SWTEST

PROBE TODAY, FOR TOMORROW

2023 CONFERENCE

Welcome to 33rd SWTest 2023 Conference in Carlsbad, CA

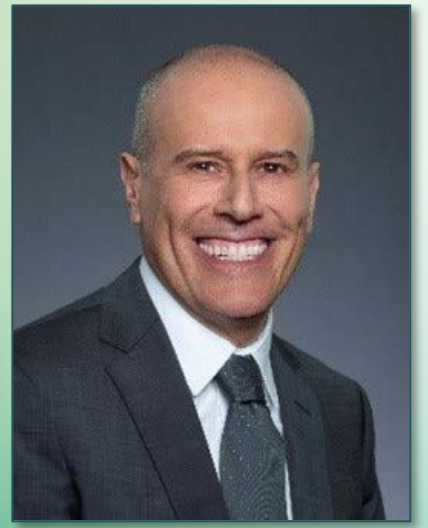
Jerry Broz, PhD

SWTest General Chair

June 5 - 7, 2023

SWTest 2023 Visionary Keynotes

Testing in the 3D NAND Zettabyte Era



Luca Fasoli, PhD
Sr. Vice President
Western Digital Corp.

Western Digital.

The Bigger the Life, The Greater the Risk

Max Lowe
Director + Documentary Film Maker

Max Lowe
Director + Photographer

SWTest 2023 eProceedings Download

Password for Monday = terramar
Password for Tuesday =
Password for Wednesday =

- Each day of the conference will be available in an e-Version for download in a password protected file.
  - Network (SSID) = Omni Meeting
  - Session and Expo WiFi Password = swtest23
  - Download at = https://www.swtest.org/
- Free WiFi access will be available during the entire conference to allow attendee access to the downloads.
- Daily passwords to the download files will be announced throughout each day, respectively.
- Non-password locked files will be made available in the SWTest Archives after the conference adjourns.

33-years of Probe Technology

SWTest San Diego and SWTest Asia

33 Years of Combined
Probe Technology

12,000+ Attendees have
participated from 60+ Countries

1,000+ Technical Podium
and Poster Presentations

Repeat Multinational Sponsors
and Premier Exhibitors

SWTEST

SWTEST
ASIA

SWTest Asia

SWTEST ASIA
PROBE TODAY, FOR TOMORROW
2023 Conference and Expo

Nov. 2 to 3, 2023

Sheraton Hsinchu Hotel
Zhubei City, Taiwan

SWTEST ASIA
PROBE TODAY, FOR TOMORROW
2024 Conference and Expo

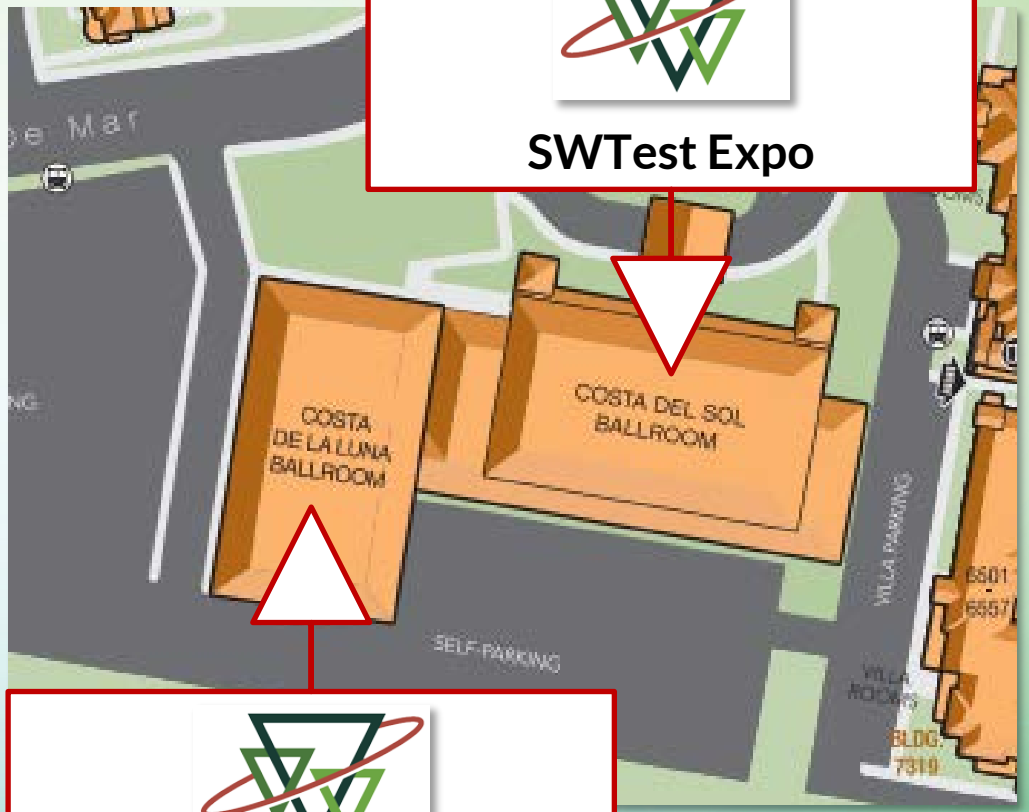
Oct. 23 to 25, 2024

Fukuoka, Japan

June 3 to 5, 2024
SWTest 2024 Conference and Expo

Omni - La Costa, Carlsbad, CA

SWTest 2023 - Map



SWTest Organization

- **SWTest Executive Team**
  - Jerry Broz, PhD, General Chair and Sr. Member IEEE
  - Rey Rincon, Technical Program Chair
  - Patrick Mui, Technical Program Co-Chair
  - Maddie Harwood, Finance Chair & Conference Mgmt

SWTest is organized, coordinated, and executed through the efforts of your colleagues.

- **Technical Program Committee**
  - John Caldwell, MJC Electronics Corp.
  - Clark Liu, Taiwan MJC Co. (Taiwan)
  - Mark Ojeda, Infineon (US)
  - Raffaele Vallauri, Technoprobe (Italy)
  - Joey Wu, STAr Technologies (Taiwan)

- **Steering Committee**
  - Davide Appello, STMicroelectronics (Italy)
  - Karen Armendariz, Celadon Systems
  - Geert Gouwy, IMEC (Belgium)
  - Michael Huebner, PhD FormFactor (Germany)
  - Joonyeon (JY) Kim, Samsung Electronics (Korea)
  - Amy Leong, FormFactor, Inc.
  - Grace Liu, PhD, Intel Corp
  - Connie Smith, Texas Instruments, Inc.
  - Alex Yang, MPI Corporation (Taiwan)

