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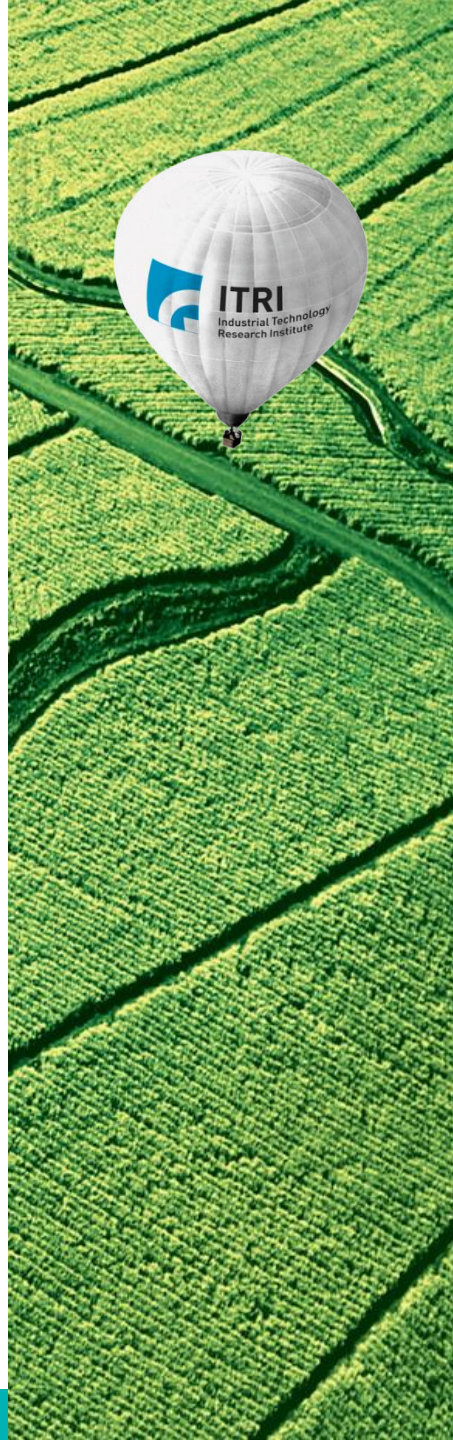
The 22nd Taiwan-Belgium
Joint Business Council Meeting



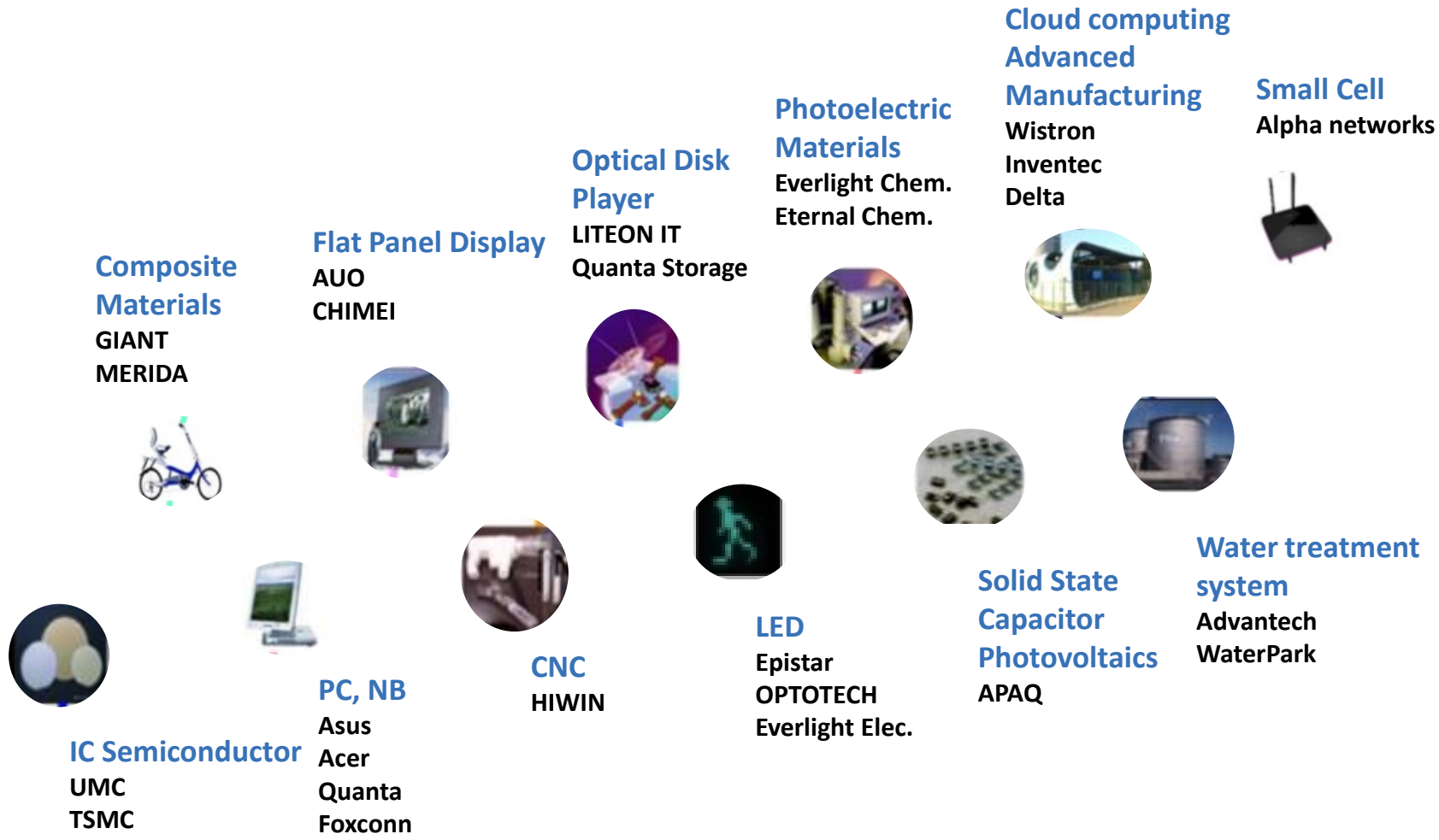
Overview of Taiwan Semiconductor Industry and National R&D Initiatives

