SSIA
Singapore Semiconductor Industry Association

# SINGAPORE SEMICONDUCTOR VOICE

Volume 20 • T05SS0291A

SSIA
Singapore Semiconductor Industry Association



## STRENGTHENING AND GROWING THE SEMICONDUCTOR ECOSYSTEM

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FOREWORD BY

# Executive Director

The uncertainty in the world today has had a major impact on our lives. The pandemic, supply chain disruption, economic tension among the largest economies and the invasion of Ukraine by Russia, have all created an air of instability and unease. Fortunately, the semiconductor industry has remained largely unaffected by the global crisis; in fact, it continues to expand to meet the surge in demand for chips globally. We are also seeing the industry growing here in Singapore with many recent announcements of new facilities being built. This growth is expected to continue well into the future. SSIA will also be ramping up our support for the industry by further expanding the Secretariat team. We continue to focus on growing and developing our workforce, and most importantly, to support and grow our local ecosystem to better support the industry's growth.

As we finally approach the end of the "long and dark" tunnel with the pandemic and start living with it as an endemic, we are seeing nations around the world gradually opening their economy and borders. Businesses are now gaining momentum and are on their way back on track to pre-pandemic days. We will see more business travels, physical meetings and most importantly, business networking happening. To that end, SSIA too will be organising larger physical events, in hope to encourage more physical networking sessions and ultimately to bring back the industry's vibrancy to help businesses thrive. This will also be in line with our mission and vision to make Singapore a successful and competitive global semiconductor hub.

SSIA is happy to present this year's Semiconductor Business Connect, an important platform for galvanizing support for and strengthening the semiconductor industry's ecosystem. This platform aims to connect the semiconductor network, innovate solutions, and collaborate for success. Last year, we had close to 40 companies participate in the event, both MNCs and SMEs. We successfully facilitated nearly 30 business connections through this platform. This year we hope to help more local companies, by connecting them with potential customers and partners.

We will also be organising our annual Summit at the end of September, with a theme on sustainability. Our annual Semiconductor Dinner, which occurs right after the Summit, is our industry's most exciting event that many have been asking for. I am happy to announce that we will definitely be organizing a physical dinner this year with more tables than the last one we organized in 2019. The Summit and dinner will also coincide with the starting week of the Singapore Formula 1 Grand Prix, which promises to bring even more excitement for all of us! Do reach out to us today to support our Summit and book tables for the Semiconductor Dinner.

Finally, I will always touch on the topic of our industry's talent pool in most of my foreword - the greatest asset of our industry. Our industry is hiring, and we need to do a lot to attract more talents to join our industry. My team will collaborate closely with companies, government agencies, and our partners to work on this. We will also be pushing for more awareness campaigns about our industry, in addition to conducting more recruitment fairs.

SSIA will also be organizing the Leadership in Engineering Programme in mid July. This programme targets the up and rising managers of your company. The objective of this programme is to prime the next generation of new leaders for the semiconductor industry by helping them develop soft skills and sharpen their leadership qualities. Most importantly, this programme emphasises networking among participants from different companies. Reach out to my team for more information on this programme.

I look forward to catching up with you physically at the next SSIA event. I hope to see you there! Until then, continue to stay safe and healthy! Thank you.


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# CONTENTS



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18-19 JUL & 25-26 JUL
VIRTUAL SESSION

# SSIA LEADERSHIP IN ENGINEERING PROGRAMME

**Following its debut in 2021, the SSIA Leadership in Engineering Programme will be back in 2022 over a four-day agenda.**

Who it's for:

Engineers who have been in the semiconductor and electronics industry for at least 3 years.

Objectives:

To prime the next generation of new leaders for the semiconductor and electronics industry, by helping them develop soft skills and sharpen leadership qualities.

Programme Features:

- Self reflection and awareness
- Importance of interpersonal and communication skills at work
- Interactive workshops with semiconductor and electronics industry case studies and discussions
- Sharing by industry veterans and leaders
- Networking with fellow participants from different sectors within the industry... and many more!

For more information, email **daphne@ssia.org.sg**

SSIA
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Strengthening and Growing The Local Ecosystem

# SEMICONDUCTOR BUSINESS CONNECT 2022

THURSDAY,
19 MAY 2022

Find out how you can support and be a part of this event

**secretariat@ssia.org.sg**

# Growing the Talent Pool for Semiconductor and Electronics Industry

**Talent attraction and development has always been a key focus of SSIA and this year, we have extended the outreach further.**

## SSIA PRESENTATIONS TO SCHOOLS

It is a delight to engage students in person in schools again, with some School Career Talks resuming on-site while others continued virtually on Zoom. SSIA outreached to 6 Secondary Schools and Junior College in Q1 2022, meeting more than 400 students. We are observing a promising trend with more students selecting to listen to our talks, seeing overbooking by students to listen about our industry, compare to 4 years ago when we are one of the unfortunate sectors with the least interest from students. For many of these students, it is their first understanding of the power of the semiconductor chip and the various career pathways they can take to join the industry.

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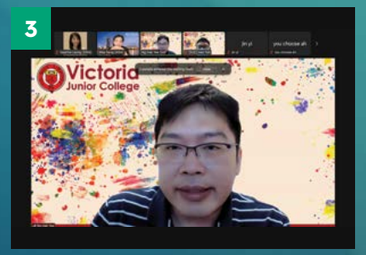


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## TALKS WITH INDUSTRY PARTNERS

As part of the Electronics Industry Day 2022 extended initiatives to outreach to future talents, SSIA collaborated with industry partners to host virtual Career Talks intended for students from the various Institutes of Higher Learning, and separately with the Ministry of Defence to reach out to young talents who are completing their National Service and will be joining the workforce soon or seeking inspiration for furthering their studies. These talks introduced participants to the various parts of the Electronics ecosystem, and the many types of positions available for fresh graduates.

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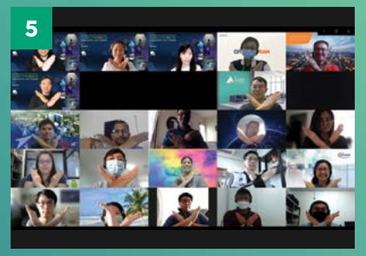

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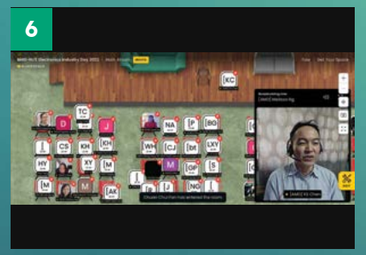





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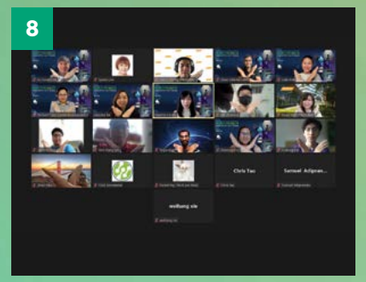

With the support from the Integrated Circuit (IC) Design Committee, SSIA also hosted 3 Career Talks titled **Semiconductor – Powering AI, Electrification and Metaverse** for the Electrical, Electronics, and Computer Engineering students from the various universities in Singapore, sharing specifically about Semiconductor Industry and IC Design sector's vibrancy.

Semiconductor Industry veteran, Francois Guibert, ex-VP & President of STMicroelectronics, had also been most supportive and delivered an engaging sharing session with NTU students on **Semiconductor – Past, Current, Future.**

## CAREER FAIRS AND JOB PORTAL

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Not missing out talents who are already part of the workforce but may be interested to join the Semiconductor and Electronics Industry, e2i and SSIA organised Career Fairs at different parts of Singapore, bringing the job opportunities closer to job seekers. SSIA also launched the revamped **Semiconductor and Electronics Job Portal**, providing yet another platform for companies to share their vacancies with potential jobseekers looking specifically to join the industry.

## UPCOMING EVENTS

Beyond these events, SSIA continues to organise outreach events to grow the talent pool for the industry. In June, SSIA and some members of the electronics industry have been invited to speak to the newly graduated students of the polytechnics during the **Joint Polytechnic Virtual Career Fair** and in the next few months will also be arranging for more career fair opportunities with our partner agencies. The journey to attract and grow the talent pool for our Semiconductor and Electronic industry will continue to strive in strength.

1. *Regent Secondary School Career Talk - 16 Mar 2022*
2. *Marsiling Secondary School Career Talk – 11 Mar 2022*
3. *Victoria Junior College Career Talk – 25 Feb 2022*
4. *Bukit Panjang Government High School Career Talk – 30 Mar 2022*
5. *IHL Industry Talk – 23 Feb 2022*
6. *AMD – NUS ECE Career Talk – 10 Feb 2022*
7. *Semiconductor Industry Sharing by Francois Guibert with NTU – 26 Jan 2022*
8. *IC Design Career Talks for NUS, NTU, SUTD, Tum Asia and SiT - Feb 2022*
9. *e2i – SSIA Career Fair – Mar 2022*
10. *e2i – SSIA Career Fair – Jan 2022*

# HR Roundtable

**SSIA hosted its first HR Roundtable of 2022 on 13 April 2022. SSIA's Executive Director Ang Wee Seng noted how the industry continues to grow despite the ongoing pandemic and supply chain disruptions, and now it faced its next challenge - attracting and retaining young talents to the industry. Hence, SSIA invited representatives of the Ministry of Manpower (MOM) and the Economic Development Board (EDB) to share updates and initiative that could help companies experiencing a talent crunch.**

## FOREIGN WORKFORCE POLICY ANNOUNCEMENTS

Representatives from MOM shared how the ministry has reviewed and updated their levers to support a strong Singapore base complemented by a high-quality and diverse foreign workforce. MOM's seeks to promote a productive, manpower-lean workforce and while ensuring that Singapore remains open to the best talent from around the world. In line with these objectives, MOM has updated the EP framework for assessing EP holders to 2 stages: the EP Qualifying Salary benchmark, and Complementarity Assessment Framework (COMPASS). The new framework will come into effect from next year onwards.

## EDB'S INITIATIVES FOR THE INDUSTRY

Also at the roundtable were representatives from the EDB to share a curated suite of local hiring initiatives to help companies access local ITE and Polytechnic graduates for their hiring needs. Echoing earlier sentiments on the talent crunch in Singapore and recognising that local engineering graduates are an increasing sparse resource, EDB proposed for companies to consider the following initiatives to sustain strong growth in the manufacturing sectors.

- Internships: Quality student internships is a key factor in influencing the career aspirations in graduates, and create ambassadors for their companies
- Work Study Diplomas: These diplomas are aimed at attracting ITE-gradates to build a ready pipeline of local work-ready talents, and eligible employers will receive grants to defray costs of developing and providing the structured OJT
- Lecturer Industry Attachment: lecturers are encouraged to have periodic industry attachments to broaden their industry familiarity to enhance their curriculum. Companies can leverage on lecturers' subject matter expertise and lecturers become spokespersons for their attachment companies to students
- Skills Conversion programmes: Companies can receive funding of up to 90% for supporting the skills conversion of mid-career employees via the Career Conversion Programme and for converting existing employees to redesigned job roles within the same company

During the roundtable, there was much constructive discussion between the agencies and companies, sharing feedback and viewpoints that were beneficial from both ends. With so many initiatives introduced to attract and retain local talents, SSIA hopes that companies will consider supporting some of them to continue to develop our local workforce.

# TRAIN, UPGRADE & RESKILL with SSIA

**As the semiconductor and electronics sector strengthen our local ecosystem and relook at ways to attract and retain talents, training, up or re-skilling and upgrading remain critical in staying relevant and future-proofing ourselves. Check out programmes in the pipeline, brought to you by SSIA and our learning partners.**

REPUBLIC POLYTECHNIC
DISCOVER. TRANSFORM. ACHIEVE

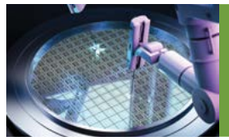
**MICROSCOPY AND THIN FILM CHARACTERIZATION FOR FAILURE ANALYSIS (1 DAY)**

**INTRODUCTION TO VACUUM AND PLASMA TECHNOLOGY (1 DAY)**

SP Singapore Polytechnic

**INTRODUCTION TO INDUSTRIAL FAILURE MODE AND EFFECTS ANALYSIS (FMEA) (1 DAY)**

**IOT FOR ELECTRONICS INDUSTRY (1 DAY)**



**WAFER FABRICATION IN SEMICONDUCTOR INDUSTRY (3 DAYS)**

**DATA ANALYTICS FOR ELECTRONICS INDUSTRY (1 DAY)**

Temasek POLYTECHNIC

**ROBOTICS OPERATION AND ADAPTATION (3 DAYS)**

**MACHINE VISION AND PATTERN RECOGNITION IN ADVANCED MANUFACTURING (4 DAYS)**

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**SEMICONDUCTOR PROCESSES (2 DAYS)**

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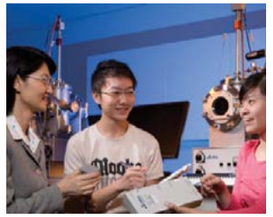


**EFFECTIVE PITCHING AND BUSINESS PRESENTATIONS FOR TECHNICAL PROFESSIONALS**

Learn how to prepare and facilitate highly effective presentations and pitches to capture, engage and persuade your stakeholders to action. Through a highly interactive online workshop, and through demonstrations, role plays and feedback, you will learn to develop and conduct the perfect pitch - and increase your chances of winning in the boardroom, in person or virtually, and even at home.