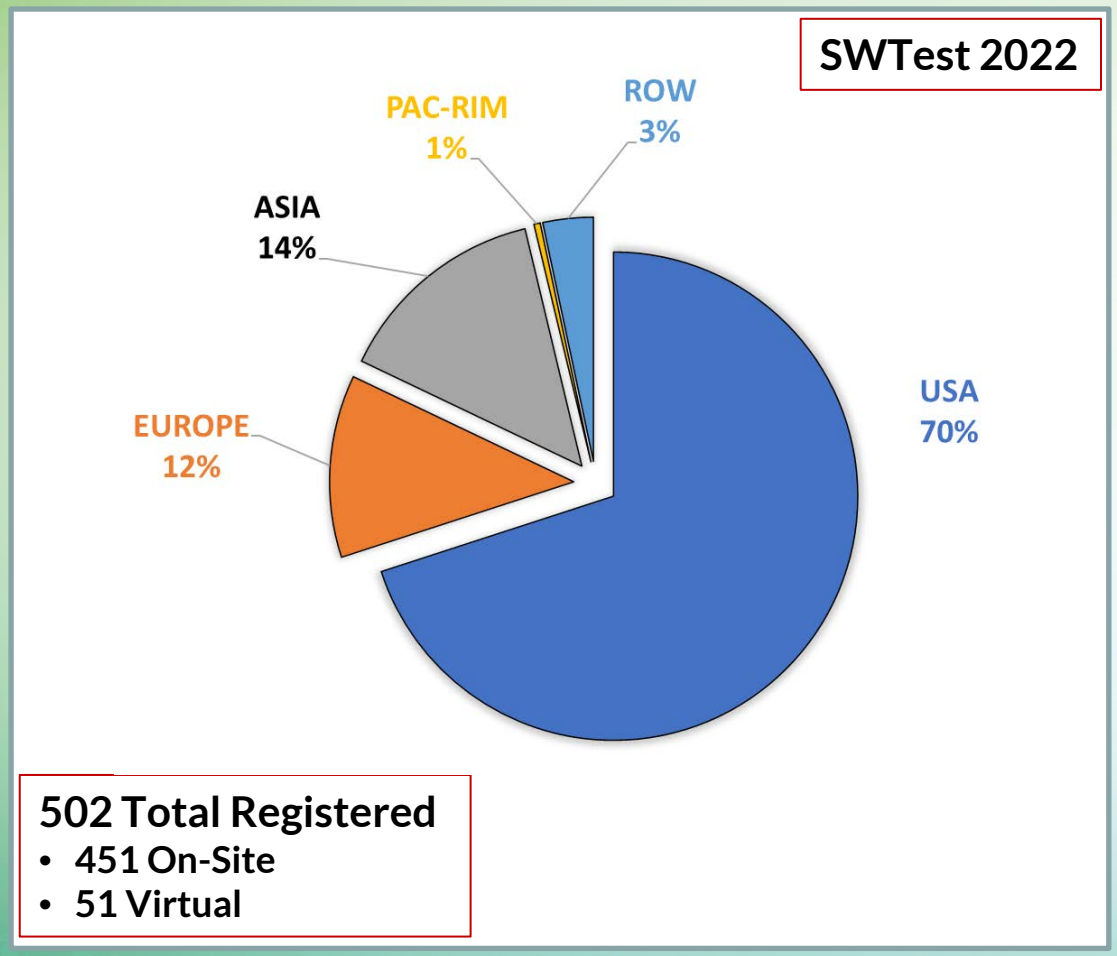
Semiconductor Wafer Test – SWTest

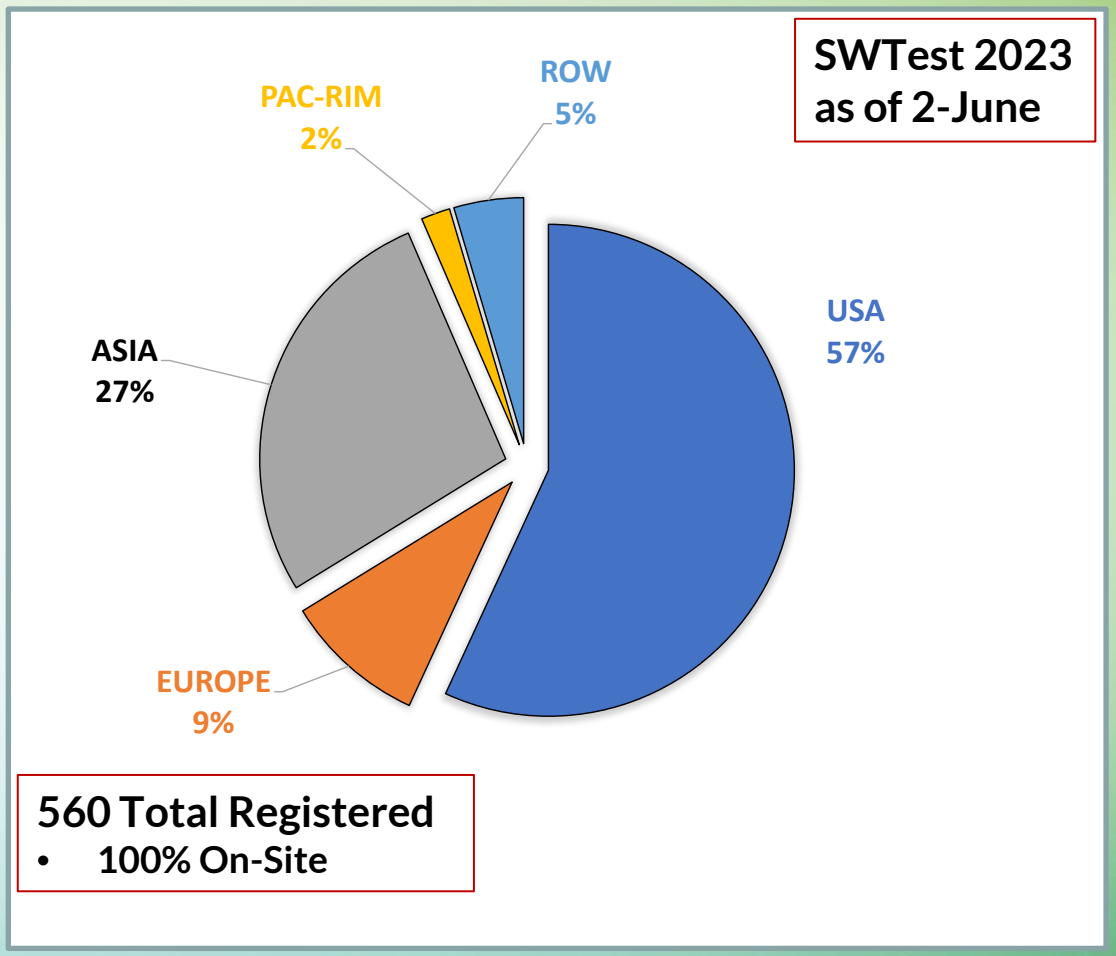
- Technology Forum for Wafer Probe and Test Professionals
  - Balance of manufacturer and supplier collaborative podium and poster presentations
  - Practical and industry focused solutions to real problems faced by test engineers.

- Focused Conference and Expo
  - Topical technical program that does not compete with Expo hours
  - Expo has leaders in probe card, probe and test equipment, and related services.

- Informal and Relaxed Networking
  - Technical exchanges in a relaxed environment
  - Great social activities facilitate networking.
  - Meet new people and have a little fun !

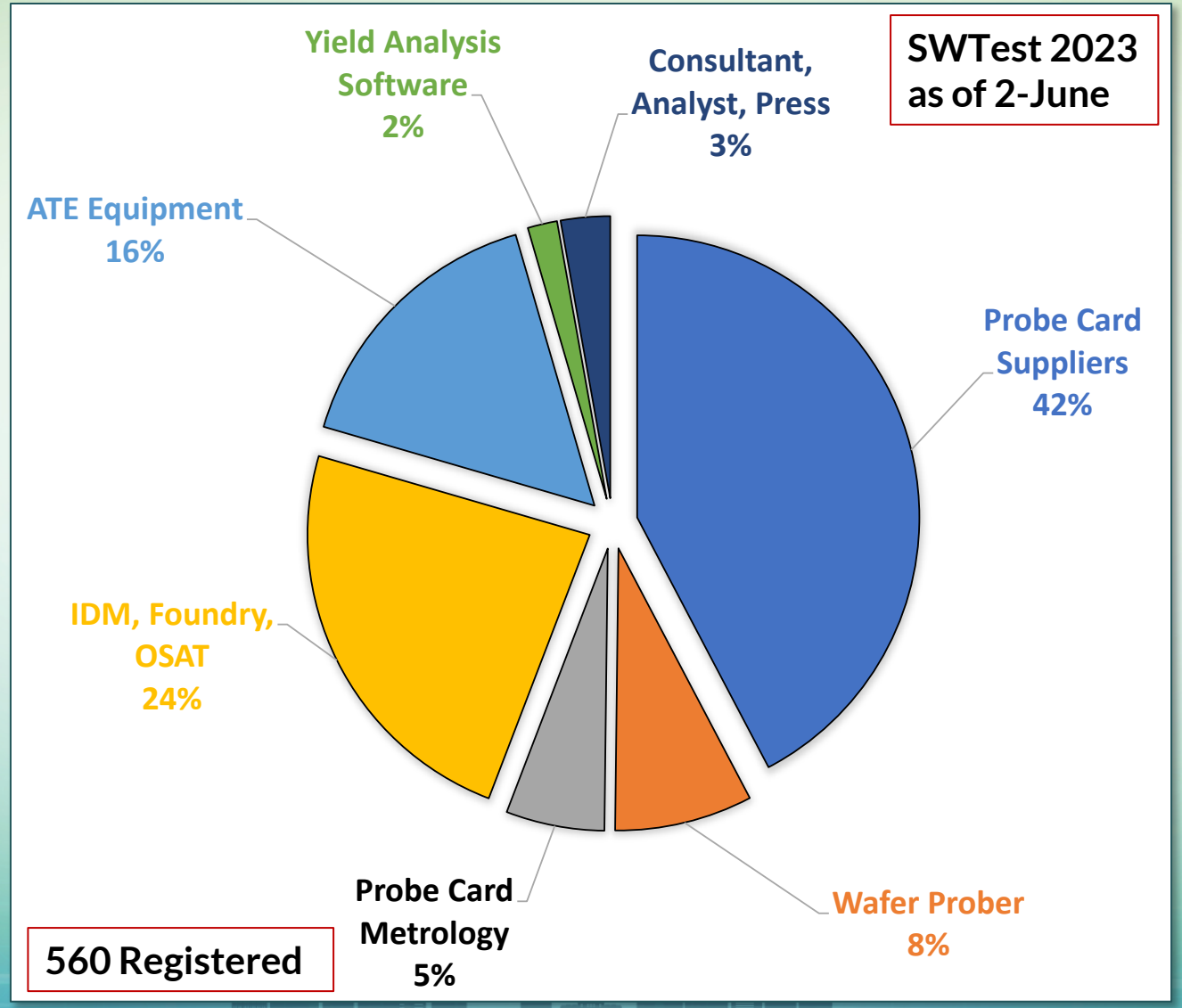
SWTest 2022 and 2023 Participation





Over 60% of Presentations have International Authors !