Ray Yang (楊瑞臨), Consulting Director

ITRI Industry, Science and Technology International Strategy Center (ISTI)

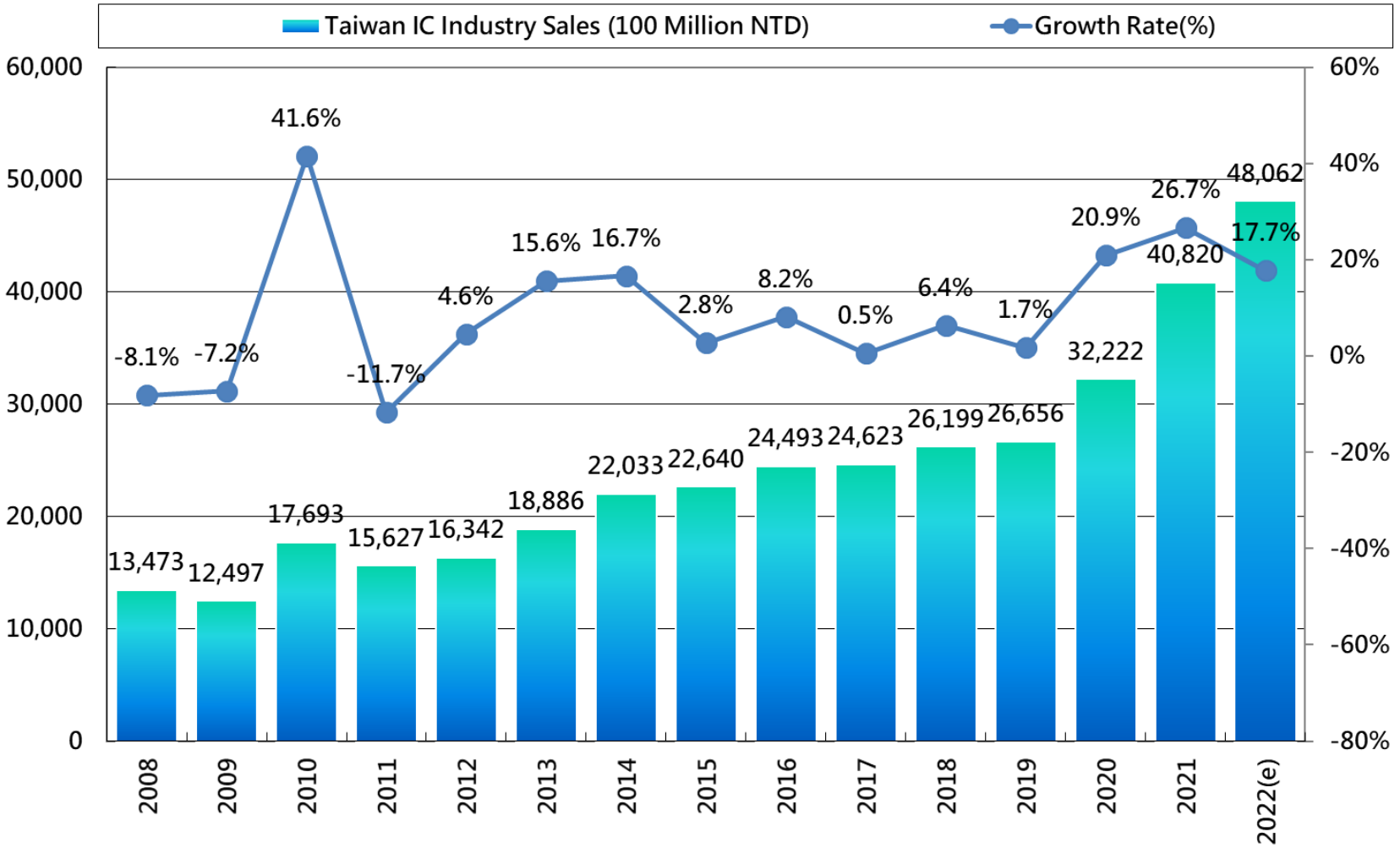
May 5, 2022

ITRI Fosters New Industries in Taiwan with Semiconductor Industry the First



ISTI Source: ITRI