**Check out SSIA website or scan the QR code for full list of events, training and courses. Or contact Cindy Chong at *cindy@ssia.org.sg.***

# SSIA Welcomes New Members

KERRY CONSULTING

Megapac

MINDOX TECHNO
PIONEERING POSSIBILITIES

SOLIDHEAT
solid solutions solid commitment

Standard Robots

SSIA

## Deionized Water Recycling Unit

# DWR1722

DISCO

## Ultra-compact DI water recycling unit with extraordinary energy and water conservation

### Multi-function ultra-compact DI water recycling unit

The DWR1722 is a DI water recycling unit for dicing saws with functions for DI water production, water temperature adjustment, filtration, and removal of suspended solids such as cutting particles.

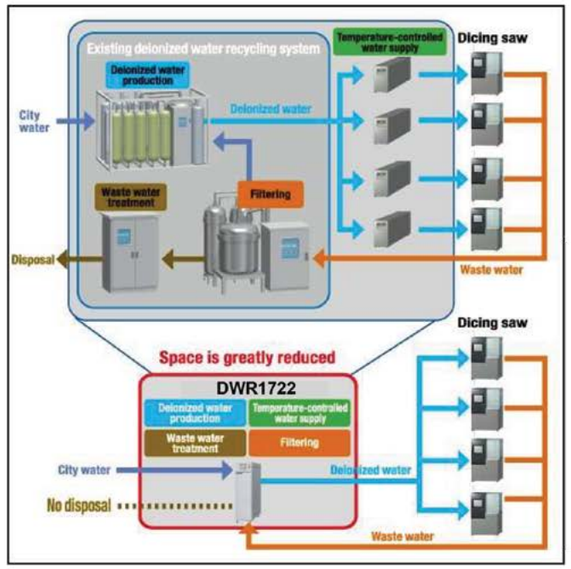
### Providing environmentally friendly performance

The high recycle rate (99.5% with zero wastewater) exceeds what is possible with conventional recycling units and greatly reduces city water consumption. Since this unit can be installed adjacent to dicing saws, piping can be shortened and water temperature fluctuations as the water runs through the piping can be minimized.

### Enabling efficient introduction into your facility

Different from the conventional large scale DI water recycling facilities, this unit can be introduced efficiently in accordance with the number of dicing saws installed. For the DWR1722, the RO unit and other functions have been reclassified as options, for a simplified standard specification.

DWR1722




CC Filter

**Easy maintenance:** The CC Filter and ion exchange resin can be replaced with a one-touch coupler connection.

**CC Filter:** The DISCO original CC Filter provides both high filtration performance and long life time. Suspended solids filtered out by the CC Filter can be disposed of easily together with the filter.

**Easy operation:** Operation of the DWR1722 can be linked with a dicing saw (optional). This reduces the load on the operator and the possibility of human error

* Notes: - A separate water supply at a controlled temperature is necessary in order to cool the chiller unit. The DWR1722 can handle two dual spindle dicing saws or four single spindle dicing saws. When producing DI water from city water, an RO film unit (option) is required. For further information please contact your local sales representatives.

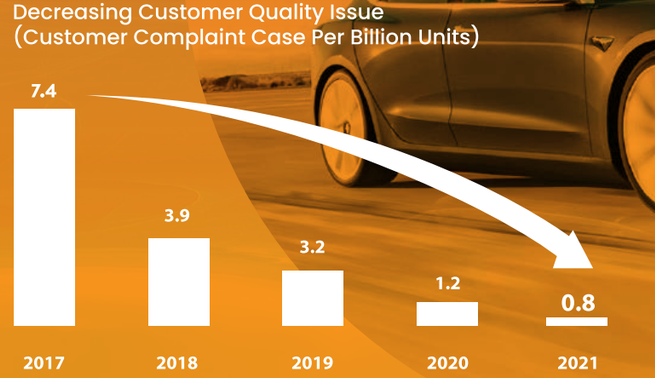
DISCO CORPORATION
www.disco.co.jp
Contact :- DHSsales@discosin.com.sg

UTAC | NOW A BILLION DOLLAR ORGANIZATION

# SUPERB QUALITY AND RELIABLE AUTOMOTIVE PERFORMANCE IS THE KEY TO OUR SUCCESS

## Less Than 10 Parts Per Billion (PPB) Automotive Rejects Achieved in Y2021

Decreasing Customer Quality Issue
(Customer Complaint Case Per Billion Units)




- 33% CAGR of Automotive Volume from Y2013 - Y2021
- 50% of Automotive Business is Full Turnkey
- Highly Regarded Automotive Assembly and Test Sites
- Leadership in Smart Manufacturing, Assembly Automation

- Automatic Guided Vehicle (AGV)
- Automated 3rd Optical Inspection
- Automated Strip Handling
- 100% Automated X-ray

**"A" RATING BY AUDITORS FROM AUTOMOTIVE TIER 1 CUSTOMERS**

Customer Complaint < 3.7 Case per Billion Units

Automotive Certifications

IATF16949 VDA6.3 EAL6 Security ISO26262

Singapore | China | Japan | South Korea | Israel | United Kingdom | Switzerland | United States of America

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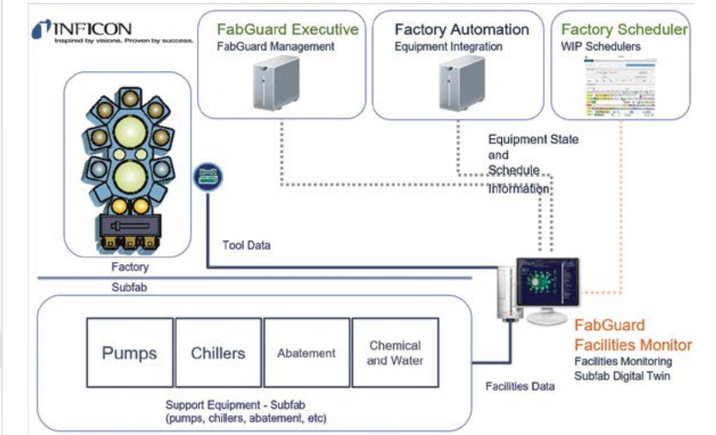
# Business Connect – Collaboration for Success




**INFICON provides numerous solutions to both frontend and backend semiconductor factories at different levels of operations. INFICON is recognized for providing expertise in leak detection, gas analysis applications, and software to enable Smart manufacturing. INFICON software assists factories in data collection/analysis, predictive maintenance and FDC with FabGuard® and the Final Phase Systems (FPS) advanced industrial engineering and factory optimization software suite.**

Through SSIA's Semiconductor Business Connect initiative, collaboration among companies is made possible by bridging the gap between solution seeking customers and innovative product providers like INFICON. Via the Business Matching platform, INFICON was able to share insights and recommend areas of improvements.

In one example, INFICON assisted a frontend wafer fab with cost saving explorations, primarily focused on sub-fab equipment such as dry-pumps, chillers, abatement systems and chemical/water. FabGuard was used for monitoring and controlling the resources consumption. Optimization was then achieved by switching the conventional consumption to condition-based consumption which allowed 15-30% reduction in chemical, water, power and gas usage.

In addition to the resource savings, the Fab was also able to do predictive maintenance for the sub-fab equipment. This generated a significant savings opportunity given that any unforeseen pump failure could cost the fab thousands of dollars in scrap wafers. Utilizing the FabGuard advanced data analysis features, INFICON showcased the ability to predict potential pump failures before catastrophic incidents occurred. This enables the fab to plan for maintenance in advance, without impacting quality and unscheduled downtime.

In another example, INFICON was able to assist a backend/test facility that required a solution for WIP management. Through SSIA's wide network connections, the backend/test facility was paired with INFICON's FPS team to address issues with WIP scheduling, dispatch, and factory throughput performance. INFICON and the backend/test facility were able to implement a comprehensive software solution to address the issues without having to increase tool counts or increase manpower investments.

The collaboration among different device manufacturers and solution providers in the semiconductor industry provide an opportunity for better communication, and result in success among the different parties involved. INFICON found the SSIA's Business Matching platform highly valuable and while it is only the first step to connect solution providers to potential customers, there is extraordinary value in continuously collaborating to develop innovations for the future.

*CONTRIBUTED BY*

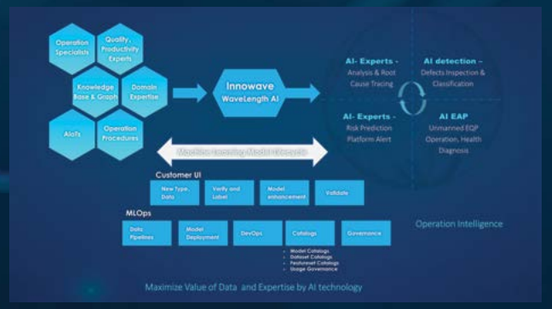
INFICON
Inspired by visions. Proven by success.

# Achieving Industrial Transformation with Artificial Intelligence

**The post-pandemic necessity to boost semiconductor manufacturing output at increasingly stringent quality has breathed new urgency into the field of industrial AI. As such, Innowave Tech is working hand in glove with various industry leaders to identify areas where AI can be applied to reliably improve output, efficiency, yield, and quality.**

## NEW AGE OF SMART SYSTEMS

To further reduce manpower and human errors, manufacturers can now rely on AI-enabled equipment automation and health monitoring applications. These applications emulate human behavior and judgement to control any equipment with unyielding accuracy and consistency, thereby increasing productivity and quality. By properly analyzing the now-available operation log, we can now detect drifts and changes in trends, providing valuable guidance for preventive actions and continuous improvements.




Through these collaborations, we created our own MLOps solution with which create a more self-sustaining way of deploying and using our solutions – such as in the use of our Machine Learning platform for defect detection, data analysis, and root cause analysis.

One of the most persistent challenges faced by some companies is the losing visibility of their parts and products. This can be resolved by using sensor-enhanced smart racks designed for different manufacturing processes that can retrieve the status and location of items such as post singulation materials, PM parts etc. on the factory floor. The data collected can then be fed into our AI engine to identify congestion points, optimize factory flow, floor layout, and equipment utilization, leading to elevated efficiency.

## SYNERGIZE ON DIFFERENT TECHNOLOGY TO UNTAP THE FULL POTENTIAL OF AI

The advent of 5G together with Multi-access Edge Computing (MEC) deployment has brought about unprecedented ways to design systems that combine the fields of industrial Artificial Intelligence (AI), Augmented Reality (AR), and Internet of Things (IoT). Real-time high-bandwidth feedback also makes advanced human-machine interfaces possible, with amazing user experience. Innowave is working with major Singapore telcos to enhance our solutions and build better, enhanced products.

At this point in the evolution of technology, manufacturers must acknowledge the critical and strategic importance of a holistic and comprehensive approach. From procurement to energy management, equipment monitoring to operation, our partners can now apply AI to visualize, optimize, and forecast all areas of operation. In the foreseeable future, this is the definitive approach to ensure sustainable growth and avoid relegation.

As we strive to remain at the forefront of this technological wave, we will continue to offer our customers the same steadfast innovation guided by our deep industrial experience and expertise.

*CONTRIBUTED BY*

INNOWAVETECH





# CapitaLand Investment-led Smart Urban Co-Innovation Lab – Innovate Solutions to Build a Smart Sustainable City

On 28 October 2020, Mr S Iswaran, who was then Minister for Communications and Information and is currently Minister for Transport & Minister-in-charge of Trade Relations (centre right), with Mr Lee Chee Koon, who was then CapitaLand Group Chief Executive Officer and is currently Group Chief Executive Officer of CapitaLand Investment (centre left), Mr Lew Chuen Hong, Infocomm Media Development Authority Chief Executive (far right) and Ms Eunice Koh, Enterprise Singapore Assistant Chief Executive Officer (far left), unveiled a plaque to mark the official opening of the Smart Urban Co-Innovation Lab.

**Headquartered and listed in Singapore, CapitaLand Investment Limited (CLI) is a leading global real estate investment manager with strong presence in Asia. CLI's portfolio spans more than 200 cities across over 30 countries. Its diversified real estate asset classes cover integrated developments, retail, office, lodging, business parks, industrial, logistics and data centres.**

The CLI-led Smart Urban Co-Innovation Lab (the Lab), Southeast Asia's first industry-led lab for smart city solutions development, opened on 28 October 2020 by Mr S Iswaran, who was then Minister for Communications and Information and is currently Minister for Transport & Minister-in-charge of Trade Relations. The Lab is supported by Ascendas Real Estate Investment Trust, Infocomm Media Development Authority and Enterprise Singapore.

The Lab brings together various industry players - local technology startups, system integrators and global corporate enterprises - to co-create solutions for smart sustainable cities, from ideation to testing to commercialisation. Located at The Galen at Singapore Science Park 2, the Lab provides opportunities for industry players to testbed their solutions at the 5G-enabled Singapore Science Park.

The Lab focuses on key industry verticals including advanced manufacturing, cloud computing, healthcare, intelligent estates, smart mobility, smart wellness, sustainability, urban agriculture, and urban logistics. The Lab's support for its members includes initiating call-for-proposals, organising workshops to promote exchange of ideas as well as facilitating proof-of-concepts and deployment.

To find out more on the Lab, please visit: **https://smartlab.expert/about-us/**

## REGISTER FOR INTRODUCTION OF THE SMART URBAN CO-INNOVATION LAB

The Smart Urban Co-Innovation Lab cordially invites SSIA members to visit the Lab on 1 June 2022 (Wednesday), 2:00pm to 4:00pm. Attendees will be able to see how solutions are co-innovated to build a smart sustainable city and how new market opportunities are seeded. For registration, please visit **SSIA's website**.