SWTest 2022 Attendee Demographics

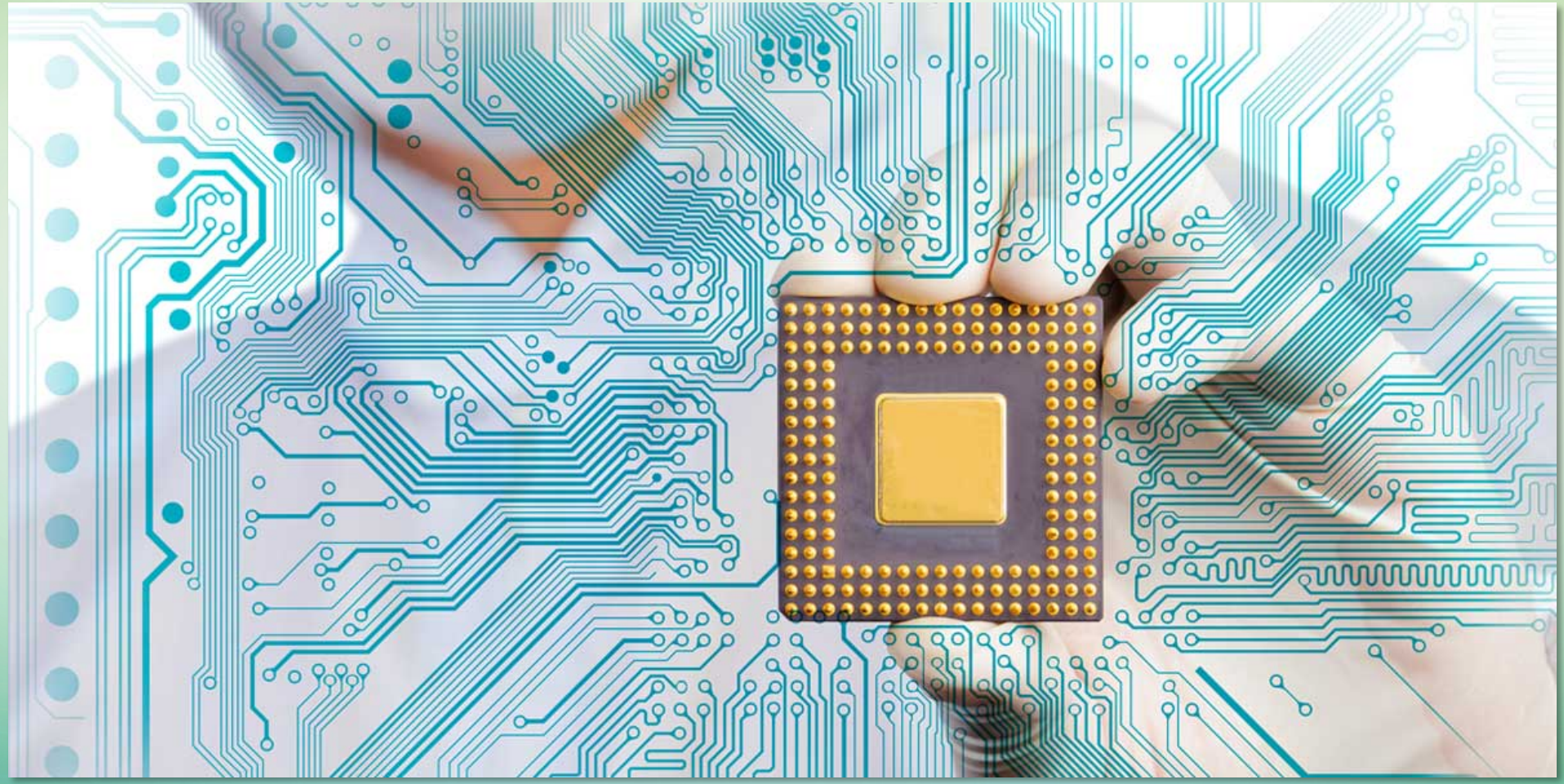


Phishing for SWTest Mailing List and Third-Party Hotel Reservations

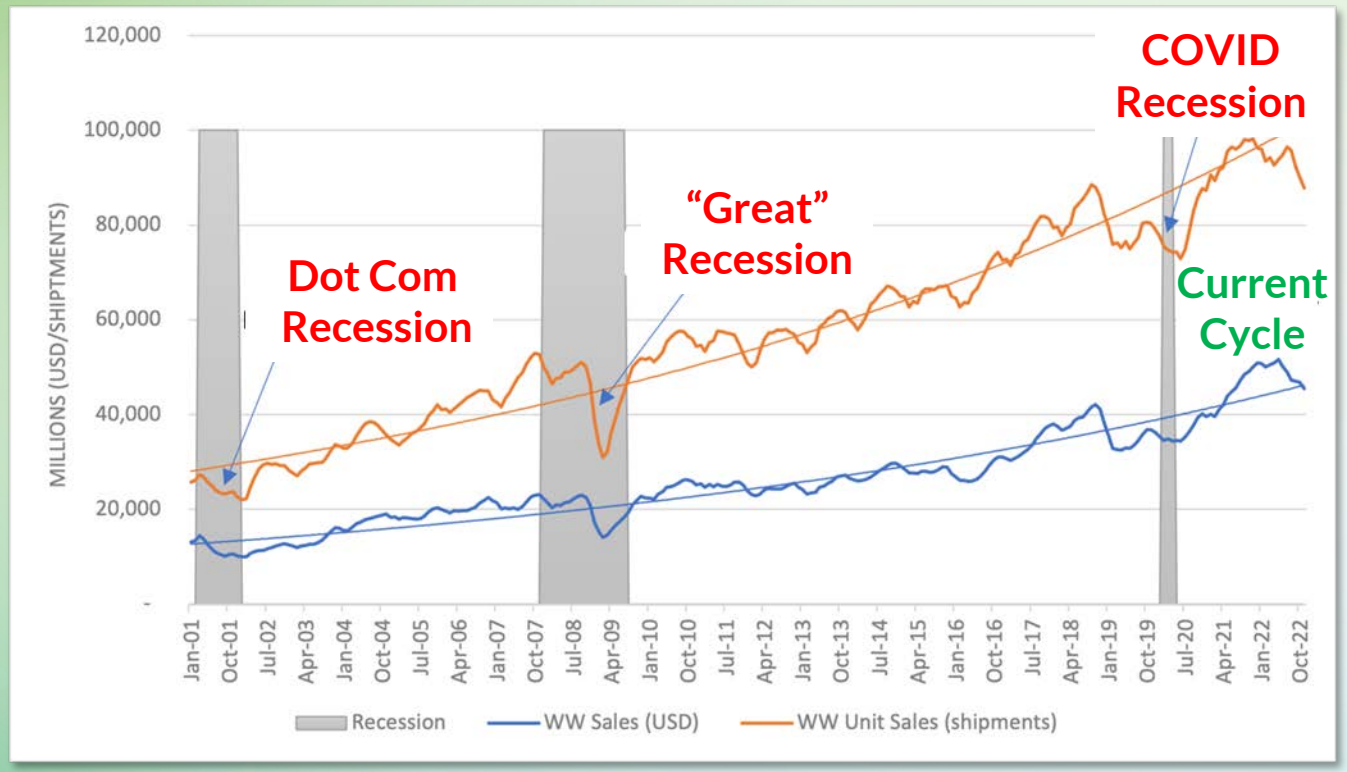
- ALL attendee information provided to SWTest and SWTest Asia is safe, kept confidential, and never sold.
- Attendees must “opt-in” for sharing their contact information through the conference Mobile App
- Attendee details are not made available to anyone without permission.
- SWTest works directly with the hotel and <u>DOES NOT</u> use third-party hotel brokers.