Taiwan IC Industry Reaches Record-high of NTD4.08 Trillions (US$145.8B) in 2021



ISTI Source: TSIA；ITRI/ISTI Research

Exchange rate NTD/USD is 28.0

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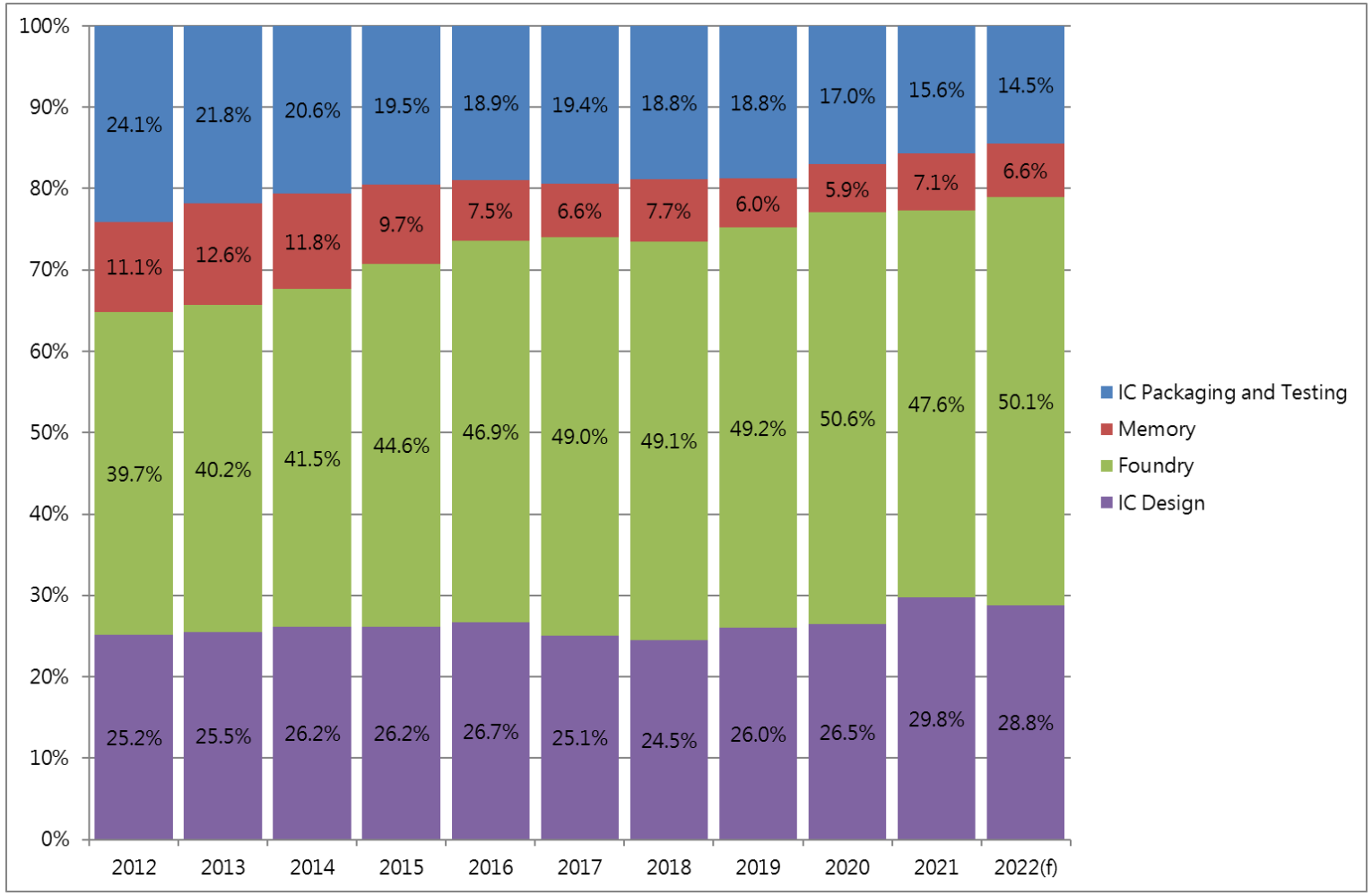
Foundry Contributes the Most, Followed by Fabless IC Design of Taiwan IC Industry