Mr Aylwin Tan, CLI's Chief Customer Solutions Officer and Director of the Smart Urban Co-Innovation Lab (right) and Mr Peter Moore, Amazon Web Services (AWS) Worldwide Public Sector Regional Managing Director, Asia Pacific and Japan (left), signed a collaboration agreement on 18 November 2021 to mark the launch of the AWS-SMARTLab Cloud Co-Innovation Lab, witnessed by Ms Jessica Tan, Deputy Speaker of Parliament and Member of Parliament for East Coast Group Representation Constituency.

*CONTRIBUTED BY*

CapitaLand Investment

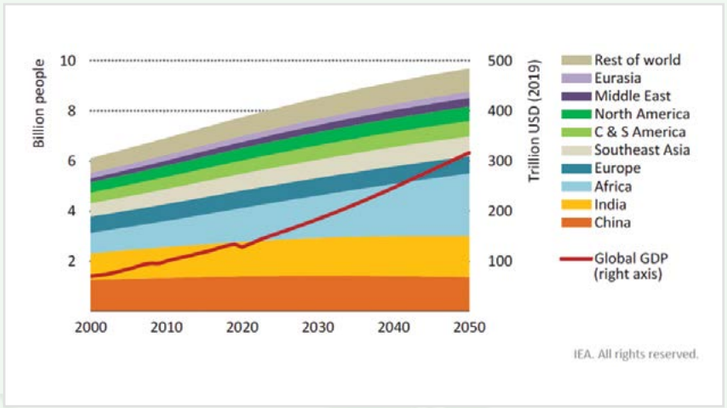
*Contributed by*
**CHRIS JONES**
Environmental Solutions Business Development Manager, Edwards

# Net-Zero by 2050 – A Roadmap for the Global Energy

In this post, we will look at highlights of a report written by the International Energy Agency (IEA), which examines the issues through a more global lens. The IEA is an autonomous intergovernmental organization established in 1974 (in the wake of the 1973 oil crisis) within the Organization for Economic Cooperation and Development (OECD) framework. One of its core missions is promoting secure and affordable energy supplies to foster economic growth. It is best known for its annual publication of the World Energy Outlook and Energy Technology Perspectives. In early 2020, the IEA called on governments to focus their economic recovery plans on clean energy investments to create the conditions required for a sustainable recovery and a long-term structural decline in carbon emissions. Its recently published report, Net-Zero by 2050 - A Roadmap for the Global Energy Sector, considers actions needed to reach net-zero emissions (NZE) by 2050. The report draws on a joint analysis collaborating with the International Monetary Fund and the International Institute for Applied Systems Analysis. It concludes that the enormous challenge of transforming our energy systems is also a huge opportunity for our economies, with the potential to create millions of new jobs and boost economic growth.

## WORLD POPULATION AND GLOBAL GDP

One of the report's most salient conclusion is that while the global population will likely grow by just over 20% by 2050, from its current level of just under 8 billion to around 9.7 billion, the global economy (gross domestic product) will more than double – resulting in a per-capita productivity increase of nearly 65%. The report notes that population growth will be greatest in less developed regions (Africa) and emphasizes the need to ensure increased opportunities and benefits are equitably distributed.




By 2050, the world's population expands to 9.7 billion people and the global economy is more than twice as large as in 2020

The pathway to NZE focuses solely on the transition within the energy sector, without offsets from outside the sector. It is designed to maximize technical feasibility, cost-effectiveness and social acceptance while ensuring continued economic growth and secure energy supplies. The report provides a global view but recognizes that countries will not start in the same place or finish at the same time. Advanced economies will reach net zero before emerging markets and developing economies and must assist others in getting there. The proposed path is one of many possible journeys, and the report examines key uncertainties, including the roles played by bioenergy, carbon capture and behavioral changes.

## OIL/GAS/COAL WHOLESALE PRICES

The report gives high priority when considering the human side of the transition. Who will benefit, and who will lose? What behavioral changes are needed, and what challenges do those changes present? It also acknowledges the uncertainty inherent in its projections.

| Real terms (USD 2019) | 2010 | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|
| **IEA crude oil** (USD/barrel) | 91 | 37 | 35 | 28 | 24 |
| **Natural gas** (USD/MBtu) | | | | | |
| United States | 5.1 | 2.1 | 1.9 | 2.0 | 2.0 |
| European Union | 8.7 | 2.0 | 3.8 | 3.8 | 3.5 |
| China | 7.8 | 5.7 | 5.2 | 4.8 | 4.6 |
| Japan | 12.9 | 5.7 | 4.4 | 4.2 | 4.1 |
| **Steam coal** (USD/tonne) | | | | | |
| United States | 60 | 45 | 24 | 24 | 22 |
| European Union | 108 | 56 | 51 | 48 | 43 |
| Japan | 125 | 75 | 57 | 53 | 49 |
| Coastal China | 135 | 81 | 60 | 54 | 50 |

For example, it predicts significant reductions in the cost of fossil fuels as we transition to renewable sources. (Other reports have different predictions.) Drops in the usage/demand for fossil fuels will preclude further fossil fuel exploration and new expansion. High-cost producers will no longer be economically viable, and production will shift to regions with proven reserves and low extraction costs. With low demand, prices will be dominated by operating costs. These predictions are perfectly logical, perhaps even obvious. For many of us who are accustomed to viewing energy as a cost to be minimized, our unconsidered reaction to lower prices is one of welcome. But for such large-scale permanent changes, we must also consider the impact on countries and individuals who currently rely on fossil fuel production for their livelihood.

## THE PRICE OF CARBON DIOXIDE

| USD (2019) per tonne of $CO_2$ | 2025 | 2030 | 2040 | 2050 |
|---|---|---|---|---|
| Advanced economies | 75 | 130 | 205 | 250 |
| Selected emerging market and developing economies* | 45 | 90 | 160 | 200 |
| Other emerging market and developing economies | 3 | 15 | 35 | 55 |

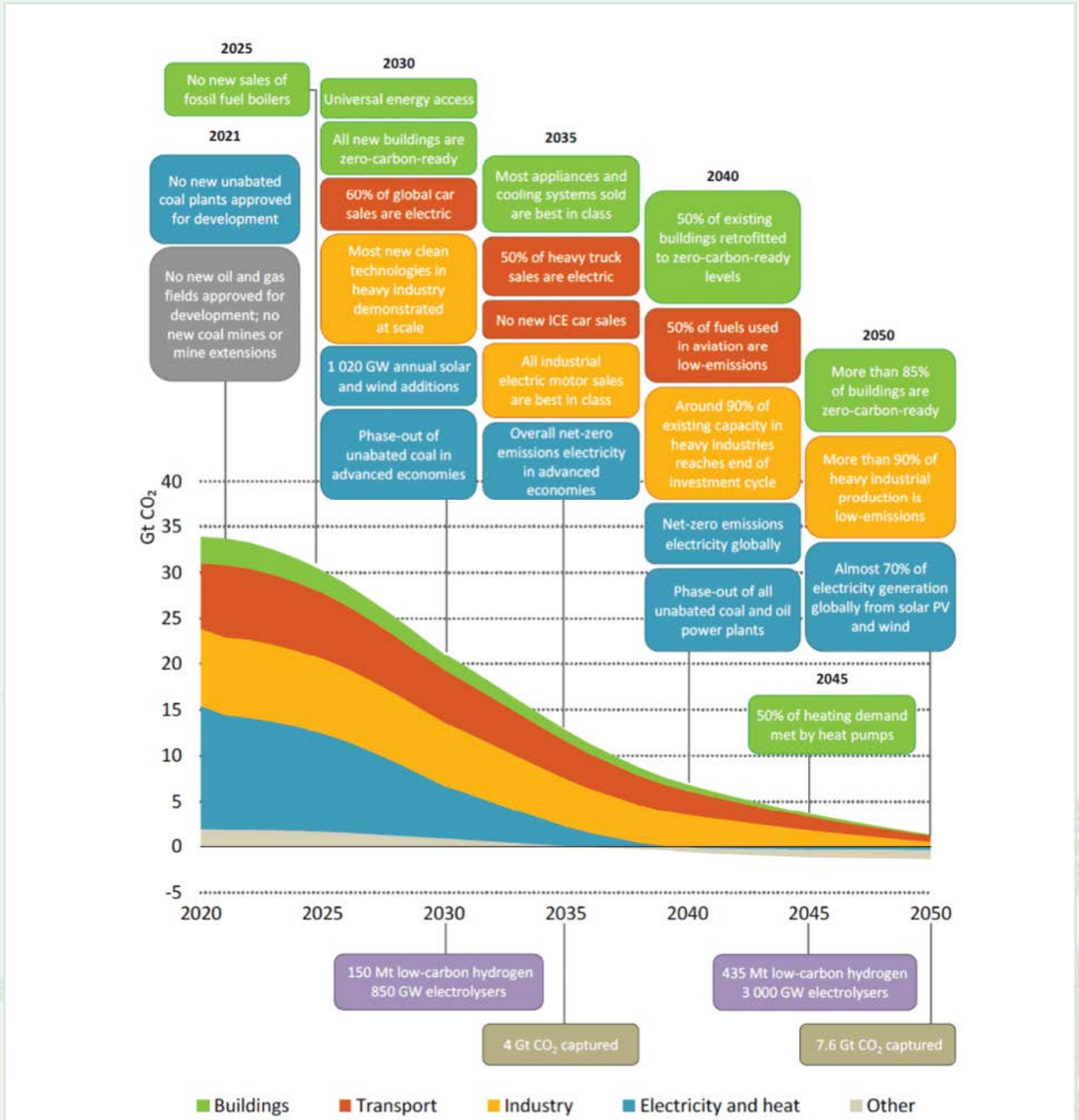
There is a broad scientific consensus that greenhouse gas emissions are causing climate change. In economic terms, these emissions are degrading a shared resource, our environment, and constitute a real but unaccounted (and difficult to estimate) cost. This report (and almost all discussions of solutions for climate change) is predicated on our ability to globally impose a price for carbon emissions that will account for the unrecognized environmental cost and allow market forces to bring about a solution. It models the carbon price as increasing over the analysis period and tiered to reflect the varying ability-to-pay across the advanced, emerging and developing economies. The advanced economies will lead, followed by emerging and then developing economies. Advanced economies will start at $75/metric ton of CO2 (tmCO2) in 2025, rising to $130/tmCO2 by 2030 and $250/tmCO2 in 2050. Mid developing economies will go from $45/tmCO2 to $200/tmCO2 over the same period. Less developed economies will go from $3/tmCO2 to $55/tmCO2. The tiered structure makes participation by less developed countries economically feasible. It puts the greatest burden on advanced economies who have the greatest ability to pay and who have historically emitted the most greenhouse gases and benefitted the most from the lack of a cost for doing so.

An example from our market helps to illustrate the impact of carbon cost. Currently, typical utility costs for an Edwards iXH6050HTXS vacuum pump are $11.7K/year. At the current carbon intensity level, a carbon cost of $75/tmCO2 will add $4K/year. $250/tmCO2 would add $13.5K/year. The messages to us as equipment suppliers are clear. As carbon costs increase:

1. Equipment suppliers must improve the energy efficiency of their products.
2. Equipment users will give more weight to operating costs and energy efficiency in their purchase decisions and expansion planning.
3. Transitioning to renewable, low-carbon-intensity energy that avoids carbon costs will provide increased economic and environmental benefits to participants at all economic levels – individual, corporate, national, and global.

## THE ROAD TO 2050

It's a journey – it's not going to happen overnight. The report sets out clear milestones – more than 400 in total, spanning all sectors and technologies – for what needs to happen, and when to transform the global economy from one dominated by fossil fuels into one powered predominantly by renewable energy. General goals include saving energy, eliminating coal, capturing carbon, pumping heat, electrifying cars and trucks, expanding wind and solar power, developing hydrogen, finding low-emission resources for air travel, and more. This graphic summarizes the most important milestones:



# AI Integration with Advanced SPC to Drive Productivity

Industry 5.0 complements Industry 4.0 with the notion that humans and machines collaborate within a digital ecosystem. Artificial Intelligence and Machine Learning (AI/ML) play a vital role in this by allowing manufacturing to optimize their processes whilst reducing human intervention, yet empowering humans with smart solutions. The ultimate goal from this human-machine interaction is to achieve maximum efficiency and productivity. Hence, implementing AI into Advanced Statistical Process Control (SPC) will provide competitive advantage for manufacturers.

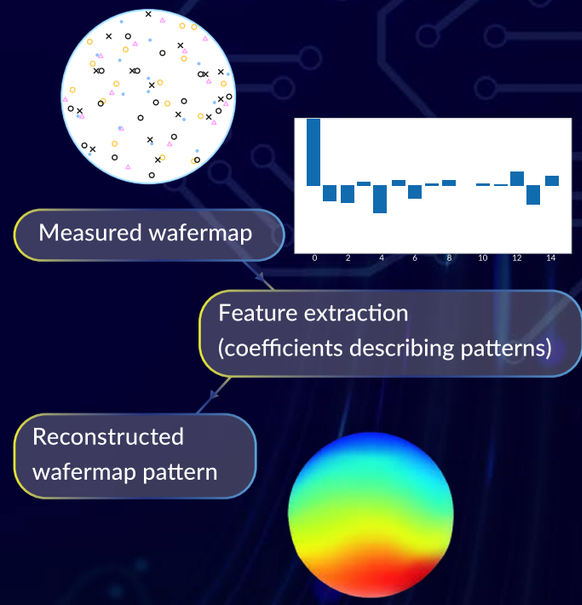
## Wafer mapping and sampling measurement

Enormous amounts of data on wafers are collected daily in modern semiconductor manufacturing. These wafer data are obtained via wafer mapping – a process to measure the spatial characteristics of wafers.