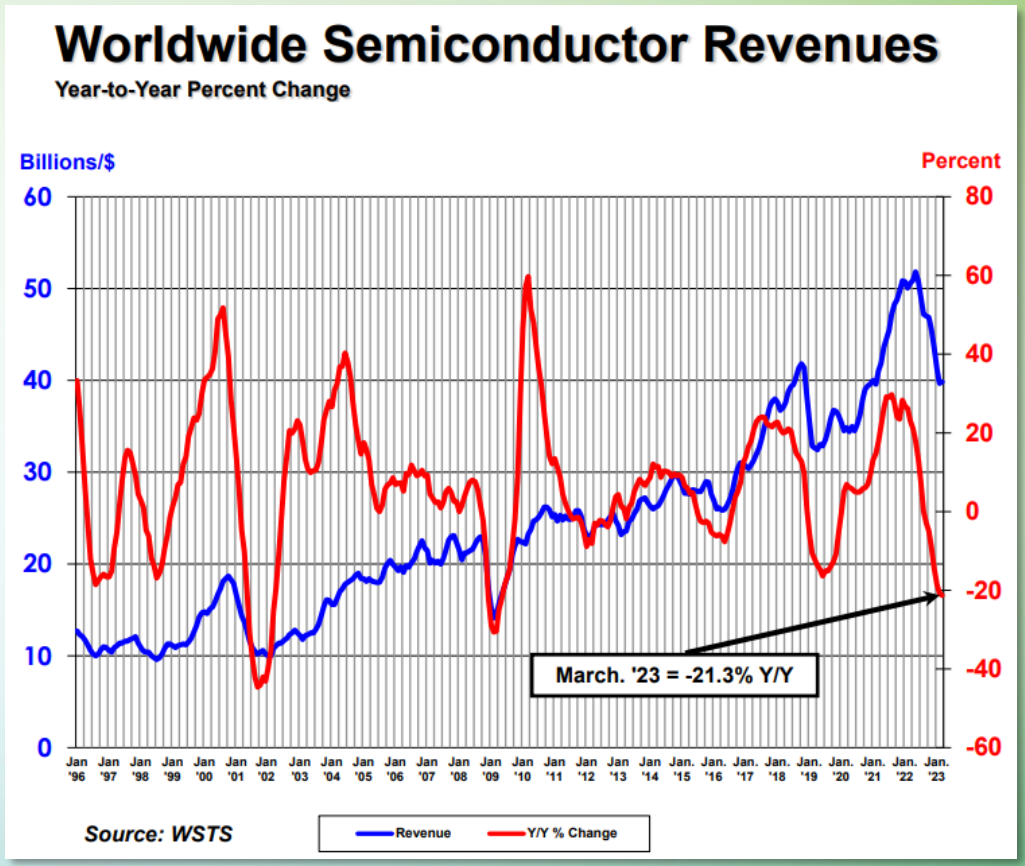
<u>Never have and never will !</u>

Ever Changing Semiconductor Landscape



Semiconductor Industry is Notoriously Cyclical



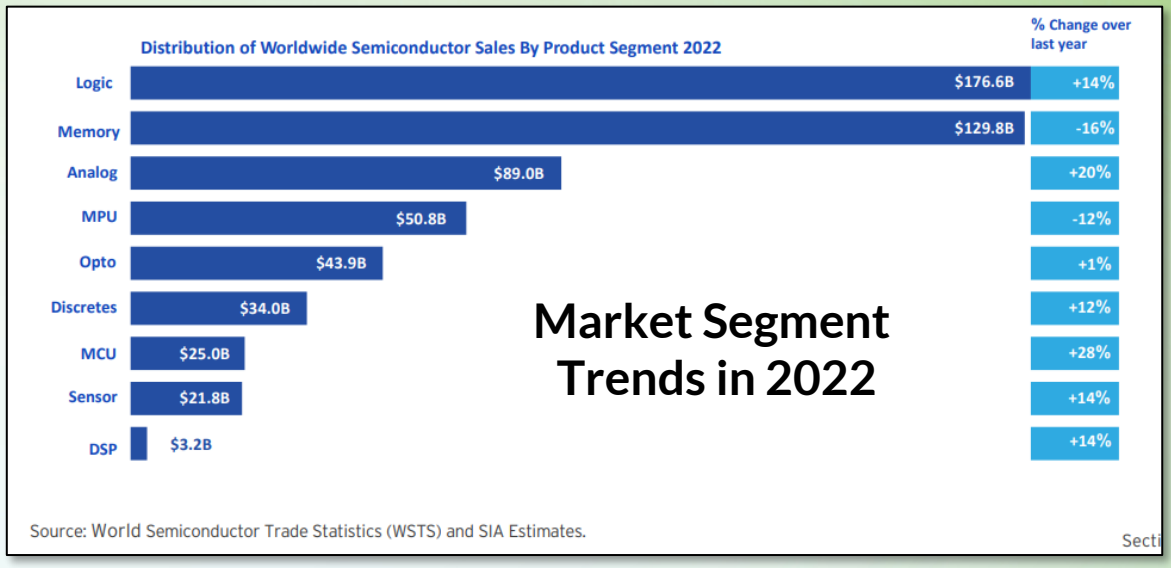


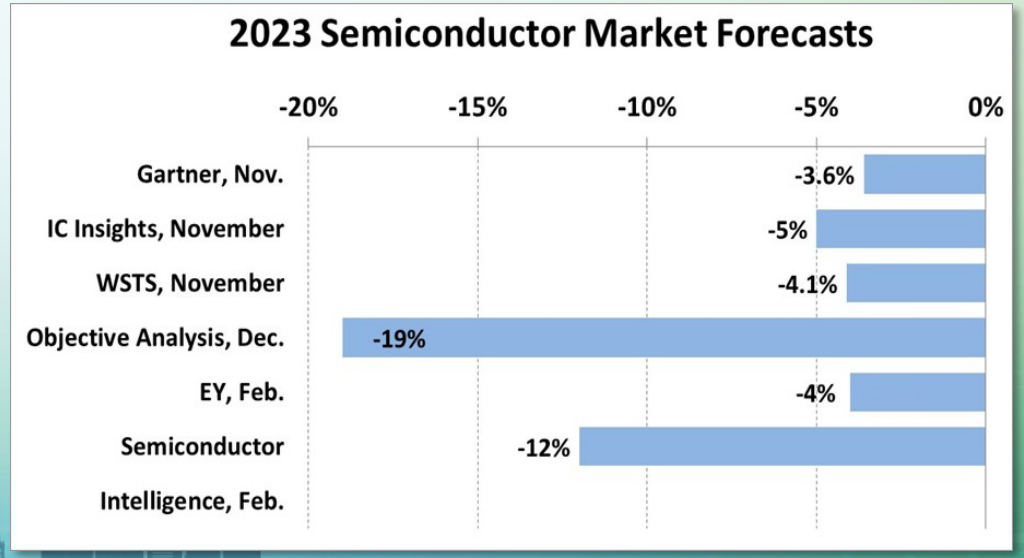
- TSMC revenue for 1Q23 decreased of 15.4% YoY.
- Intel revenue for 1Q23 decreased of 36.2% YoY.
- Samsung revenue for 1Q23 decreased of 18.1% YoY.
- Hynix revenue for 1Q23 decreased of 58.1% YoY
- Qualcomm revenue for 1Q23 decreased of 16.9% YoY

Consumer spending slowed amid the uncertain global macroeconomic environment.

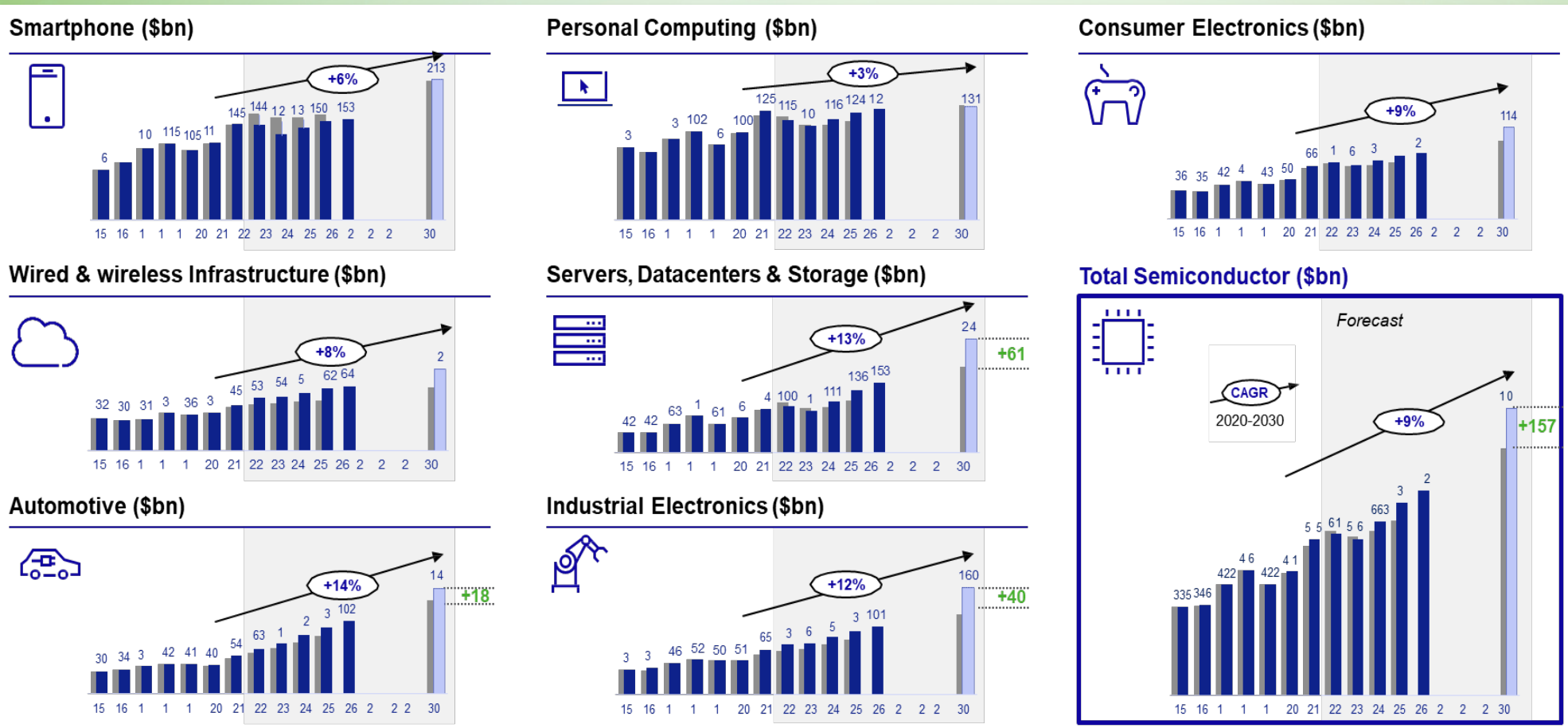
Semiconductor Growth into 2023

- In 2022, Global Semiconductor Market was up +0.2% percent at US$ 599 billion
  - Top 25 Companies accounted for 77.2% of Revenue!
- Since 4Q22, faced overall decline of 21.5% as companies work through excess inventories and consumers cut back on purchases due to rising inflation.
- Into 2023, memory revenue (which accounts for ~23% of overall market) declined sharply by more than 35%.
  - Weak demand, overcapacity and excess inventory
  - Significant pressure on average selling prices
  - Double digit rebound for Memory expected in 2024
- Other markets are expected to have growth driven by different sectors automotive, industrial, IoT and military/aerospace.
  - Automotive is forecast to grow 13.8%, reaching $76.9 billion in 2023.
  - PC, tablet and smartphone semiconductor markets expect steady, but minimal, growth.





Long Term Growth Expectations



Source: Historical data: Gartner. Outlook: Gartner 3Q22 Forecast (Sep22, 2022) for years '22-'26; Outlook 2030: ASML estimate; segment revenue extrapolated using '20-'26 Compound Annual Growth Rate (CAGR). Some deviations from this methodology due to expected growth profile differences across the decade

ASML Investor Day - 2022

Market Challenges

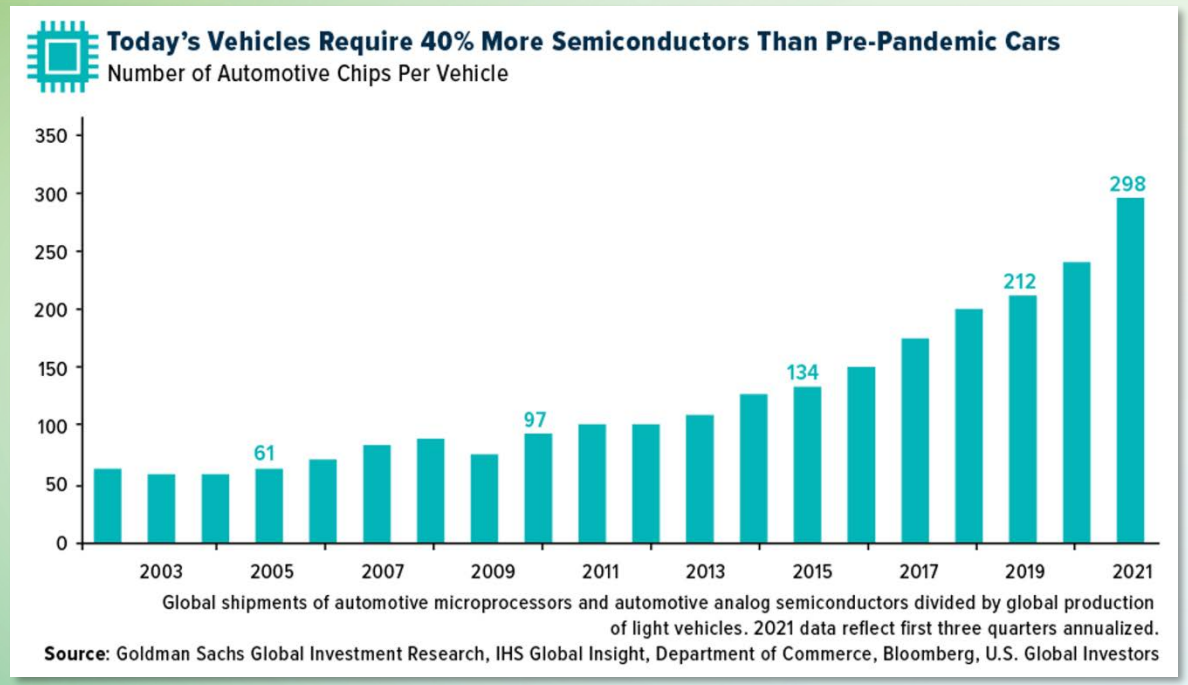
- Overcapacity and excess Inventories
- Decreased DRAM and NAND pricing
- Reduced consumer spending
- Possible domestic and global recessions
- Ongoing China restrictions.