ISTI Source: ITRI/ISTI Research

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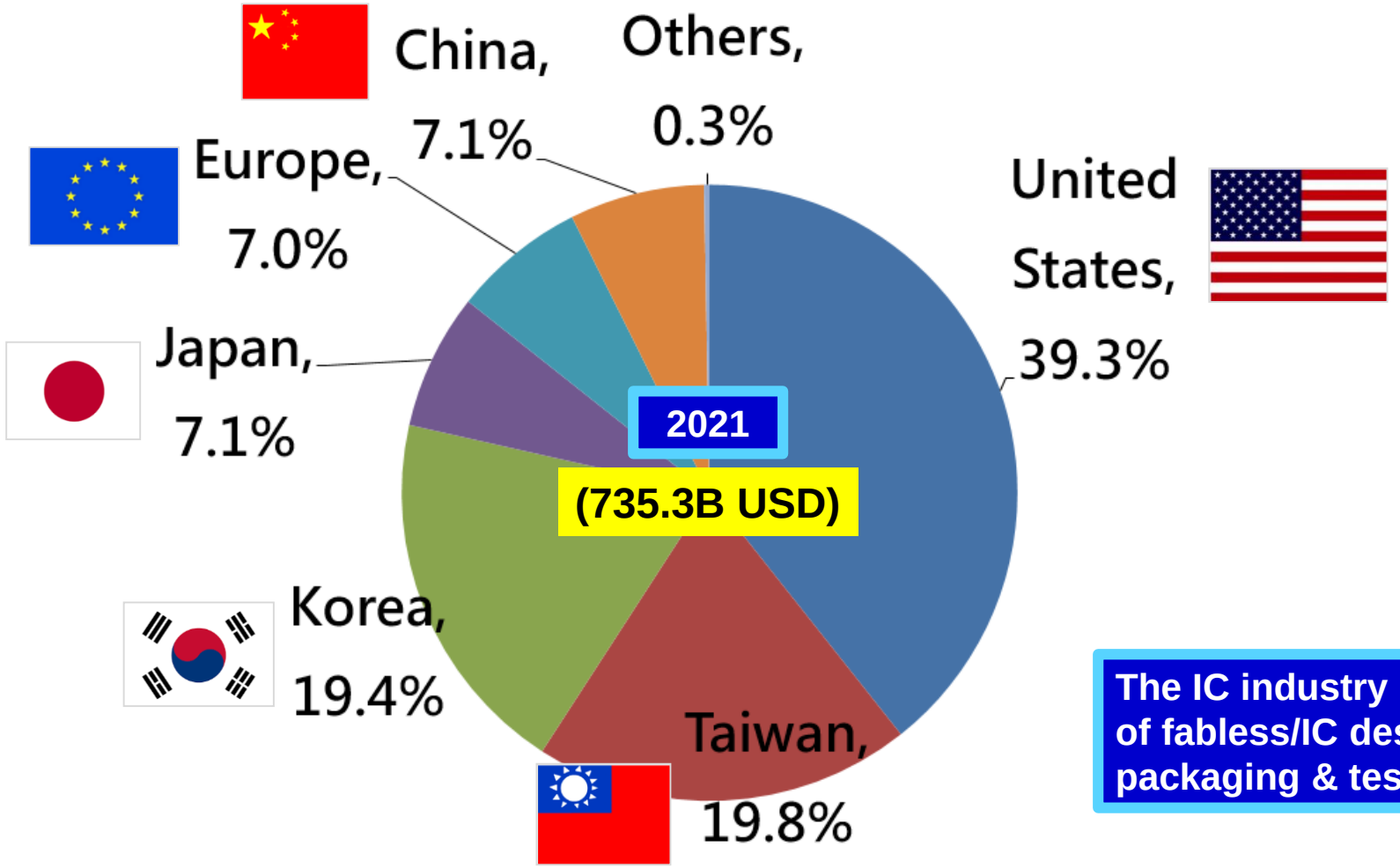
2021 Global Semiconductor Industry Competitiveness

The total output value of US semiconductor industry ranks No.1 in the world, followed by Taiwan and South Korea.



The IC industry includes sub-segments of fabless/IC design, pure-foundry, IC packaging & testing, and IDM.

ISTI Source: ITRI/ISTI Research

Note: Revenue calculated based on which country the company's HQ is located in.