Typically, analysis of spatial wafer profiles is done using summary statistics and sampling measurements collected from SPC Charts. However, essential information such as the location, shape, and sharpness of the variation patterns are not present, which poses a limitation to this analysis method.

Traditional measurements collected by SPC systems also has its limitations due to the sampling measurement method on measured products. Therefore, to save time, sampling method is used to take a few coordinate locations only. From this, the AI/ML solution can understand the entire product profile via scoring method and uses it to drive workflow if a bad product profile is detected.

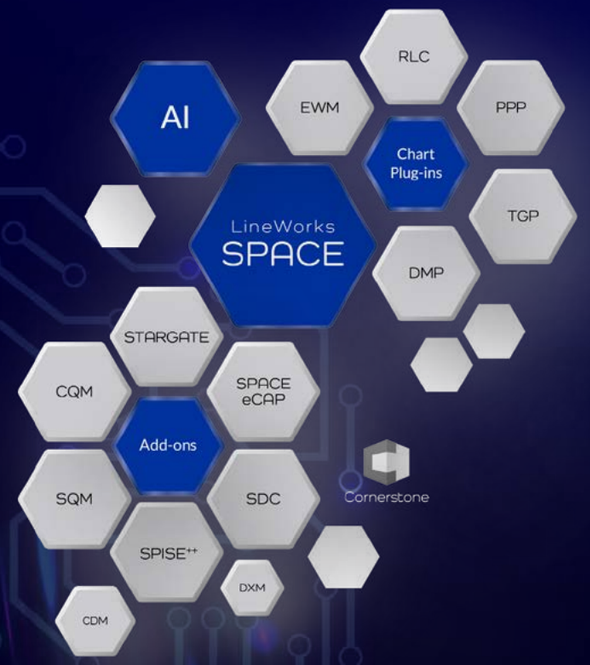
Just imagine the unfathomable capabilities when integration of AI to SPC framework is implemented. Once the AI is trained to understand the wafer profiles, it will drive the next level of automated Out-of-Control Action Plan (OCAP).




## Overcoming complex data formats

Complex data formats such as images and time series data are difficult to capture even in current state of the art control charts.

AI/ML can overcome this by enriching the SPC framework's anomaly detection ability with complex data formats for recognizing these time series data and images. AI/ML has been proven effective in recognizing error patterns and shapes from these complex data flows. Therefore, integrating such capabilities with the SPC framework will take it to a whole new level of problem-solving. In this case, the mentioned SPC framework refers to LineWorks SPACE.




▲ Kernel for Smart digital manufacturing

## Implementing real-time AI/ML scoring

LineWorks SPACE eCAP is an add-on module to LineWorks SPACE that provides a workflow for OCAP events detected by the SPC system. Implementing AI/ML scoring through automated eCAP requires training the AI models using stored data within the SPC system.

The AI will learn the typical actions and decisions applied to all wafers having similar critical bad profiles and initiated eCAP processes immediately when an anomaly is detected, executing the same set of actions done in the past.

If a combination of actions is found, human decision input will be requested. Users can decide the appropriate corrective actions and design the execution accordingly. This is how AI/ML complements LineWorks SPACE eCAP through further learning and helps drive manufacturing.

## Enhance the power of LineWorks SPACE with AI

LineWorks SPACE is the data source for all measured data, from product quality, to equipment sensor data. Its ecosystem consists of various SPACE Chart Plug-ins and Add-ons.

By integrating the ecosystem with AI/ML algorithms, it further enhances process productivity through developing deep learning models in wafer profile detection. Users will discover the features and source of anomalies impacting process outcomes. This applies not only on single process steps, but also across the entire manufacturing chain at different product lines.

AI/ML technological capabilities include prediction of the system performance and further analyzes the root cause of process deviations, before identifying the best course of corrective action. This interactivity between AI/ML and LineWorks SPACE assists humans in making more intelligent decisions and actions. Engineers can now initiate effective Electronic Corrective Action Plans (eCAPs) whenever an anomaly is detected.

## Achieving best of both worlds: sustainability and productivity

Semiconductors are essential components to every electronic device in modern life and the demand for it continues to rise. Despite concerns over adverse effects the industry has on the environment, we cannot deny that these materials are pivotal to produce other green technologies such as solar panels to reduce carbon emissions.

Therefore, implementing process control systems to enhance process productivity is of utmost importance. This will increase yield and at the same time reduce scrap rate – a direction towards sustainability.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# Electrotek – Your Technology Partner to Enable Smart Factory Capabilities

**In the past decade, the emergence of advanced digital technologies such as Internet-Of-Things (IOT), Artificial Intelligence (AI), Big Data and Analytics have enabled the rise of the fourth industrial revolution. Smart factory capabilities have proven to create positive impact on bottom-line profitability. The value of digital transformation of the manufacturing and production process and a connected ecosystem are increasingly recognized with the increase in successful cases of smart factory deployments. Companies seeking to embrace Industry 4.0 may have very different starting points, capabilities, making it difficult to realize smart factories as it involves revolutionizing the way the entire business operates and grow.**

A connected data architecture is the foundation for enabling a smart factory before advanced capabilities like predictive analytics and machine learning can be deployed but many are still struggling to create a connected data infrastructure due to the use of legacy tools. The lack of connectivity and easy access to data within the equipment/machines pose a formidable challenge for businesses looking towards smart factory migration.

Since replacement of these still-functioning machines/equipment and OEM support is costly, the next best solution would be getting SECS/GEM capability through modernization of your legacy system with a third-party software.

A technology partner like Electrotek with expertise and proven track experience in providing host and equipment software connectivity solutions in the semiconductor industry is crucial. Electrotek solutions eliminates the need to develop in-house capabilities to achieve a connected ecosystem and gain access to data across a broad range of equipment data sources through “plug-configure-play” solutions. Building a proper data architecture with Electrotek paves the path for successful deployment of higher-level smart factory capabilities to gain traceability, enable predictive maintenance and autonomous decision making.

For more information, please refer to our website **https://www.electrotek.com.sg/about-us/our-services**

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ELECTROTEK PRIVATE LIMITED





# Mobile Robots and Manipulators for Material Handling Operations

**In the years leading up to the pandemic, the semiconductor industry began to see increased fluctuations in the supply of labour. The pandemic exacerbated this situation, resulting in production stoppages, parts unavailability and unpredictable lead times.**

To this end, it is essential to use available manpower optimally. Mundane tasks such as material handling, intralogistics and machine tending can now be handled by a combination of mobile robots and manipulators. This frees up additional manpower to focus on high value processes requiring initiative, discretion, and human intelligence.

SESTO Robotics offers a comprehensive range of robotics solutions to bolster production teams that are overstretched in the fabrication process. These solutions provide dependable and cost effective methods for the material transfer of work-in-progress parts, bulk movement, and loading/unloading from tools.

The SESTO Prime AMR (Autonomous Mobile Robot) is equipped with a 7-DOF (Degree Of Freedom) manipulator, capable of carrying 20kg. Designed to carry up to 2 FOUPs (Front Opening Unified Pod), Prime can pick up FOUPs from work-in-progress racks and transfer them directly to tool load ports for processing.


Once processing is complete, Prime AMRs can be tasked to pick up FOUPs for transfer to the next tool, or to buffer areas. Swap tasks can also be generated. This allows a fresh FOUP to be loaded into a machine while the completed one is removed, thereby maximizing tool usage.

Extensive APIs enable SESTO products to be integrated with MES (Manufacturing Execution System), WMS (Warehouse Management System), or other backend systems to allow for automatic task creation and the tracking of execution status. Event and error notifications can be relayed to staff, alerting them of situations that require assistance or intervention. The digitalization of transfer information enables process owners to track machine efficiency and transfer metrics. This helps to identify deficiencies and drive process improvements.

SESTO’s Magnus Lifter AMR (Autonomous Mobile Robot) can be used to transfer trolleys or shelving units around the production floor. This enables the transfer of parts between stations. Other use cases include the distribution of spares and consumables to maintenance teams on the production line, allowing the teams to focus on repair work rather than material movement.

Mobile robots and manipulators have matured sufficiently to the point where both deployment and capabilities are cost effective, safe, and reliable. As production lines continue to automate and modernize, robotic platforms offer excellent opportunities to improve productivity and build resilience in fabs and other manufacturing plants.

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SESTO™

I.C.E Aluminium Pte Ltd was established in 2018 and we provide precision aluminium parts manufacturing services.

I.C.E Aluminium emphasises heavily on quality. We are certified ISO9001, the international standard of quality management, and this gives clients the assurance and guarantee that we are able to manufacture excellent products as per their specifications.

We are equipped with advanced types of machinery - CNC machining centres, automated electrophoresis equipment, grinding machines, dust-free automatic spraying, oxidation, and various types of tooling equipment.

**Advantages of our Aluminium CNC Machining Services:**

- Experience, accuracy, and powerful machinery
- Relatively stable CNC machining of aluminium
- Design and produce complex custom aluminium parts
- High production efficiency and cost saving
- Simultaneously realize various and large quantities of production
- Provides clients high quality parts with comparable timelines
- One-stop instant service

## *Our Services*

### Extrusion Service

Aluminium extrusion is the process of aluminium forming. The aluminium extrusion process uses the original form of aluminium, which is called the aluminium billet of the aluminium ingot. The aluminium billet is preheated to a specified temperature at which the aluminium becomes soft and malleable, and then forced through a mould or die that is designed to shape and form the aluminium material to different aluminium profiles with desired cross-section shapes.

### CNC Machining Services

As a professional CNC Machining service provider, we have our own specialized technical staff and management team to design as per clients' custom drawings and samples.
We understand each type of aluminium material characteristic hence we are able to offer clients the best machining aluminium solution according to their requirements for aluminium parts and products.

I.C.E Aluminium
聯洲精密鋁業有限公司

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(Business Development Manager)
Email: haolin.zhao@icealum.com
Phone: +65 8130 7282

www.icealum.com
Tel : +65 6250 9081
Email: enquiry@icealum.com

**Product Description Of Our Aluminium CNC Machining Services**

Wide range of machining aluminium materials:
Aluminium 2024, Aluminium 5052, Aluminium 6061, Aluminium 6063, Aluminium 7050, Aluminium 7075

Custom Colors:
Black, Natural, Blue, Green and different colors as your requirements

Surface Finishing:
Sand blasting, shot blasting, polishing, anodizing, oxidation, electrophoresis, chromate, powder coating and painting

Various CNC Machining Process:
CNC milling, CNC turning, CNC drilling

Aluminium CNC Machining Applications:
Aluminium CNC parts can be applied to automotive, electrics, military, medical, aircraft, power generation, aerospace, and industrial engineering

### Surface Finishes

You can choose from a wide selection of metal surface finishing services after machining at our CNC machining centres to improve the parts appearance, surface smoothness, corrosion resistance and other performance of your CNC machined parts.

- Electroplating/Plating
- Powder Coating
- Anodizing
- Black oxide
- Bead blasting/Bead blast
- Abrasive blasting/sandblasting

### Other Services

- Abrasive blasting
- Polishing
- Silk printing
- Laser marking



# Kinetics At-A-Glance


**Founded in 1973, Kinetics is a Full-Service Process and Mechanical Contractor Specializing in the design and installation of process, mechanical, plumbing and HVAC system. We had proven experience supporting global clients in the microelectronics, solar, biopharmaceutical, data center, R&D and other technology-driven market.**

With approximately 2,000 employees in 24 regional offices in North America, Europe, the Middle-East and Asia, Kinetics can support the challenging requirements of our global clients in all regions of the world. Our engineering project and support teams cover a broad range of technical disciplines and provide competent design services for clients in diverse industries. Our design-build and turnkey solutions enable our clients to focus on strategics issues leaving the important details to the Kinetics team.

- Process chemicals
- Planar slurry chemical systems
- Bulk & specialty gases
- Ultrapure water
- Vacuum systems
- Compressed dry air
- Process cooling water
- Waste treatment systems
- Hook up of production process tools
- Cleanroom environments
- Specialty analytical and test equipment
- Life safety systems
- Design & manufacture equipment for chemical, slurry, process gas and ultrapure water systems
- Full facilitation of HPM rooms
- TGCM

For enquiries, please contact **Nelson Wang**, Sales Manager Singapore.