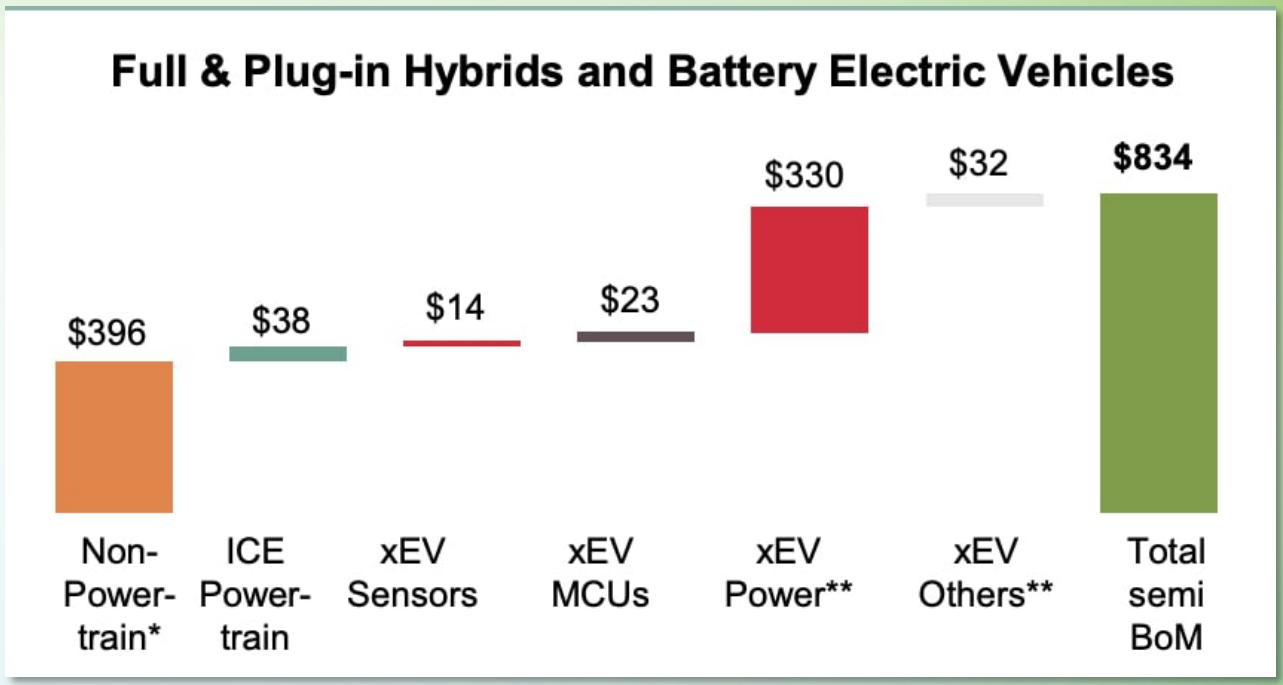
Market Positives

- Automotive sector is most important for driving semiconductor
- Strengthening demand for chips in high performance computing (HPC), datacenter, cloud storage
- Developments in auto, industrial, clean energy, IoT, healthcare, online services and defense segments.

Datacenter, Automotive and Industrial are Expected to Outperform

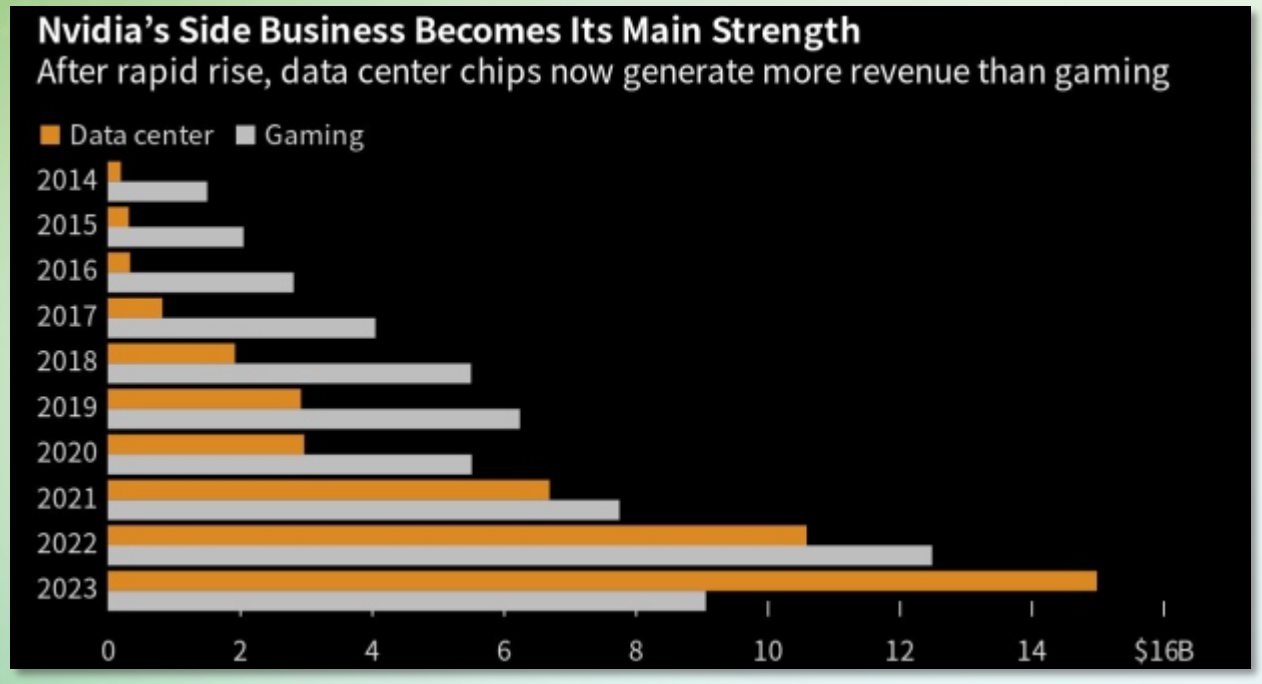
Semi Growth Drivers - Automotive

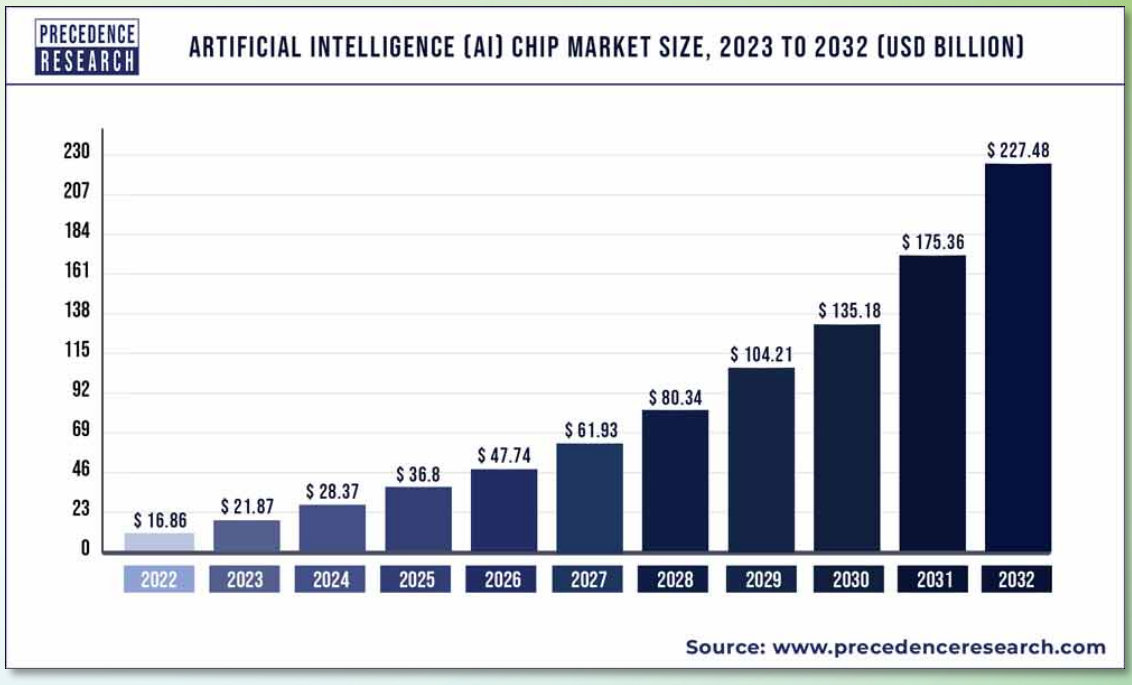




- Automotive: a tripling of demand into the future, fueled by autonomous driving and e-mobility.
- By 2030, the cost of semiconductor content in a Society of Automotive Engineers (SAE) Level 4 car with an electric drivetrain could be about $4,000 compared with $500 for an SAE Level 1 car powered by an internal-combustion engine.