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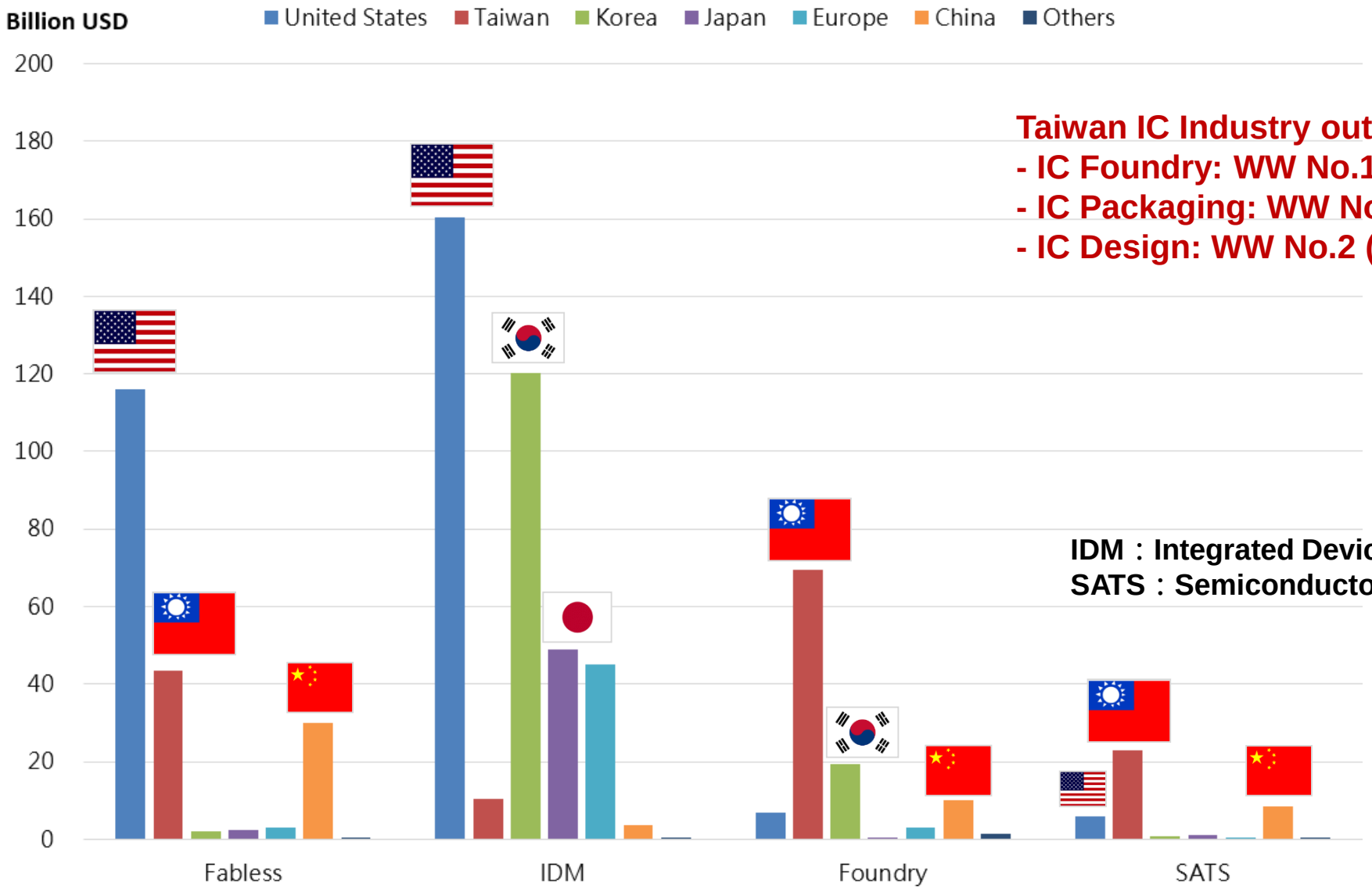
Taiwan's Foundry and SATS Serving WW Customers



Taiwan IC Industry output value ranks WW No.2
- **IC Foundry: WW No.1 (2021 WW share：63%)**
- **IC Packaging: WW No.1 (2021 WW share：58%)**
- **IC Design: WW No.2 (2021 WW share：22%)**

IDM：Integrated Device Manufacturer
SATS：Semiconductor Assembly and Test Services

ISTI Source: ITRI/ISTI Research

Note: Revenue calculated based on which country the company's HQ is located in.

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Attracting foreign partners' investments to increase their value-add to upgrade Taiwan IC ecosystem