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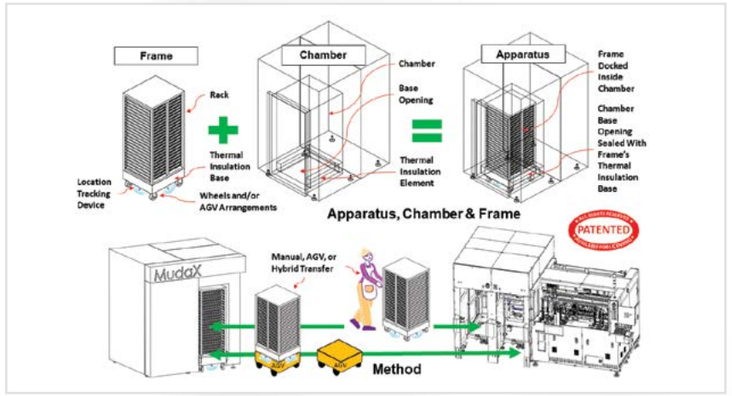
KINETICS
THE PROCESS PEOPLE

# Keep it Simple & Save (KISS) in Burn-In Operations



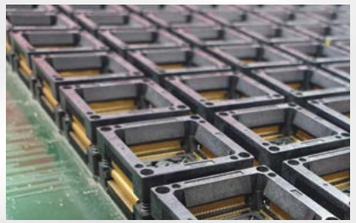

**Semiconductor burn-in is a process to weed out early failure ICs, so that only reliable ICs are shipped to manufacturers who will then use it in final products that demands high level of reliability. Eg. automotives (cars), memories (data storage), communications (5G), aerospace & defence.**

While enhancement had been done in the last few decades to improve burn-in operational efficiency with the automation of IC loading / unloading on the burn-in boards, transfer of burn-in boards within the burn-in area & to the burn-in ovens remains largely manual. These manual transfer process had created several operational issues & companies had cope mainly by increasing resources (manpower, space, equipment, etc) in the operation.

With autonomous cars, data centres & communications driving huge demand for more reliable ICs, & operations driving demand for even higher density burn-in boards to reduce unit cost & cycle time, manual transfer in burn-in operation is becoming increasing untenable. Various robotics automation proposed for existing burn-in operation had also proven to be neither cost effective, nor process efficient.

MSV, having worked with various companies for over 20 years on burn-in equipment (ovens, loaders/unloaders, boards, transfer trolleys), understood well the problems that companies are facing.

In 2021, after 3 years of development, MSV had filed & was granted the patent for "Apparatus, Transfer Method, Chamber & Frame for Semiconductor Burn-In Process".



The patented direct trolley burn-in oven & transfer method will solve most of the operational issues & increase throughput with reduced amount of resource, enabling companies to Keep It Simple & Save (KISS) in burn-in operations with rapid return on investment (ROI).

Once implemented, it will also facilitate further automation of the burn-in operation in a cost effective & process efficient way, straightening the way towards a lights off burn-in operations. Contact us to find out how you too can also Keep It Simple & Save (KISS) in your burn-in operations.

Joe Tan founded MSV Systems & Services Pte Ltd in 2002. He graduated from the National University of Singapore with Degree in Electronics Engineering & Master's in Industrial & System Engineering.

Keep It Simple & Save (KISS) had been presented in TestConX China 2021 – Session 1 **https://www.testconx.org/premium/testconx-china-2021/**

KISS 2.0 will be presented in TestConX USA on May 2022 - Session 5 **https://www.testconx.org/premium/testconx2022-tuesday/**

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MSV

**info@msv-asia.com**





# Wintech Nano – "Lableless" Vision to Build a Robust Ecosystem for Local Semiconductor Industry

As introduced by Mr. Li Xiaomin, President of Wintech Nano Group, in November 2020 as a viable business model to the industry, "Lableless" vision received vast positive responses from the industries. The core concept of "Lableless" is both a projection and a recommendation for semiconductor industries to engage well-established 3rd party analytical lab services instead of investing heavily in ever-evolving analytical equipments and technical expertise of talents. This is primarily driven by 3 key intrinsic challenges of conventional inhouse laboratory setup: 1) high cost/low utilization of analytical equipment, 2) Ever-developing analytical equipment technology, 3) glass ceiling of analytical experts in inhouse lab.

To assist regional semiconductor industry growth, WinTech Nano Singapore introduced different "Lableless" business model for local customers. One of the successful business model is the service contract, similar to those of equipment suppliers, where a fixed periodic service charge enjoy an increased amount of analytical services. It helps to fix the yearly analytical service cost with an ease of mind to enjoy more analytical services. This business model is appealing to the start-ups and SMEs who are in the stage of fast growth, mainly rely on 3rd party analytical services, and mindful of potential high cost.

To enable the "Lableless" vision, 3rd party analytical service providers must grow. As the leader in this area, Wintech Nano Singapore has been continuously investing. In the last 12 months, Wintech Nano Singapore newly installed a list of latest equipment as below:

- High Resolution Confocal Scanning Acoustic Microscope (C-SAM)
- Double Side Probe Station Upgrade for EMMI/Obirch
- Reactive Ion Etch (RIE) for passivation removal during delayering process
- Nanoprobing Solution with EBIC/EBAC function (collaboration with IMINA, Point Electronics and Tektronix) for Transistor level analysis
- Enhanced Lock-in Thermal Emission for IC fault isolation (to be installed in May 2022)

Looking forward to collaborate, let WinTech Nano be your Lableless Vision Enabler.

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WTech NANO

# Your Trusted Partner in Logistics for the Semiconductor Industry – SIN CHEW WOODPAQ

**The Semiconductor sector has been steadily expanding over the years, with the industry expected to reach about US$600 billion this year. We understand that semiconductor machinery and equipment are delicate and sensitive. It is important to have a dependable one-stop logistics provider to protect and position your equipment with care. With the services listed below, we can partner with you to fulfil your logistics needs.**

## CUSTOMISED WOODEN CRATES

With our own in-house design & engineering team and production capability, we are able to design and build wooden cases to accommodate your equipment. We offer ISPM15 Material Treatment services such as Heat Treatment for the wooden packing materials.

## DESIGN & ENGINEERING CAPABILITIES

Our Engineering Cases are designed using 3D CAD, and we can produce proof of durability for the protection of your sensitive equipment. We have the capability to perform finite element analysis and calculations with the CAD design to simulate how it would react to real-world impacts, vibration and other physical effects.

Vibration sensors are used to test and analyse the impact of vibrations on the cargoes. From that, our engineers will calculate and select the suitable dampening devices and cushion foams for your equipment.

## INDUSTRIAL PACKAGING SOLUTIONS

Our in-house team has a thorough understanding of industrial packaging solutions for semiconductor equipment such as moisture extracting and shock absorbing packaging. For example, we utilise desiccants and moisture vapour barrier bag combined with vacuum sealing for moisture control and protection requirements for their cargoes. Impact indicators will be used to track the impact on transit.

## INDUSTRIAL MACHINERY MOVING

Specialised moving equipment like air float system is used to move large semiconductor equipment that are sensitive in nature. We are equipped with cleanroom attire and chromed plated pallet jacks and rollers to conform to the cleanroom standards.

## AIR RIDE TRANSPORTATION

We are able to provide Air Ride Suspension Transport with climate control container to ensure safe delivery of sensitive equipment used in Semiconductor industry across Singapore. We provide seamless planning to ensure on time delivery of your cargo, providing you with a peace of mind.

**For more info, visit us:**

www.sin-chew.com.sg

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# Attracting and Retaining Employees with Better Commutes

**Many semiconductor companies are located in areas relatively inaccessible by public transportation. Unless the company provides transportation, the daily commute can be time-consuming for the employees, and it may even become a source of dissatisfaction over time.**

Commuting also affects their decision to return to the workplace. A recent **study** by Nanyang Technological University found that people are more likely to return to their workplaces if their journeys to work were shorter and more comfortable. [1]

Whether it is to encourage more employees to return to the workplace or to improve their commute experience, it is worth looking into solutions to make the journey an easier one.

## INTRODUCING SMART EMPLOYEE TRANSPORTATION

For company transportation, most companies operate bus services with fixed timings and stop points that do not adjust to fluctuations in demand, which may lead to inefficiencies that cost more in the long run.

Introducing SWAT's demand-responsive employee transportation - Behind it lies an algorithm that calculates the optimal routes and fleet combination that reduces trip times and maximises vehicle utilisation.

Digitalising transport simplifies transport planning, helping companies cope with changing schedules and flexible work arrangements. It also makes it easier to manage transport, with platforms to track vehicles and service reports on key metrics.

- Up to 80% less time on transport management
- Automated route planning
- Average 20% reduction in fleet costs

Smart mobility has been making great strides in transforming the traditional employee transportation, turning it into a more cost-efficient service for companies to provide.

## HAPPIER EMPLOYEES

Imagine employees booking rides in advance through a mobile app and getting picked up close to their homes.

Smart employee transportation lets employees enjoy:

- Pick-up and drop-off points that are within walking distance of their homes
- On-time arrivals
- Direct, transfer-free rides
- Comfortable, safe and convenient journeys

Companies like Katoen Natie have shared that such technology can be a powerful recruiting tool and that candidates are more likely to accept offers because of better transport.

**SWAT Mobility** is the leading smart mobility solutions firm in South-East Asia, with extensive experience working with organisations such as Sembcorp Marine and Singapore Airlines to solve employee transport issues and improve commutes. Its proprietary algorithm holds a record on the global Li & Lim benchmark in optimisation efficiency. In 2021, SWAT Mobility was listed on Forbes Asia 100 to watch list as a startup on the rise in the Asia-Pacific region.

Get in touch to see how smart mobility can work for your organisation: **www.swatmobility.com/**

[1] Crowded trains sway people's decision to work from home: Study. The Straits Times. https://www.straitstimes.com/singapore/transport/crowdedness-on-trains-sways-peoples-decision-to-work-from-home-study

*CONTRIBUTED BY*

SWAT MOBILITY

# Green Manufacturing is a Choice, Not an Afterthought

**Lim Han Bin, Section Manager of the Environmental, Health and Safety Team at GlobalFoundries shares about the challenges a foundry addresses, and the creative solutions put forth to operate a sustainable foundry.**

### WHAT ROLE DOES THE ENVIRONMENTAL, HEALTH AND SAFETY TEAM PLAY IN GLOBALFOUNDRIES?

The Environmental Team in GF specializes in environmental management, engineering, and compliance, guiding GF through a rapidly changing regulatory landscape and stakeholder expectations. We develop tools and techniques tailored to our company's needs to achieve innovative sustainable manufacturing.

GF recognizes the unprecedented global challenge of climate change and is committed to grow responsibly and minimize our environmental impact. We take ownership and conscientious steps to manage our energy and water usage, our waste treatment and work towards reducing total greenhouse gas emissions 25% by 2030.

The impact of our environmental work in GF can be felt beyond our facilities and is deeply entrenched in the regional geopolitical and resource challenges. Water is a critical resource for semiconductor manufacturing and its supply is uncertain after 2061 when Singapore's Second Water Agreement with the Johor State government ends. We are one of the first semiconductor manufacturers to adopt NEWater for industrial use and today, we recycle and reuse more than 50% of that water.

Similarly, with the narrowing lifespan of the Semakau landfill, GF needs to reduce waste from our operations. We have systematically reduced and recycled our waste over the years, and just last year, GF was recognized by Underwriters Laboratories (UL) as the first semiconductor manufacturer in Southeast Asia to achieve the landmark "UL 2799 Zero Waste to Landfill".

### HOW DO YOU TACKLE THESE UNIQUE CHALLENGES?

Our challenges come from all facets of our operations and require close partnership between our modules, facility teams, and our customers to resolve. Our current largest carbon reduction project was driven by one of our process engineers. His team applied knowledge learnt from another process to dramatically improve their fluorinated plasma processes efficiency. By striking plasma in a smaller and dedicated compartment instead of the much larger process chamber, the process gases could absorb energy much more efficiently, sharply decreasing the fluorinated gas needed.

Another interesting way we manage these unique challenges is to take a circular economy approach. We identify opportunities to repurpose our waste output in another of our processes. For example, spent acid generated from wafer processing is reused for neutralization treatment and cleaning air emissions.

Cleaner air emissions with better air abatement technology

Beyond technical solutions, sustainability is the right thing to do. It guides our interactions with our employees, communities, customers, partners, and our approach to environmental stewardship. To ensure a sustainable supply chain, we have a longstanding Conflict Minerals Policy where we verify that our goods and materials are ethically sourced. Sustainability is a conscious business decision, not an afterthought.





Supplementing our energy needs with Solar energy

### WHAT ARE THE CURRENT AND FUTURE ENVIRONMENTAL CHALLENGES THAT GF WILL FACE?

In the near-term future, we will face increasing complexities in resource management and depletion. The effects of climate change are beginning to show, and its impacts intimately felt around the world. Just last year, Taiwan faced its worst drought in over half a century, causing its reservoirs to dip to unprecedented levels. By diverting water from agriculture and other purposes to semiconductor manufacturing, Taiwan was able to maintain its chip production. Singapore does not have such an option; sustainable water usage is now a matter of business survival.

As for longer term challenges, reducing carbon emissions will be the most prominent. While energy efficiency projects could reduce some of the energy needs, they only chip away at the problem. For GF's Journey to Zero Carbon to succeed while expanding manufacturing, our dependence on renewable energy sources must grow significantly in this decade.

### FINALLY, HOW CAN WE EXPAND THE ROLE OF SUSTAINABILITY IN OUR BUSINESS?

Everyone has a part to play, and GF encourages making small but meaningful changes to our individual lifestyles, such as recycling coffee grounds and rewarding employees to use their own mugs and reusable containers for takeaways in our cafeterias.

Take the initiative to look for opportunities to optimize resources and improve sustainability in our work. Sustainability is good for business. GF supports grassroots initiatives via our cost-saving program which pairs members of sustainability-related projects with an environmental subject matter expert for advice and support.

Recycling coffee grounds from Café

And finally at the organizational level, make sustainability one of the key considerations for business decisions. To truly change the industry that is changing the world, we must go beyond simply sustaining the status quo and look to decisions which pave a better future for all of us.