Semi Growth Drivers - Compute





- **Computation and data storage: growth is fueled by the demand for servers and data centers that support applications such as AI and cloud computing.**
- **From 2023 to 2030**
  - **AI is expected to expand at a CAGR of 29.72%.**
  - **Global cloud computing market is projected to grow at a CAGR of 20%**
  - **Data Center Storage forecast to expand at a GAGR greater than 10%**

Semi Growth Drivers - Communicate

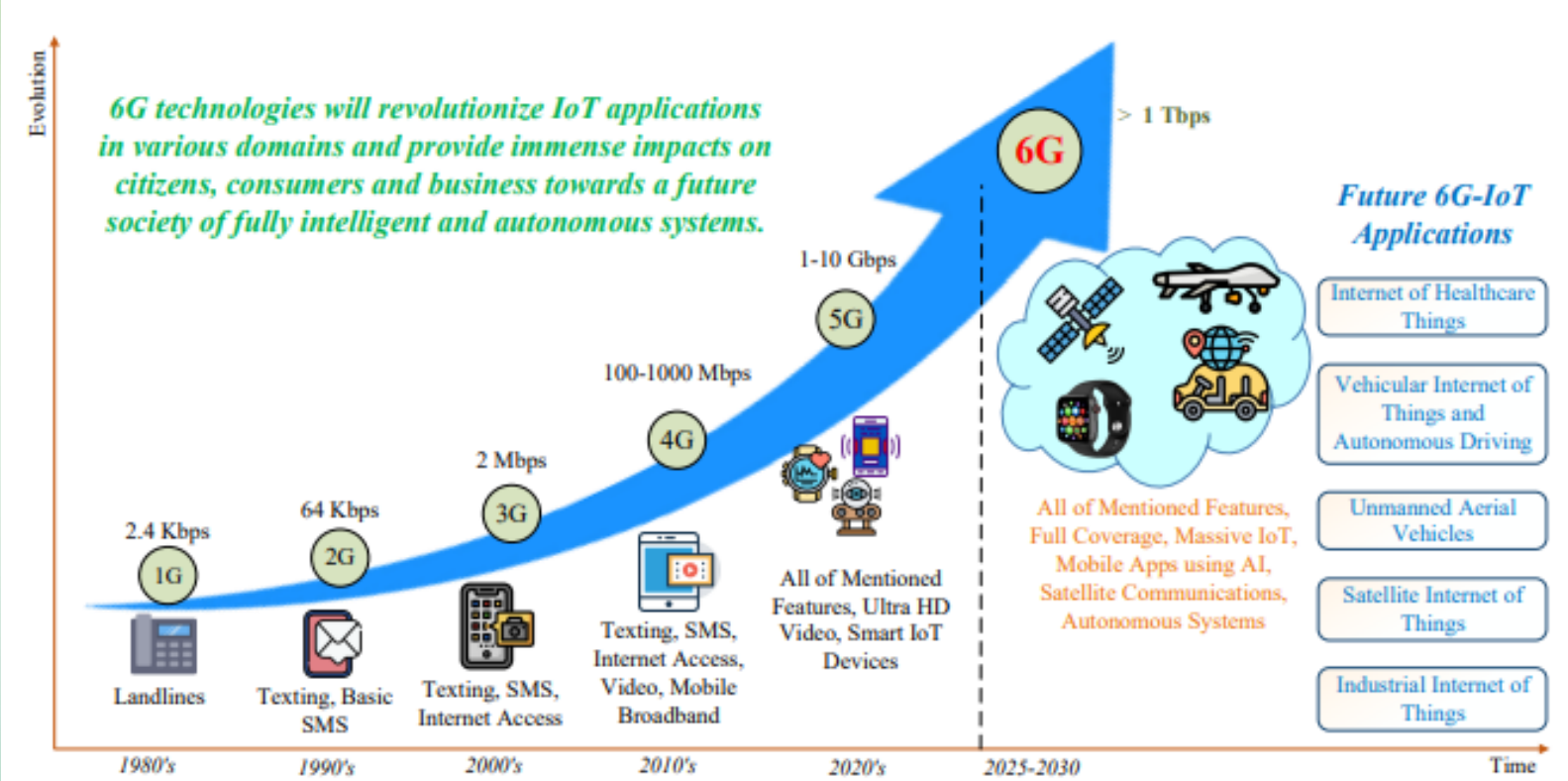


Fig. 1: The evolution of wireless networks toward future 6G-IoT.

- **Wireless Communications: smartphones could account for most of the expansion, amid a shift from lower-tier to mid-tier segments in emerging markets and backed by growth in 5G (and 6G).**
- **This market is anticipated to flourish at a CAGR of approximately 15.2% during 2023 to 2030.**

Worldwide Semiconductor Initiatives

$52B

US CHIPS Act
- Incentives for National Semiconductor
- Technology Centers to regain global leadership.
- Investmnet tax credits

$46B

EU Industrial Alliance
- Rebuild capacity for high-end microelectronics.
- Various tax incentives

$100B+

"Big Fund" (Integrated Circuit Industry Investment Fund
- $20.7B Phase 1
- $30.5B Phase 2
- Objective : 100% domestic self sufficiency by 2030

$6.8B

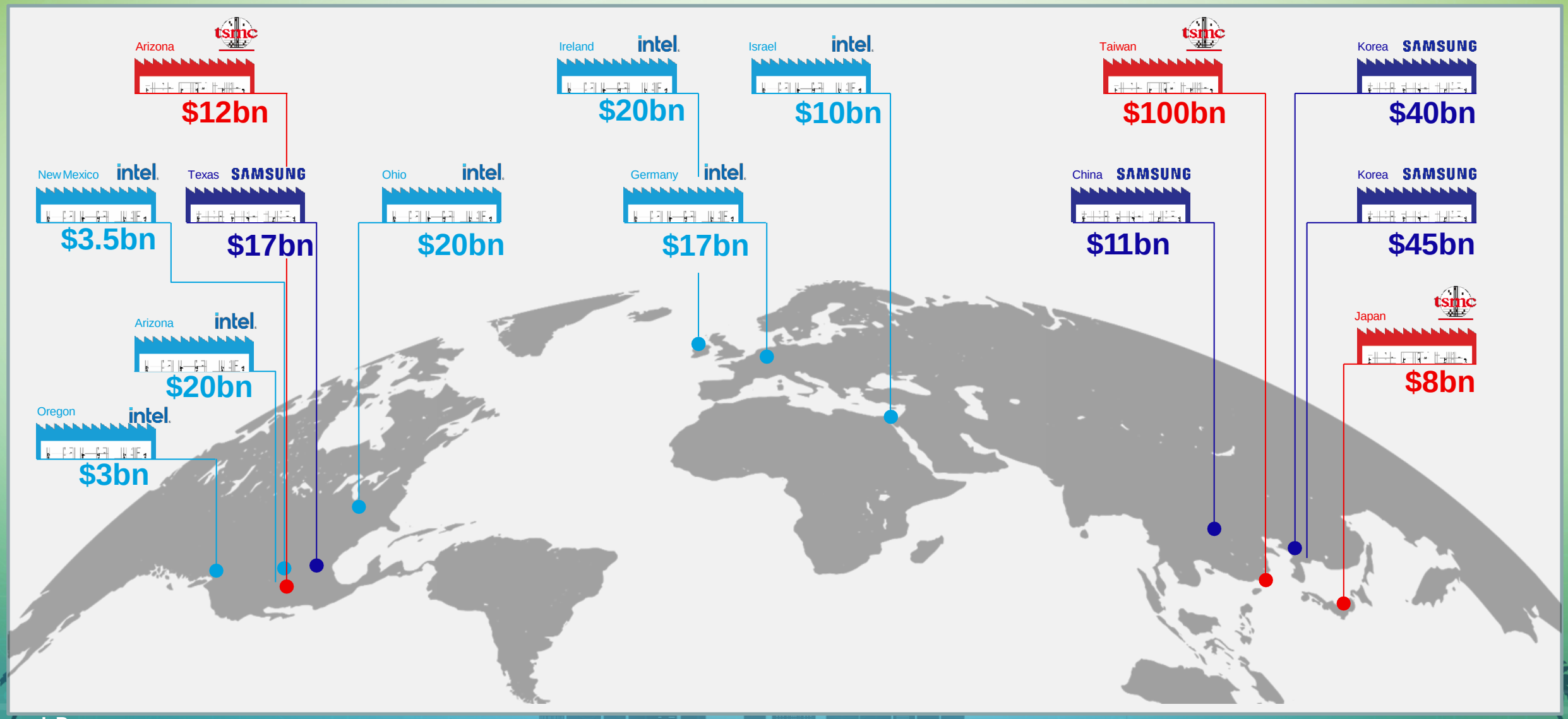
Specified ICT Utilization
- Japan Ministry of Economy, Trade & Industry (METI)
- Gov't fund for advanced semiconductors
- TSMC Fab and advanced chipmaking technology.

$450B+

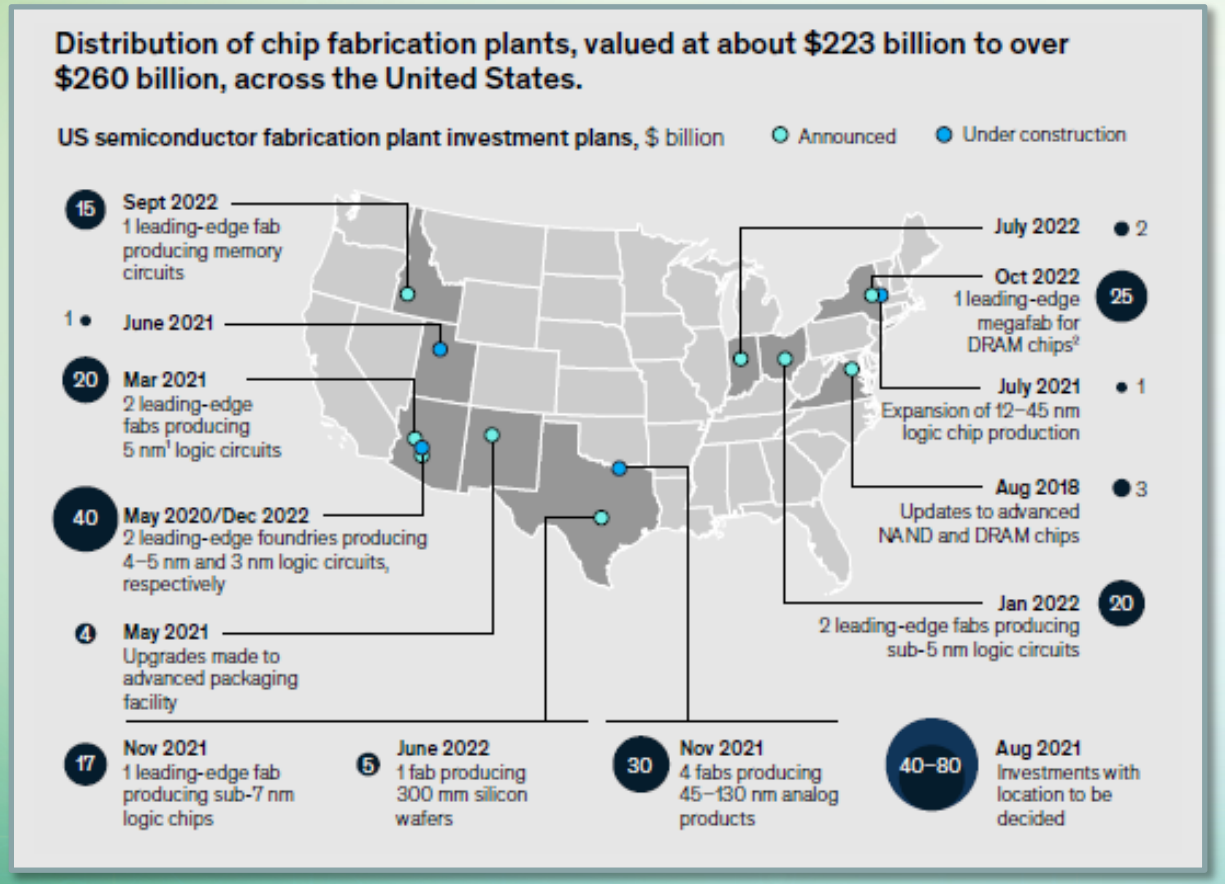
K- Semiconductor Belt
- $450B in funding to increase capacity by 2030.
- Substantial tax credit for domestic companies