ISTI Source: ITRI/ISTI Research

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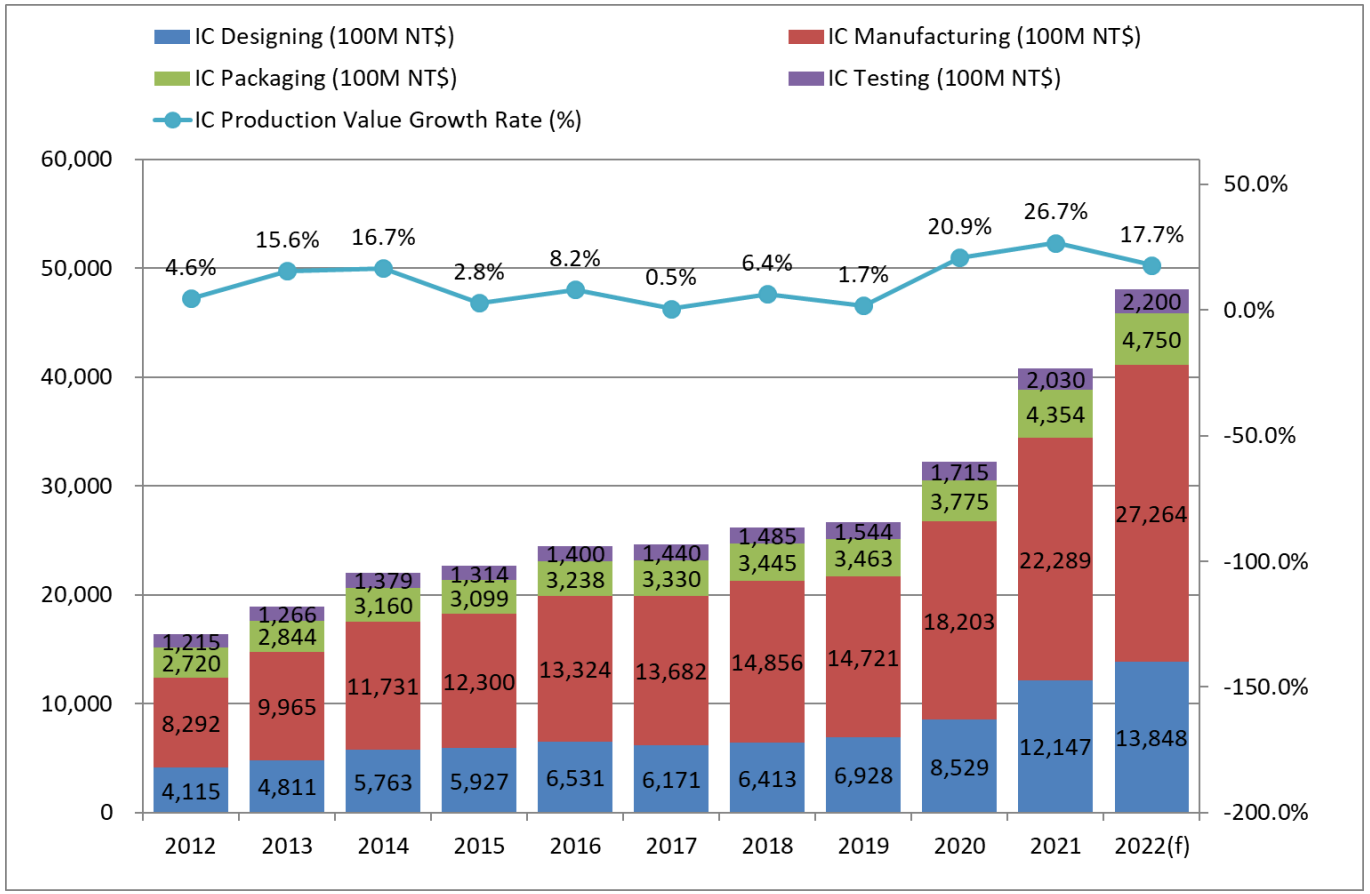
Taiwan IC Industry Outperforms WW Growth in the Last 10 Years, and What's the Next 10's ?

Clustering ecosystem with agility and flexibility, increases and enhances international partnerships, from various applications of NB and smartphone to data center and automotive



2012-2022(f) CAGR %：
Taiwan IC Industry 11.4%
Worldwide 7.5% (WSTS)

2012-2022(f) CAGR%：

IC Testing 6.1%
IC Packaging 5.7%

IC Manufacturing 12.6%

IC Design 12.9%

ISTI Source: TSIA；ITRI/ISTI Research

Exchange rate NTD/USD is 28.0

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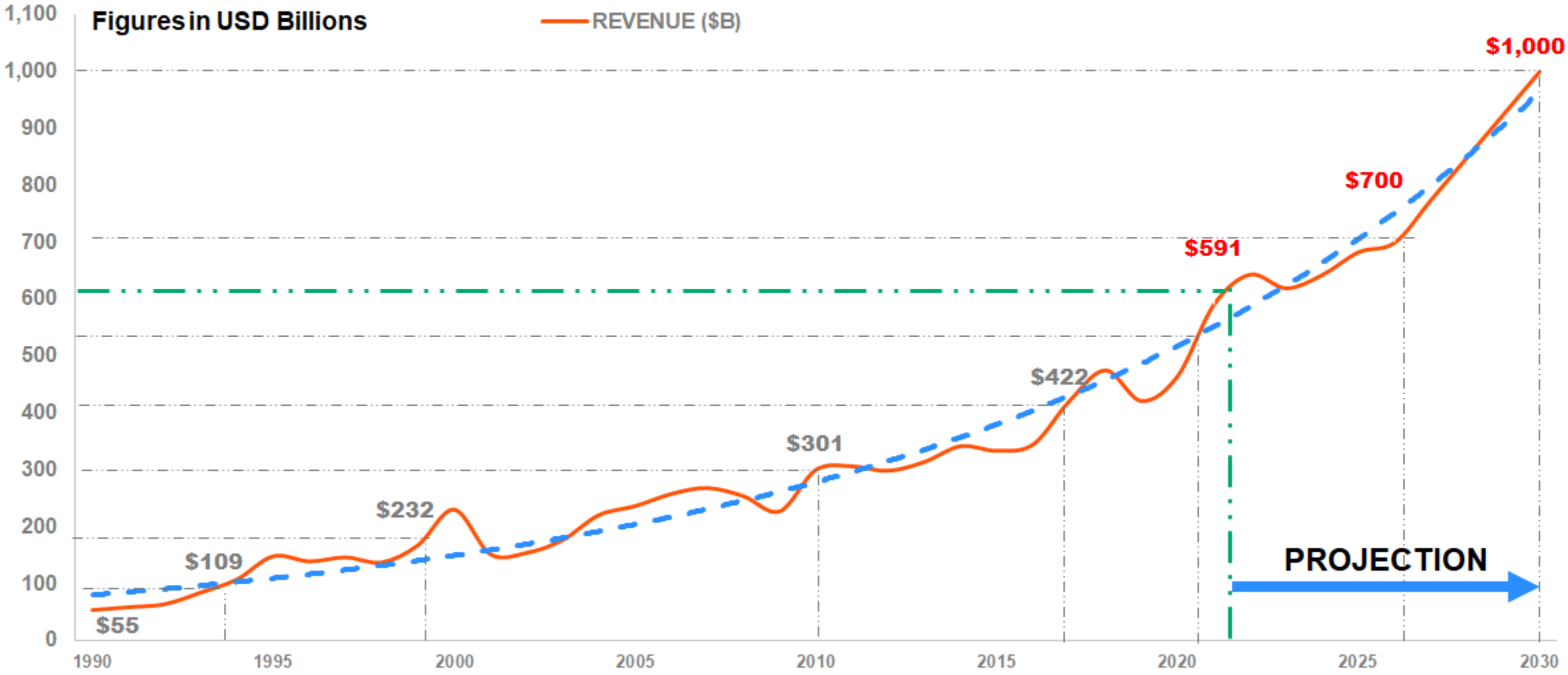
Semiconductor Revenue to Hit $1 Trillion by 2030 !?