*CONTRIBUTED BY*

GlobalFoundries

# **Applied Materials** Is Committed to Building a Future-Ready Workforce

**Tan Lee Sar**, Managing Director,
HR Business Partner Regional Lead

**“ It is an exciting time to be in the semiconductor industry... We are committed to growing our talent in Singapore to create a future-ready workforce.**

**Lee Sar** leads the HR teams in delivering organization and talent strategy and initiatives to enable the overall Applied Materials business in the region. She brings over 14 years of HR experience in the public service from the Singapore Economic Development Board and Ministry of Manpower.

**What are the opportunities that Applied Materials sees amid the unprecedented demand for semiconductors?**
It is an exciting time to be in the semiconductor industry. As the impact of digitalization on lives and businesses has accelerated, the demand for semiconductors is stronger than ever. New technology trends such as Internet of Things (IoT), Big Data and AI are also generating new growth opportunities for the industry and creating the need for new innovations in semiconductor technology.

As the world's leading semiconductor equipment company, we are growing to support the unprecedented demand for our products. We are investing in our infrastructure and our talent, as we deepen and broaden the span of our operations in Singapore.

**How does Applied upskill its workforce and what are the opportunities for employee development?**
Applied Materials is an exciting place to work with leading-edge products developed by the brightest minds in the field. We are committed to growing our capabilities and investing in our talent in Singapore, to create a future-ready workforce that allows employees to perform their best.

To cultivate a data-savvy workforce, we worked with local universities like National University of Singapore (NUS) and Singapore Institute of Technology (SIT) to incorporate data analytics and AI courses into our learning resources. We aim to upskill our workforce, as we make data part of our business language and DNA.

For employees who are motivated to go the extra mile to further their studies, we also support them through an education assistance program. One of our employees, Nazirudeen, had a diploma when he joined us as a technician. He was given opportunities for career development and overseas visits to customer sites. Two years ago, he decided to upskill himself with a part-time Mechanical Engineering degree, and has now progressed to become a manager and leads a team!

**How does Applied contribute to the talent in semiconductor ecosystem in Singapore?**
Being at the forefront of technology, Applied Materials invests heavily in R&D to maintain its leadership in materials engineering solutions. To bring new innovations to the industry, we will continually bring in new products and processes to our operations in Singapore. This creates new capabilities in the local semiconductor ecosystem as skills and technology are transferred to our workforce here.

As a global company with operations and customers all over the world, Applied employees have the valuable experience of collaborating with colleagues globally. They also have access to a global career through our internal jobs portal.

Digital transformation is accelerating, and some industry observers predict that semiconductor industry revenue could reach $1 trillion by 2030! It is truly an exciting time to be in this industry. We look forward to more people joining Applied Materials and developing their careers with us.

## Hear From Our Talent

**Azreen, Test Engineer**
I graduated from university and joined Applied Materials in 2020, in the midst of the pandemic. It was definitely challenging starting work in a work-from-home setting, but the warm support and help from my teammates and learning resources from Applied helped me get up to speed.

As a Test Engineer, we build testers to validate our manufacturing tools and ensure that they meet standards. I appreciate the culture of continuous learning in Applied, and my manager has always encouraged me to take up courses to upgrade myself. Besides our internal learning resources, I have also had the opportunity to take external courses in pneumatics and vacuum technology, which have equipped me with skillsets to bring my work to the next level and helped to build my confidence as a young engineer.

**Yvonne, Chemist**
I first joined Applied under the NUS SGUnited Traineeship Program for post-docs in the Applied Materials-NUS Advanced Materials Corporate Lab. I am grateful for the opportunity to be part of a team focused on pioneering R&D in niche semiconductor areas, and to be involved in the projects from ideation, planning to execution.

After the traineeship, I decided to join Applied full-time due to its nurturing and inclusive culture where teammates help each other to learn, grow and advance. An extremely purpose-driven and fast-paced company, Applied also pushes the boundaries of science, technology, and engineering to build knowledge and create innovation.

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We worked with industry leaders from commercial, industrial and data centres to change their approach. It's time to work smarter, not harder.

## What improvements to expect?

Below are typical improvement figures given Singapore's good water quality and rigorous maintenace regime. For many sites, NEWater is used, which leads to less mineral-related issues, but more corrosion issues.

| SITE COOLING LOAD | IMPROVEMENTS | ANNUAL SAVINGS |
|---|---|---|
| **20,000 RT**<br>TYPICAL FAB IN SG<br>2,000 – 20,000 RT | **5-10%**<br>LESS ENERGY*<br>**80%**<br>LESS WATER DISPOSED | BY USING 5% LESS ENERGY<br>**~5,007,000 KWH**<br>($0.30/KWH)<br>**~78,070 $M^3$ WATER**<br>($1.28/$m^3$) |

* sites on NEWater typically see improvement nearer to lower bound

ROI : 1.13 years

### Reach out to us

I'm Wei Yang, Director at Deston. Finding the right way to tackle the root of problems is my passion.

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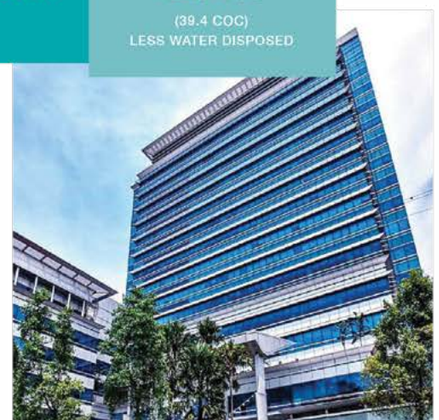
**The result of installing & testing our treatment system on a building already awarded *Green Mark Platinum..***

**7.1%**
LESS ENERGY
**81.4%**
(39.4 COC)
LESS WATER DISPOSED

A 14-month study was carried out as part of BCA's Super Low Energy Building challenge in 2018. The results speak for themselves and the project was featured in World Cities Summit, SG Green Issue 12.0 and The Straits Times.

Similar results were seen in our 3M, UOB, Pokka sites in Singapore.



Micron

# Delivering innovation through diversity

We firmly believe a workforce with diverse backgrounds, experiences, and perspectives — that is focused on inclusion, makes Micron a great place to work.

Interested in pursuing innovation in the semiconductor industry? Join Micron Singapore now.

**micron.com/careers**

# WELCOME TO WOODLANDS HEIGHT

*ASM officially opens state-of-the-art Singapore manufacturing facility and operations hub*


## ASM EXPANDS IN SINGAPORE TO MEET GLOBAL CUSTOMER DEMAND FOR ADVANCED SEMICONDUCTORS

**Woodlands Height**

In March 2022, ASM officially unveiled Woodlands Height, its state-of-the-art manufacturing facility and operations hub in Singapore. While the building was already completed in 2020, the official opening was postponed due to the worldwide pandemic. Even so, the facility has been thriving in the meantime – and ASM has now broken ground on a second manufacturing floor at the site, which is expected to be operational by early 2023.

The expansion is well-timed in light of the recent surge in demand for semiconductors, on the back of accelerating digital transformation. Spread across 38,000 square meters, the Woodlands Height facility brings together 850 people from 19 nationalities. ASM takes great pride in fostering an inclusive and diverse workforce where different ideas, opinions, and backgrounds are embraced and encouraged.

**Growth and Innovation**

Semiconductor technology has never been more essential to people's lives, and ASM is entering an exciting new era in the company's journey. With the second manufacturing floor at Woodlands Height, ASM's global capacity will more than triple.

As a leader in semiconductor technology, ASM is driving innovation in the international semiconductor manufacturing space, driving innovation in the electronics market, and improving people's lives.

As accelerated digitalization continues, ASM's advanced deposition tools, including ALD and Epi, are critical for producing leading-edge semiconductor devices, helping to meet the surge in demand for the technology used in everyday items from mobile phones to cars.

And with its unwavering dedication to innovation and excellence, it will continue to push the industry's boundaries in key technologies like ALD and epitaxy.

The new facility represents ASM's largest infrastructure investment in its history, a strategic investment designed to increase ASM's flexibility in meeting customer demand amidst global semiconductor shortages and global supply chain constraints. ASM President and Chief Executive Officer Benjamin Loh explains, "We aim to increase our ability to help our customers transition to the next technology nodes. Our investment in Singapore is an important step in that ambition and will consolidate our position as a technology leader in pursuing our 'Growth through Innovation' strategy."

**The Power of People**

Founded in 2003, ASM Singapore was the first semiconductor wafer processing equipment manufacturing facility in Singapore. Since then, the company has grown into ASM's main manufacturing and operations hub, boosted by Singapore's highly educated workforce, robust semiconductor ecosystem, and business-friendly climate.

The number of professionals working at ASM Singapore has more than doubled over the last five years, with about 60% of the workforce being Singaporean. The company is keen to offer its people long-term, exciting, and sustainable careers in various professional domains. Besides manufacturing, the company also fulfills key global functions in the ASM network, such as supply chain management, global IT, People, and leadership positions. ASM is proud to continue to develop its one-of-a-kind talent pool.

**A Sustainable Future**

Woodlands Height was built with ASM's people, customers, and the planet at its heart. Sustainability is an integral part of its global strategy, with priorities encompassing innovation, people, the planet, a responsible supply chain, and governance. Late last year, as part of its ambitious sustainability agenda, ASM announced its targets for net-zero emissions by 2035.

Woodlands Height embodies these sustainability ambitions. The energy-efficient building is Green Mark Gold Plus certified and has greenery incorporated into the design. In addition, the fixture and fittings are water-efficient, and sustainable building materials were used in its construction.

Alongside caring for the planet, ASM has been increasing its contributions to local communities. At Woodlands Height, employees are instrumental in driving forward activities and fundraising initiatives to support charities and causes in Singapore.

**"Our investment in Singapore is an important step...and will consolidate our position as a technology leader in pursuing our 'Growth through Innovation' strategy'"**

*Benjamin Loh, ASM CEO*

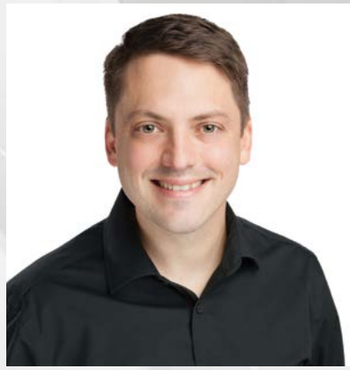
**Shaping the Future**

ASM is excited to see what leading-edge innovations and ideas it will develop and roll out in the coming years – at its ambitious Woodlands Height facility in Singapore and elsewhere at the company around the world.

To learn more about ASM and find out how you can join its journey, go to asm.com or linkedin.com/company/asm

# An Inflection Point for the Internet of Things

**Daniel Cooley is the Chief Technology Officer and Senior Vice President Technology and Product Development, at Silicon Labs. He is responsible for the company's overall research and development strategy and execution. Cooley is a respected IoT industry visionary and has been instrumental in building the unmatched breadth and depth of the company's wireless connectivity portfolio. Since 2005, Cooley has served in a variety of engineering and business leadership positions at Silicon Labs in the US, Asia and Europe.**



Four major trends will drive growth for the Internet of Things in 2022. **Daniel Cooley, CTO at Silicon Labs**, shares his thoughts on what to expect.

## THE INTERNET OF THINGS IS HERE

The Internet of Things has come into its own. The technology is mature and the IoT ecosystem is thriving. Even during these challenging times, the market holds tremendous opportunity for the semiconductor industry. By 2023, global microcontroller shipments are expected to reach 30 billion units and show no signs of slowing down.

**Silicon Labs** set its sights on the IoT more than a decade ago. We invested in the technology. We integrated like-minded customers into the innovation process. And we rallied an ecosystem around what we saw as the incredible potential of smart, connected devices.

Today, the IoT has arrived in Smart Homes and increasingly in Smart Cities. New, innovative commercial and industrial IoT applications are driving businesses forward. Industries from retail to healthcare, energy to manufacturing are embracing the value of IoT to improve productivity, sustainability, and safety of operations.

New technology trends are accelerating the use cases, and the global market for IoT end-user solutions is expanding.

## FOUR TRENDS FOR 2022 AND BEYOND

### 1) From isolated product to integrated lifecycle services

Companies have now finessed the product distribution process. With large-scale product deployments, the installed base is rapidly growing. Device makers and developers understand that long product lifecycle and great services are key to winning customers and maintaining this installed base.

They are moving away from the sale of isolated products to integrated product and service offering, which delivers continuous value while a product is in use. With the introduction of edge-to-cloud computing, IoT devices can continuously feed information about usage and condition back to the manufacturers, who can then utilize this data to deliver proactive maintenance and better product features. They are finally comfortable using insights, obtained post-deployment, to learn about the user and iterate product itself.

Device makers are adopting new ways to remotely and safely update devices in the field with the latest software and firmware. Over-the-Air programming allows manufacturers to push new software features and additional functionality out to an entire fleet of installed smart devices at once. But this calls for more advanced security services.

### 2) Advanced Security

Developers face a hard challenge driving innovation in IoT products for homes and mission-critical industries while securing them against ever-evolving cyberthreats. Trusted security hardware and software solutions are essential to their success.

Information Security teams seek to manage the device over its entire lifecycle. They want advanced security to the edge and to guarantee that the end-users' private data will be handled with integrity at all times. They want roots of trust, secure code running on devices and secure boot.

At Silicon Labs, we recognize the need to integrate cybersecurity by design. In September 2021, we launched our **Custom Part Manufacturing Service** (CPMS), which allows makers to customize their Silicon Labs hardware (wireless SoCs, modules, MCUs) at the factory. These essentially function as a root of trust for the chip (and any device that uses it), allowing customers to provision their chips securely themselves before the chips even leave the factory. This way, customers have a footprint they can track throughout the entire chip's journey.