Sources: IC Insights, McKinsey & Co, European Commission, Technode, ASML

Top Three IDM Global FAB Investments >$300B

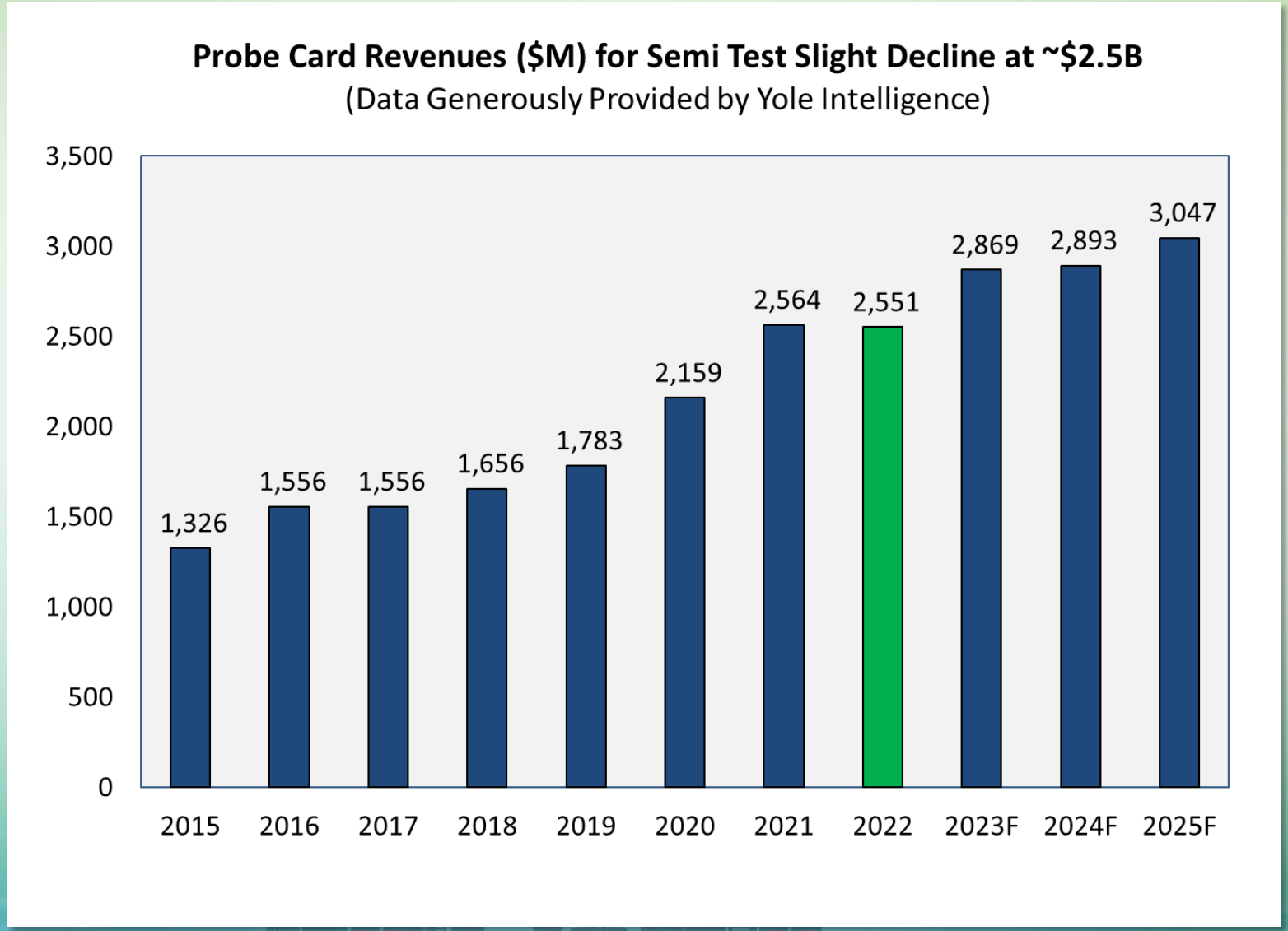


US Domestic FAB Investment from CHIPS



- Nearly 500 locations in 42 states. (https://www.semiconductors.org/u-s-semiconductor-ecosystem-map/)
- Over $210 billion in new private investments announced across 19 states to increase domestic manufacturing capacity
- Over 50 new semiconductor ecosystem projects announced across the U.S., including the construction of new fabs, expansions of existing sites, and facilities that supply the materials and equipment used in chip manufacturing
- 44,000 new high-quality jobs announced in the semiconductor ecosystem as part of the new projects, which will support many more jobs throughout the broader U.S. economy

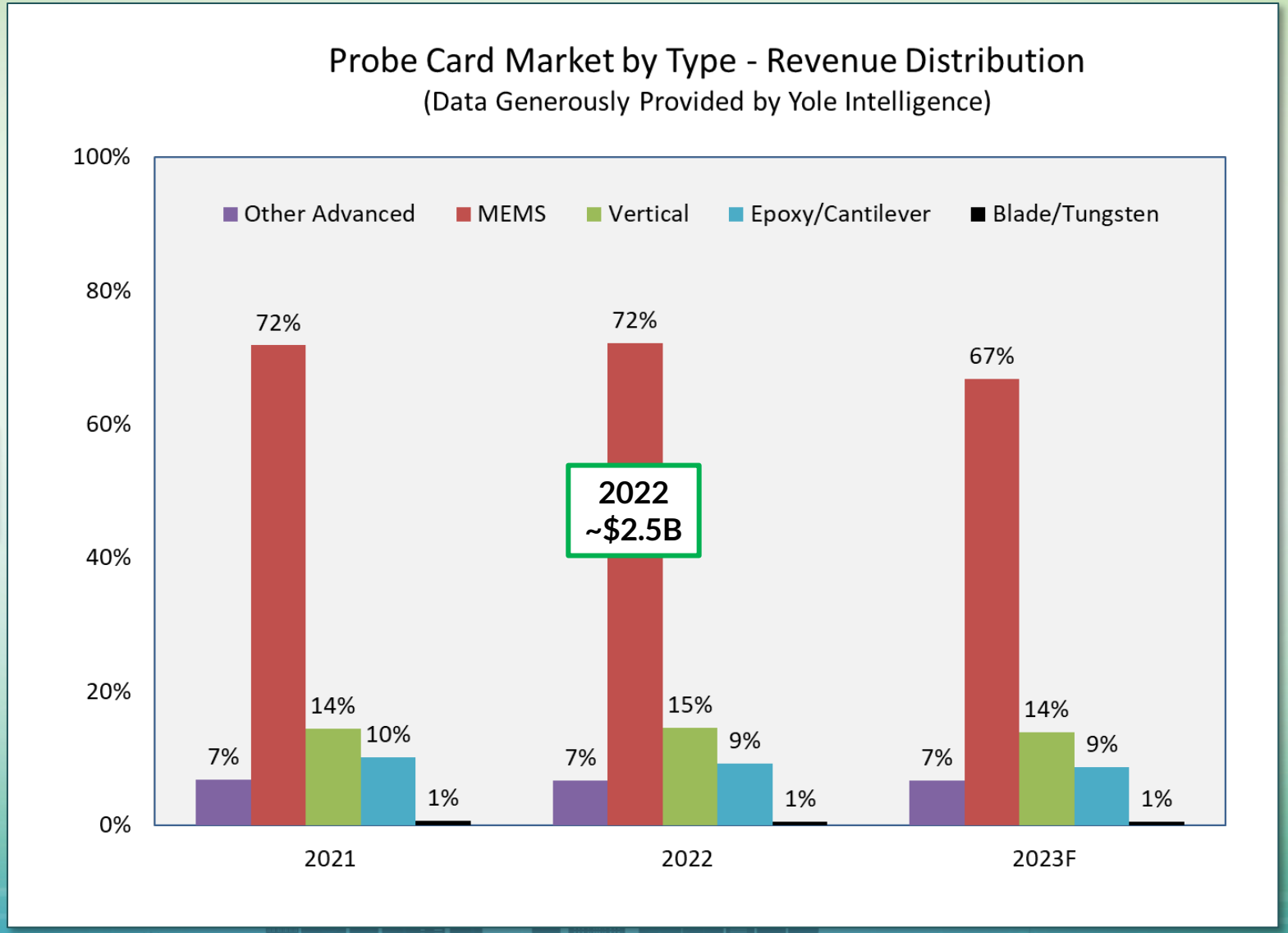
Probe Card Market Landscape



YOLE Group

Thanks to Yole Intelligence
- John West
- Lin Fu

Probe Card Technology Trending



YOLE Group

Thanks to Yole Intelligence
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- Lin Fu

Top Probe Card Vendors of 2022

Semiconductor Probe Cards

Sales, $M, Calendar Year

Thanks to TechInsights
- Risto Puhakka
- Panchami Phadke

Rank	Company	Market	% Growth
		2022	YoY
1	FormFactor	591.5	-6.6%
2	Technoprobe	577.2	26.1%
3	Micronics Japan	307.3	-5.1%
4	JEM	154.6	-22.3%
5	MPI Corporation	138.4	4.1%
6	Nidec SV TCL	84.2	17.3%
7	Korea Instrument	70.7	-6.6%
8	TSE	65.8	-14.0%
9	STAr Technology	50.7	24.3%
10	Microfriend	47.5	-9.2%
	Other	453.3	-1.6%
	Probe Cards	2541.0	
	Annual Growth	0.7%	

