from China-owned entities

Source: World Fab Forecast report (December 2017, SEMI)
Surging China Fab Investment – Foundry & Memory Lead

Key Spending Projects

2017
- Intel Fab 68 - upgrade to 3D NAND
- SK Hynix C2
- UMC Fab 12X
- SMIC B2

2018
- Intel Fab 68 Phase 2
- Yangtze Memory Technology (Wuhan)
- TSMC Nanjing Phase 1
- Globalfoundries Chengdu Fab 11
- Hua Li Micro Fab 2
- Fujian Jin Hua - DRAM

2019/2020
- Tsinghua Unigroup (Nanjing) and Samsung Xian phase 2
- SK Hynix C3
- SMIC new Shanghai fab
- Hefei Chang Xin Memory

Source: SEMI World Fab Forecast, December 2017
The Rising Share of China Capacity

Strong growth from 2016 to 2020

Source: SEMI

World Fab Forecast, December 2017

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

Source: SEMI World Fab Forecast, December 2017
Capacity Trend in China

Foundry, Memory and Discrete (LED) Fuel the Growth

8" WPM (Thousand)

China Capacity by Product Type

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

Source: SEMI World Fab Forecast, December 2017
Memory Capacity in China

3D NAND showing stronger momentum

![Bar chart showing China Memory Capacity Forecast (300mm K wpm) for DRAM and NAND FLASH from 2016 to 2021.](chart)

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

Source: SEMI World Fab Forecast, December 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.
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
- Record spending in 2017 and 2018
- 3D NAND, DRAM, Foundry and China investments are key drivers to spending

The Surge of China
- 19 new projects planned from 2017 onwards.
- China is forecasted to become the largest capital equipment market in 2019
- Investment in foundry and memory segments are paving the way for China’s place on the global semiconductor stage.
China IC Industry Outlook

POLICIES – ECOSYSTEM – INVESTMENTS - CAPACITIES

• New Expanded Edition Coming in September, 2018
• Segmented Market Details
• Supply Chain Database
• Forward Analysis with
• Opportunities and Challenges

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