The new services, which advocate the concept of 'trust nothing, verify everything,' provide robust authentication and verification processes - regardless of device location - to IoT products throughout their lifecycle. This offering stengthens our **Secure Vault™** technologies with additional first-of-its-kind custom injection of IoT device identity certificates. It prevents attackers from using connected products as network entry points. The offering also includes a dedicated long-term software development kit support service spanning up to 10 years of an IoT product's lifecycle.

### 3) ML is going to happen

Advancements in machine learning (ML) are opening the doors to a profound new future. There are many benefits to be extracted from ML on the edge. An ML algorithm can train a model, evaluate its own performance, and make predictions, which is very exciting. This is a world where ML applications can be run on miniature devices that are used for a life-easing applications – from predictive maintenance, building automation and the provision of audio analytics to vision and motion detection for autonomous operations.

To cater to this, Silicon Labs is addressing the challenge of running ML models on wireless SoCs. We're exploring applications where single chip solutions - that integrate ML and wireless connectivity - make the most sense. This will become a radical revolution for the IoT industry. In the next few years, it's going to change everything.

### 4) Industry consolidation

We saw many silicon players enter this market and now it will go into consolidation phase.

Growth momentum in the IoT and semiconductor space will do two things: On the one hand, it will see companies significantly growing in value. Conversely, it will cause other players to fall out of the game. When the revenues get big, the budgets get even bigger, and this prevents new entrants from gaining a foothold - unless they can afford to pay their way in. Many will seek to improve their margins through merger and acquisitions to benefit from the resultant economies of scale.

Niche won't win. IoT devices will not operate on one single protocol. The dominant players will have all the wireless options in their portfolio. At Silicon Labs, we spent the last decade putting ourselves in the position to support every wireless technology and with the recent release of **Unify Software Development Kit (SDK)**, we will become a vital translator too. Unify SDK allows IoT cloud and platform developers to design capabilities into their devices so that they can interoperate across current and future wireless protocols. This will help companies to scale smart home, city, building and industry ecosystems with confidence.

This upcoming year will mark an inflection point for silicon providers. The tech is mature, the market is ripe. Soon there won't be a single industry untouched by the virtues of IoT, edge, network tech – providing security remains top priority for all.

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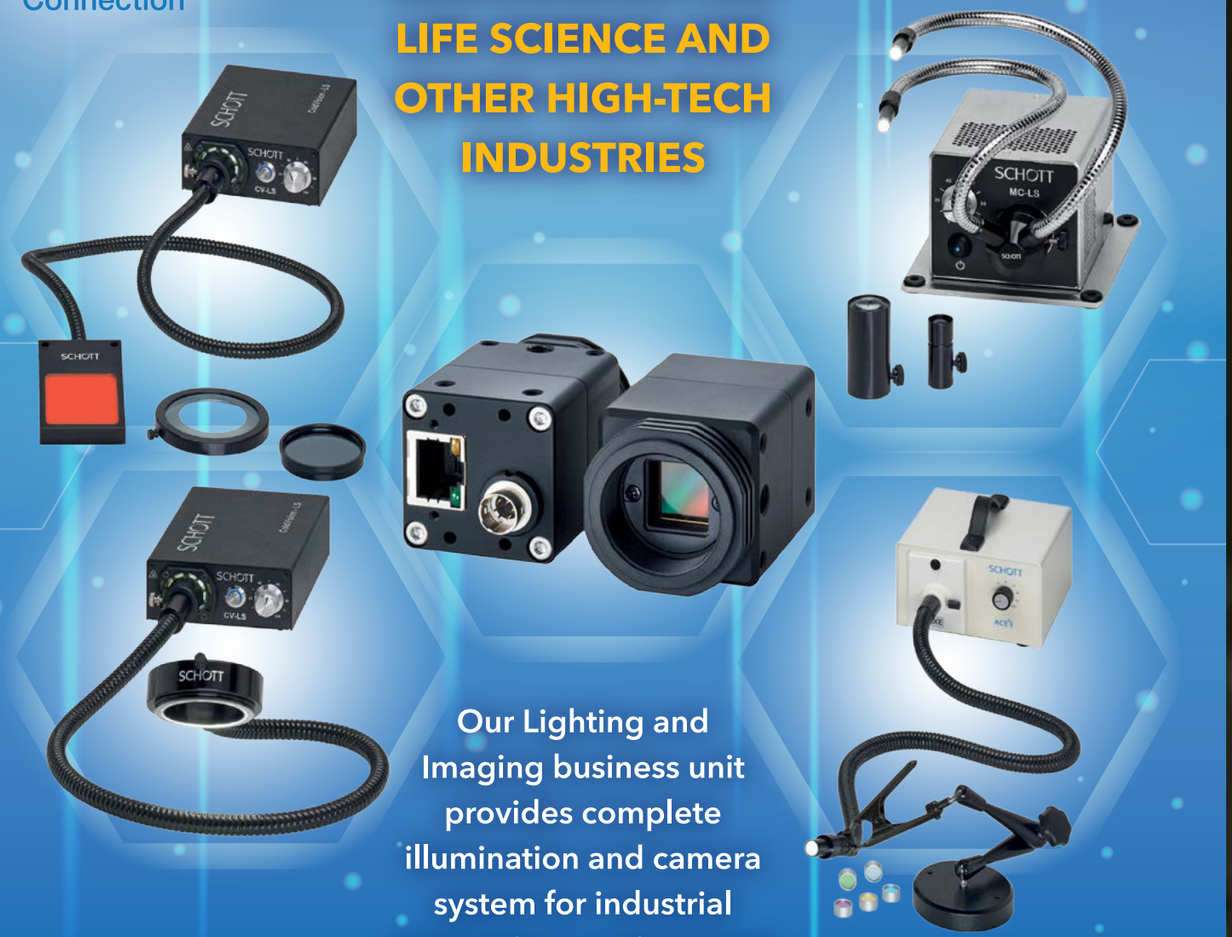


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# ENABLING THE ADVANCES OF TOMORROW

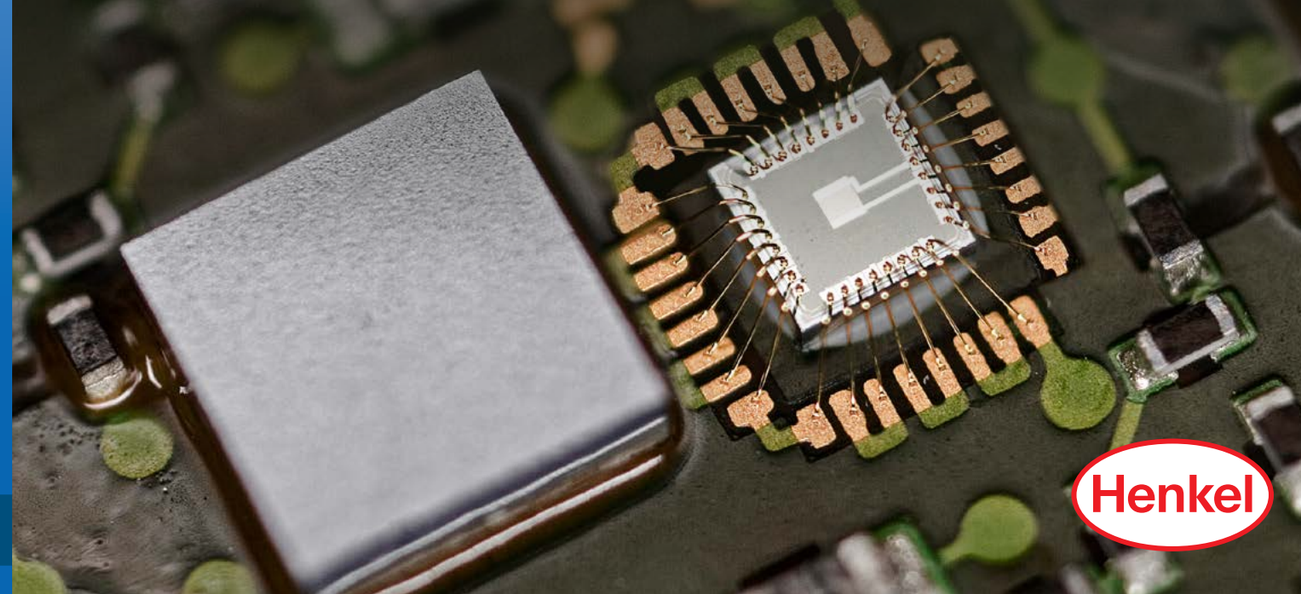
## Versatile Material Ideal for Power Package Applications

Henkel launches LOCTITE® ABLESTIK® ABP 8068TD, a high thermal die attach paste developed for use in applications where no die back-side metallization (BSM) is required, although can be used if desired. The adaptability of the material gives semiconductor companies a high thermal conductivity die attach option for bare silicon (Si) die integration and is particularly well-suited for high power applications.

LOCTITE ABLESTIK ABP 8068TD extends the benefits of pressure-less sintering to a wider variety of power packages using different types of die and lead frame finishes. The material has bulk thermal conductivity of 50 W/m-K equivalent to soft solder and was evaluated across several standard testing regimens with bare Si die and Ag-metallized die of various dimensions, up to 5.0 mm x 5.0 mm; as well as on copper (Cu), Ag and pre-plated (PPF) lead frame finishes.

LOCTITE ABLESTIK ABP 8068TD has achieve MSL 3 on most tested die finish/lead frame combinations, and MSL 1 for several Ag-BSM and bare Si die/lead frame pairings.

**SCAN QR CODE FOR MORE INFO**



Henkel

# How Standard Robots Accelerate Semiconductor Production

**The global trend of chip shortage is intensifying. How to rapidly increase production capacity has become a pressing problem for the semiconductor industry.**

As a manufacturer of industrial-grade mobile robots, Standard Robots supplies future-proof Industry 4.0 solutions for the semiconductor industry with perfectly matched hardware and software meeting the demand of networking capability and manufacturing flexibility.

In the following case, Standard Robots has helped a semiconductor company increase its production and expand its plants with a suite of solutions.

## PROJECT BACKGROUND

A Top 3 company in China's semiconductor industry wants to use AMR (Autonomous Mobile Robot) for wafer distribution in wafer depots, using manual wafer sorting and calling AMR with PAD to move the wafers across the factory after original sorting.

## PROJECT DIFFICULTIES

1. Wafers are extremely expensive and fragile, so jittering is prohibited during long distance handling of wafers.
2. AMR needs to move wafers across floors and locations, and needs to interface with elevators, automatic doors, and cargo showers.
3. The handling process needs to pass through an 800m long corridor with high difficulty in AMR positioning.

## SOLUTIONS

AMR: 34 units of Oasis 300UL-SRL (Submerged autonomous mobile robot with lifting rotation module)

Software: FMS dispatch system, central control system, Matrix system.

## PROJECT HIGHLIGHTS

In order to avoid the shaking of loaded wafers, Standard Robots customizes closed carts with shock absorbing springs to fully protect the delicate wafers.

Moreover, through the transformation of elevators, automatic doors, and cargo shower rooms, the wireless docking module is added to enable the AMR system to be wirelessly docked with the module to achieve the effect of automatic opening and closing.

Also, Standard Robots has upgraded its positioning algorithm with an environmentally adaptable positioning algorithm, making AMR capable of accurate positioning and stable transportation even in long corridors.

Wafer handling by AMR greatly reduces the labor lost, improves the efficiency of handling, solves the problem of difficulty in recruiting workers for the plant expansion, and achieves the purpose of automation upgrade and efficiency increase.

Standard Robots (Shenzhen) Co., Ltd. focuses on AMR (Autonomous Mobile Robot) R&D and manufacturing, applying broad and self-developed technologies including robot positioning algorithm, operation system and robot controller. Featuring less investment and quicker return, Standard Robots provides laser SLAM AMR to manufacturers worldwide to aid on both logistics automation and intelligent manufacturing.

*CONTRIBUTED BY*

Standard Robots

Contact Us
overseas@standard-robots.com

# A*STAR Collaborates with Local Start-Up I.O.T. Workz to Develop Wirelessly Powered Localisation System for Asset Tracking

**The Agency for Science, Technology and Research (A*STAR) and local start-up I.O.T. Workz Pte. Ltd (I.O.T. Workz) is pleased to announce a joint collaboration to develop and productise an asset tracking and localisation system that can be adopted for indoor and outdoor applications based on a sensor network that is being powered wirelessly.**

Founded and based in Singapore, I.O.T. Workz is a multi-dimensional Internet-of-Things (IoT) smart solutions provider and the company has licensed A*STAR's wirelessly powered localisation system for asset tracking to create various practical applications. Combining A*STAR's research capabilities and expertise in user interface application development with I.O.T. Workz's strengths in solutions integration, both parties have jointly developed an asset tracking system that can automatically track the physical location of hospitals' wheelchairs, which typically range in the hundreds per hospital.

This asset tracking system has been tested and subsequently deployed on 150 wheelchairs at Khoo Teck Puat Hospital (KTPH) since April 2021, across common areas such as wheelchair parking zones, carpark lobbies as well as wheelchair parks outside Specialist Outpatient Clinics. Wireless tags are attached as beacons on the wheelchairs, and the tags send location information to network devices installed in strategic positions within the hospital.

(Photo Credit: Khoo Teck Puat Hospital) Battery-powered wireless tag device installed on 150 wheelchairs at Khoo Teck Puat Hospital, with location information routinely sent to a nearby router beacon for real-time location tracking.