Semiconductor Probe Cards

Sales, $M, Calendar Year

Thanks to Yole Intelligence
- John West
- Lin Fu

Rank	Company	Market	% Growth
		2022	YoY
1	FormFactor	591.5	-6.6%
2	Technoprobe	555.8	21.4%
3	Micronics Japan	294.8	-9.0%
4	JEM	148.3	-25.5%
5	MPI Corporation	134.6	0.5%
6	Korea Instrument	81.6	0.5%
7	Nidec SV TCL	65.5	-4.4%
8	TSE	63.0	-16.8%
9	Will Technology	56.0	-1.2%
10	STAr Technology	40.0	
	Other	520.0	21.3%
	Probe Cards	2551.2	
	Annual Growth	-0.8%	

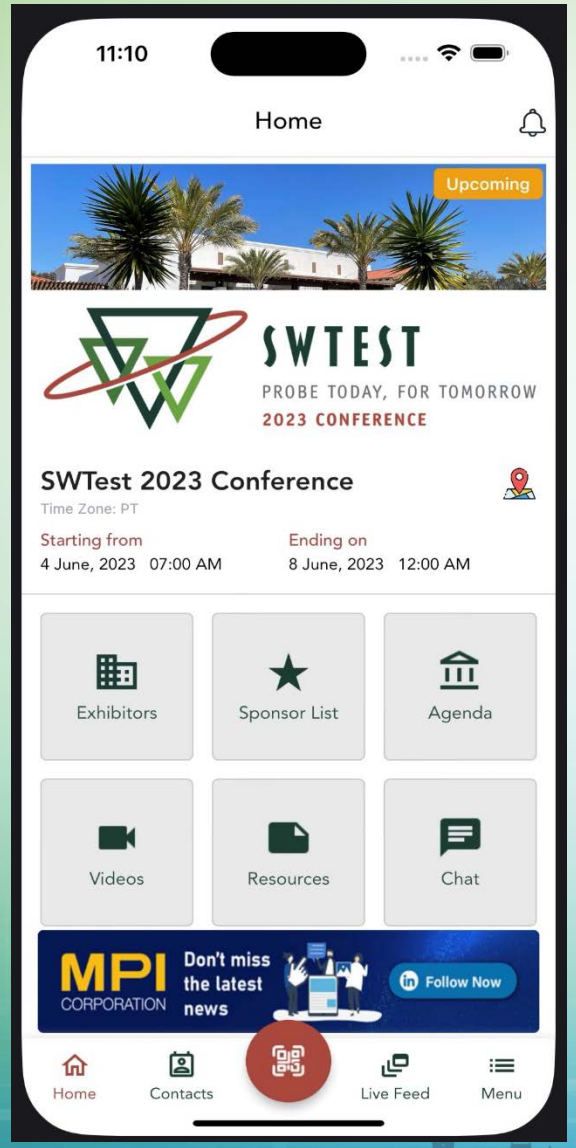
Technical Program Overview

- Sunday, June 4
  - William Mann Memorial Benefit Golf Tournament
- Monday, June 5
  - Technical Program with a Visionary Keynote and 4-Technical Sessions / Poster Session
  - SWTest EXPO with 64-Key Suppliers On-Site and w/ Meal Reception Stations
  - Meet and Greet with the Speakers at the “Speaker’s Corner”
- Tuesday, June 6
  - SWT Crew Update and 3-Technical Sessions / Poster Session
  - SWTest EXPO with 64-Key Suppliers On-site
  - Meet and Greet with the Speakers at the “Speaker’s Corner”
  - Tuesday night Social and Networking Event
- Wednesday, June 7
  - Technical Program with 2-Technical Sessions
  - Conference adjourns

SWT Crew
Strong Women Together

CASINO Night

SWTest Conference Mobile App



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- Connect with the Sponsors and Exhibitors
- Program Schedule in the Auditorium
- View Exhibitor and Sponsor Videos
- Read the Literature from the Exhibitors
- Connect with Attendees that have “opted-in”
- Check out the Job Board Postings

Platinum Sponsors

Gold Sponsors

Silver Sponsors

Recognition & Awards

- Best Overall Presentation
- Best Data Presentation
- Most “Inspirational” Presentation
- Best Presentation, Tutorial in Nature
- People’s Choice Award

- A presentation from SWTest 2023 will be selected for publication in Chip Scale Review

MEDIA PARTNER

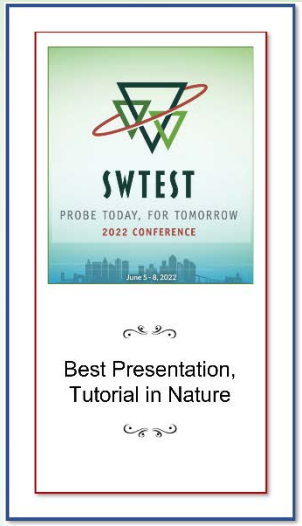
Chip Scale Review

SWTest 2022 Awards

Best Presentation, Tutorial in Nature

Copper pad probing with vertical technologies featuring hard metal tip: ARIANNA™ probe family

Salvatore de Siena (Technoprobe S.p.A. – Italy) and Erwin Verardi & Alberto Pagani, PhD (STMicroelectronics



On-Site in San Diego

Salvatore de Siena
Technoprobe S.p.A. (Italy)

Remote in Italy

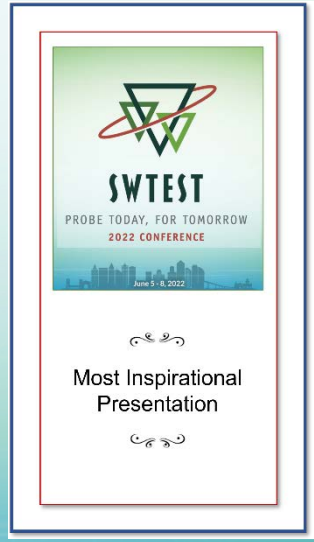
Erwin Verardi
STMicroelectronics (Italy)

Alberto Pagani, PhD
STMicroelectronics (Italy)

Most Inspirational Presentation

On Shifting Defect Detection in Quantum Chips From Cryogenic to Ambient Temperature

Francesco Lorenzelli (IMEC – KU Leuven – Belgium)



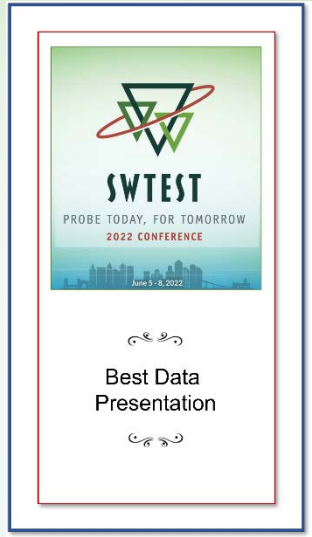
Francesco Lorenzelli
IMEC – KU Leuven (Belgium)

SWTest 2022 – Awards

Best Data Presentation (tie)

55GHz Octal-site Wafer Test Probecard for 5G mmWave devices

Peter Cockburn (COHO – UK)



Peter Cockburn
Coho, Inc. (USA)

High Speed Digital: How to Optimize a Probe Card for PAM4 to a non-50Ω device

Daniel Bock, PhD (Formfactor – US)

Daniel Bock, PhD
Formfactor, Inc. (USA)

SWTest 2022 - Awards

Best Overall Presentation

An Advanced Method for Pad Stack Crack Assessment during Probe-Over-Active-Area

Oliver Nagler, PhD (Infineon Technologies – Germany)

Oliver Nagler, PhD
Infineon Technologies (Germany)

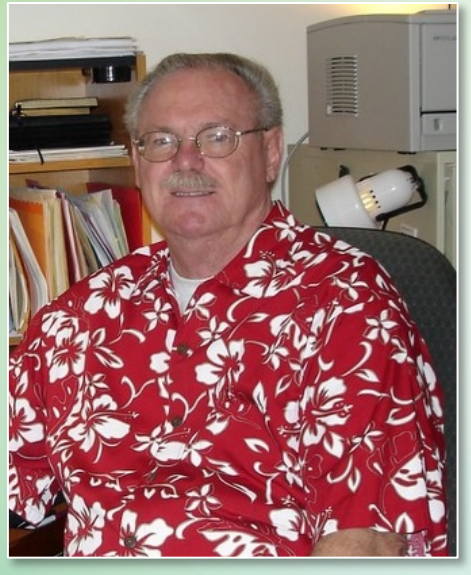
People Choice Award

Advances in Vertical Probing for High-Speed Digital Test at Wafer Sort

David Raschko (Formfactor – US)

David Raschko
Formfactor, Inc. (USA)

William R. Mann Student Travel Grant



Bill Mann
Founder of SWTest

- Partially funded by the SWTest annual Golf Tournament's "Beat the Pro" hole contest.
- SWTest Conference provides a stipend of up to $1,000 to cover expenses for travel, hotel accommodations, and student registration.
- Student Grant was Awarded for 2023
  - Tobi Gaggl, Undergraduate Student from *Technische Universität Wien - Austria*

Want to Learn More ?

- **Chip Scale Review**
  https://chipscalereview.com/

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- **Semiconductor Review**
  https://www.semiconductorreview.com/

MEDIA PARTNER

- **IEEE European Test Symposium (ETS)**
  https://cas.polito.it/ETS23/

CONFERENCE PARTNER

- **IS-Test Conference**
  http://www.is-test.com

CONFERENCE PARTNER

- **TestConX**
  Formerly BiTS Burn In & Test Strategies
  https://www.testconx.org/

CONFERENCE PARTNER

- **Yole Développement**
  http://www.yole.fr/

- **International Semiconductor Executive Summits (ISES)**
  https://isesglobal.com/

CONFERENCE PARTNER

- **TechInsights**
  https://www.techinsights.com/

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Technical Program
SWTest 2023

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