ISTI Source: Gartner

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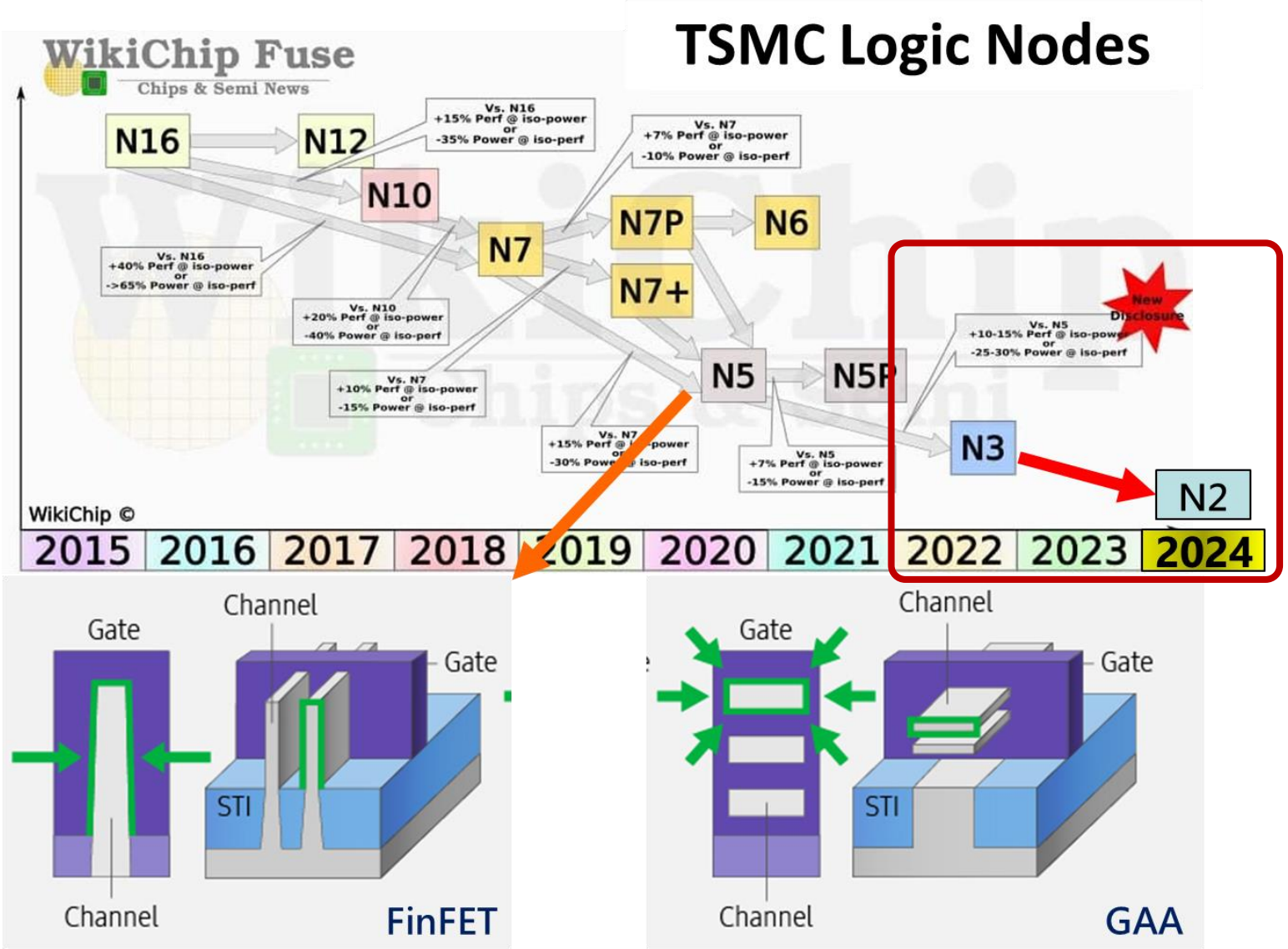
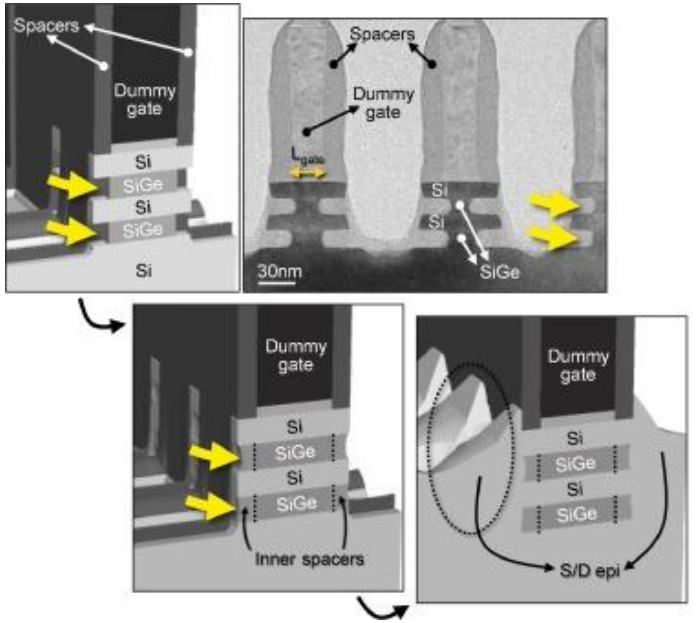
Taiwan Leads for N2 Technology Node Development in Gate-All-Around (GAA) Manufacturing