The data is then presented on a mobile application, and hospital staff such as Patient Service Associates (PSA) can easily monitor and track the location of wheelchairs. They are notified when the number of wheelchairs at designated key areas are running low and need replenishing, as well as which areas they can find excess wheelchairs. This has improved staff productivity and helps ensure the constant availability of wheelchairs for patients.

The application's intuitive digital dashboard is easy to use and shows which wheelchairs are due for servicing at a glance, which further enhances the overall productivity and safety of the hospital's wheelchairs.

This project was funded by the Electronics and Sensor Productisation Laboratory (ESPL), a Gap Funded initiative by A*STAR, where funding and resources are given to support the translation of research into impactful new products and services that benefit the economy and society and to support the commercialisation of new technologies based on licensed A*STAR technologies. Besides tracking wheelchairs in hospitals, other potential applications of the wirelessly powered localisation system include industrial IoT, smart buildings and environmental monitoring.





## THE TECHNOLOGY BEHIND THE WIRELESSLY POWERED LOCALISATION SYSTEM FOR ASSET TRACKING

The asset tracking system includes a Radio Frequency (RF) energy-harvesting interface to recharge the battery, a power management unit, and ZigBee System-on-a-Chip (SoC) to support data connectivity.

A*STAR's Institute of Microelectronics (IME) created a miniaturised antenna solution for Radio Frequency (RF) energy harvesting with higher sensitivity than commercially available solutions. By applying the RF energy harvesting capability to the sensor nodes or end terminals, the system aids to extend the battery lifetime and improve operational efficiency. This is complemented by ZigBee networking protocols and firmware from A*STAR's Institute for Infocomm Research ($I^2R$).

The asset tracking system leverages this differentiating technology with Zigbee Mesh Topology to provide coarse localisation of over 300 existing wheelchairs in KTPH's premises, further enhancing the engineering to provide long-range transmission. Since the end-to-end solution relies on both hardware and software, these capabilities work synergistically for power-efficient operation, providing a wireless-powered solution for asset tracking and monitoring, including predictive maintenance. With this advancement, end users can expect to power the system for a longer duration and attain greater cost-effectiveness. Such systems are useful for applications where human intervention is limited, such as in chemical plants.

"IME, alongside other A*STAR research entities, works with local SMEs to address industry challenges by leveraging innovative technologies. This wireless-powered sensor technology will aid the adoption of IoT across various sectors such as machine health monitoring in heavy industries, microclimate sensing in agriculture, smart home solutions, and in manufacturing plants where limited human access is preferred due to hazardous conditions," said Mr. Terence Gan, Executive Director of A*STAR's IME.

"Together with A*STAR, supported by KTPH and the interns of Singapore Polytechnic, we are the first to provide localization trackers with over-the-air wireless charging. The sensor network we have developed is further extendable to cover all areas in the hospital to achieve active tracking and monitoring of wheelchairs that will improve the productivity and safety of these hospital assets that are used by patients on a daily basis. Our collaboration with A*STAR has enhanced our service offerings, allowing us to target new market segments and create new opportunities for us to partner local manufacturers to develop new solutions. We look forward to further develop our long-term working relationship with A*STAR to further add value to the technology and manufacturing ecosystem in Singapore", said Mr Shawn Koh, Founder of I.O.T. Workz.

"At KTPH, we are always looking for opportunities to improve our patients' experience through engineering innovation. A large majority of our patients require wheelchairs to move around KTPH. Wheelchairs are parked at multiple locations for our patients' convenience and will need regular maintenance.

(Photo Credit: A*STAR) Interior of a wireless tag device, which transmits wheelchair location and battery status information to a coordinator via ZigBee wireless technology.

Previously, our staff may have to spend more than 30 minutes scouring for 'lost' wheelchairs, but now their real time location is available. This enables our Patient Relations Associates and maintenance colleagues to top up wheelchairs where needed, and to bring in any wheelchairs for timely maintenance.  The time saved can now be used to care for patients," said Ms Yen Tan, Chief Operating Officer of KTPH.

"Given the success of implementation, this system could be scaled to track other high movement equipment. We are also exploring areas like recording temperature data, monitoring lighting conditions or controlling external devices. By leveraging on modern technology to provide innovative solutions, we can improve the efficiency and productivity of our hospital's overall operations and processes."

*CONTRIBUTED BY*

Institute of Microelectronics
IME

# SEMICONDUCTOR TRADEWINDS MARCH – APRIL 2022

**We have already completed the first quarter of 2022, and so far, 2022 is continuing on the same trajectory as 2021 left off, with the semiconductor industry reaching new heights and continuing to grow.**

## Q1 RESULTS

SIA reported that February set a new record for global semiconductor industry sales, the 11th consecutive month of year-on-year growth. Sales reached US$52.5billion in February up 34% compared to February 2021.

Taiwan's Wafer Foundry manufacturers had another record quarter in Q1, TSMC reported record Q1 revenue of almost US$17billion, up 33% yoy, whilst UMC and VIS also both reported record quarters in Q1, with revenue up 35% and 47% respectively driven by both demand and ASP increases.

It was a similar story in the backend as OSAT's also reported another very strong quarter. ASE Technologies ATM group which includes both ASE and SPIL OSAT's reported revenue of US$3billion, up almost 16% compared to the same period a year ago.

## MARKET OPTIMISM CONTINUES

Looking ahead, SIA is predicting that global chip sales will increase almost 9% this year to exceed US$600billion. The foundry market is expected to grow 20% in 2022 according to IC Insights with leading foundry TSMC predicting it will outgrow the segment. A survey of semiconductor executives by KPMG shows industry confidence is high with over 95% expecting their company revenue to grow this year and over half of the respondents expecting the chip shortage to last into 2023. With wireless communications and automotive segments being the leading revenue drivers, and sensors/MEMs representing the greatest product growth opportunity.

Over the last 40 years, electronics and semiconductor devices have become an integral part of our lives with electronic devices now being used in almost every aspect of our daily lives. To support this demand there has been a phenomenal growth in terms of IC unit shipments in the semiconductor industry over the years. According to data from IC Insights, worldwide IC shipments were just 9.8billion in 1980, this has grown by a massive 44x over the last 40 years and shipments are forecast to reach a whooping 428billion units in 2022.

## CAPACITY EXPANSION CONTINUES

As companies race to increase capacity to support the semiconductor demand, global Fab capital expenditure is expected to increase 24% to over US$190billion in 2022 according to IC Insights with TSMC leading the expenditure followed by Intel.

Intel announced its plans to invest US$36billion in Europe with Germany being selected to build 2 new leading edge "Mega" Fabs at a cost of US$19billion. Intel will also invest in new R&D and design hub in France and in R&D, manufacturing and foundry services in Ireland, Italy, Poland, and Spain, with potentially a new US$5billion back-end manufacturing facility in Italy.

Memory manufacturer Kioxia announced it will build a new 2nd Fab at its site in Iwate, Japan, with the groundbreaking ceremony held in April.

Wafer substrate manufacturer GlobalWafers has announced it will build a new 300mm wafer manufacturing facility in Italy with operations expected to start in 2nd half of 2023. Whilst SK Siltron announced it will expand its 300mm wafer manufacturing facilities in Gumi, South Korea and Soitec announced it will build a new SiC wafer manufacturing facility at Bernin in France.

Locally, equipment manufacturer ASM officially opened its new manufacturing facility in Singapore, and announced the groundbreaking of a new 2nd manufacturing floor at the site.

To encourage US manufacturing, the US Congress is slowly inching towards to approving the US$52billion in funds to subsidize US based semiconductor manufacturing. Whilst both US House and Senates have approved versions of CHIPS act to release US$52billion in funding the differences still need to be reconciled before the act can be passed into law. In addition, a complimentary act the FABS Act was introduced into Congress which provides investment tax credits for setting up US based semiconductor manufacturing, design, and research

## CAUTIOUS OUTLOOK

Whilst overall the market looks very healthy and wafer capacity remains fully booked, recently there have been some slight signs of localized weakness in some certain sectors of the market, specifically consumer electronics, personal computing and Chinese smartphone markets. These markets together with the weakening stay-at-home economy, the pandemic in China, international tensions, and rising inflation in 1H22 will need to be carefully watched in the coming months.

As we move into the 2nd Quarter of 2022, we have seen that the first quarter of 2022 continued the same upward trajectory from 2021 with extraordinary growth seen in the IC manufacturing and associated equipment, wafer and materials markets. To support this phenomenal demand for IC's, more and more capacity is being planned by manufacturers. For now, capacity remains tight and lead-times long and it seems this trend will continue for the time being but keep your eye on the weather forecast in case sentiment changes.

*CONTRIBUTED BY*

**MARK DYSON**
Foundry Account Director
ams OSRAM

"Having been in the aviation industry for 8 years, I was intrigued by the semiconductor industry's growth. I wanted to take charge of my career by exploring the opportunity through WSG's Career Conversion Programmes. The on-boarding training and the assistance provided by my team members helped me gain in-depth understanding of my new role during my transition."

**Cheng Kim Ann**
Manufacturing and Equipment Engineer
Micron Technology

# Journey of Growth through Workforce Singapore's Career Conversion Programme

**Workforce Singapore's (WSG) Career Conversion Programme (CCP) seeks to reskill and equip Singaporeans and Singapore Permanent Residents with new capabilities to take on jobs in growth areas or redesigned roles**

An interview with Cheng Kim Ann, Manufacturing and Equipment Engineer from Micron Semiconductor Technology.

Kim Ann joined Micron since 2020, through the CCP for Electronics Engineers / Assistant Engineer. He was previously working as an Airforce Engineer with the Republic of Singapore Air Force (RSAF), mainly working on F-15 engine maintenance.

**Why did you decide to make a career switch?**

I took up a part-time Degree during my time with the RSAF. Upon graduation, I was exploring opportunities outside the aviation industry. I wanted to take charge of my career and grow professionally in an industry that excites me. Unfortunately, the aviation industry took a bad hit during the pandemic and was not hiring. Seeing that the semiconductor industry was growing, I wanted to explore that opportunity and be part of the growth.

**Why the semiconductor industry?**

The semiconductor industry is growing and rapidly advancing with the development of technologies powering up our different devices. I wanted to be part of this growth. Besides, I also found that the roles and job openings in were relevant to my engineering background and previous experience in equipment maintenance.

**Any challenges faced during the switch and how did you overcome?**

The aviation and semiconductor industries are quite different, and everything was new to me. However, through the CCP for Electronics, I was able to leverage on my transferable skills from my previous experience in equipment maintenance, and equip myself with the necessary skills to start a new career in a new industry and transit into my new role quickly.

The six-month structured training programme comprised of classroom training and On-the-Job Training (OJT). The first two months of on-board training was the most useful as it helped me learn the basics of the industry and the company, and understand and assimilate into Micron's culture, such as having a growth mindset. On the other hand, the subsequent technical training and OJT provided me with more in-depth knowledge and skills to prepare me for my new role. I managed to learn from scratch with good mentorship and guidance from my team members and managers.

**Are your family members supportive when you told them you wanted a switch?**

Definitely! My family was supportive of me trying something new and joining a new industry. I am glad that I made this switch because I can see that Micron is really a great place to work at and support my career growth.

*CONTRIBUTED BY*

Micron Wsg Workforce Singapore

# Being customer-centric means first investing in our people culture

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From a contract manufacturing company to a global leader in test innovation, AEM is transforming the test industry by providing comprehensive and best-in-class technologies in test and handling solutions for semiconductor and electronics companies worldwide.

Established in Singapore in 1992, AEM has played a notable role in contributing to Singapore's manufacturing and innovation capabilities in the semiconductor industry.

Customer success, engineering, innovation, and teamwork are at the heart of our company.

A unified business organization means investing in our people first and cultivating relationships with all our stakeholders and communities. Talent is one of the greatest assets a company can have. At AEM, customer success, engineering, innovation, and teamwork are at the heart of our company.

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"There are always opportunities to hone and grow different skills – technical and soft skills – with our learning and development team constantly providing workshops and programmes. I've learnt a great deal of new skills and technology that I've been able to bring into new products.

The innovative culture of the company allows us to try new things. We are empowered to challenge the status quo with leaders who will motivate and encourage us, and our customers that are willing to take a chance on us."

**Arun Kumar**
Staff Electrical Engineer

"The innovative entrepreneurship spirit of the company opens many doors for me to hone and grow myself. I was fortunate to have the opportunity to visit the company headquarters in Singapore and take part in a month-long training. It was a great experience where I learned from colleagues from different teams and specialties, who were all helpful and supportive throughout the experience."

**Richard Chiu**
Senior Field Application Engineer

"When an issue surfaced with just three days before the project deadline, the project leads took this challenge in stride. Together with the leads, we pushed our sleeves up and worked on solving the problem together – even when it took extra time and effort. This experience showed me that with resilience and perseverance, anything could be possible."

**Foo Jia Lim**
Software Engineer

"I've been with the company for more than 15 years, and it feels like I've grown with the company. The industry continues to change rapidly, but with the internal courses organised for us, I've been able to stay relevant and keep up with the latest industry developments. By upskilling, I believe my team members and I can bring AEM to the next level of service excellence."

**Raymundo Daniel**
Quality Assurance Manager

"I've had the opportunity to work with team members from various functions and across our offices worldwide. AEM has a Learning Organisation culture, and everyone is open to sharing their knowledge. Despite being new to the company, I've been able to learn about the business quickly. This allows me to delivery meaningful and impactful contributions."

**Christine Fu**
Communications Specialist