N2 Gate-All-Around 3D Structure



- In-die measurement: 50 x 50 μm²
- **Atomic level** measurement:
  - **0.1 nm precision** for etch back, inner spacer, line width, side wall angle, 3D profile
  - Film thickness: **0.01 nm precision**

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New Semiconductor Initiatives and RD Programs

- **Angstrom Semiconductor Program**：To expedite advanced research on low-dimensional materials and emerging devices, and Å-scale in-line metrology, as well as 3DIC and chiplet stacking enabling technologies that could maintain Taiwan's IC leading position for the next decade.
- **Compound Semiconductor Program**：To address wide bandgap semiconductor opportunities for high-power and high-frequency applications.
- **AI-on-Chip Program**：To extend our reach to ultra-low-power Edge AI processor and heterogeneous integration platform, based on Taiwan's IC industry's capabilities and advantages.

ISTI Source: ITRI/ISTI Research

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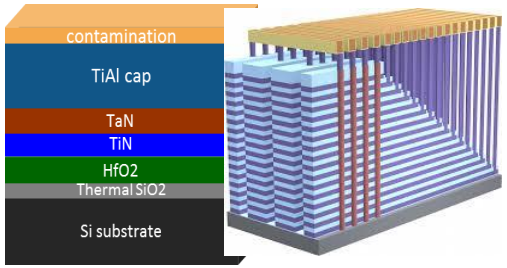
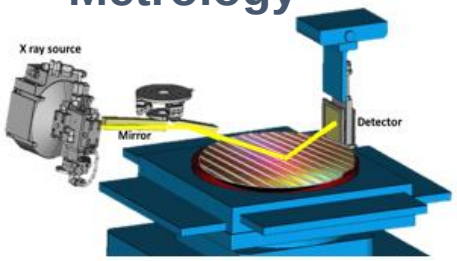
ITRI First Online Measurement Tool to Support N2 GAA Front End Processes

- **Technology Milestones**
  - 2022: Completion of **Reflection X-Ray Metrology** developments
  - 2024: **Commercialization tools** available for pilot run and mass production

- **Metrology Features**
  - Satisfied nanoscale CD measurement demands in front-end processes where no commercial tool is available: **buried CD structure** with ~1 nm variations, 3D complex structures, and **atomic resolution ≤ 0.1 nm**
  - Measurement time reduced by > 60%



Reflection X-ray Metrology



Commercial Tool

ISTI Source: ITRI/CMS

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Conclusion

- **Taiwan semiconductor industry's high resilience with well-integrated ecosystem and clusters during pandemic, will have three consecutive years' double-digit and record-high growth and is forecasted to reach NTD4.8 trillions (US$171.6 billions) in 2022.**

- **To upgrade international partnerships, we most welcome foreign partners' participation in Taiwan's new semiconductor initiative and programs to grow together for future business opportunities.**

ISTI Source: ITRI/ISTI Research

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International Linkage

Resilient for Co-Innovation

Sustainable for Co-Prosperity

2021 IEKTopics

IEKNet

THANK YOU

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