
## Smart and Green Manufacturing Summit

### Welcome Remarks

L. Altimime
President
SEMI Europe, Berlin, Germany

**Abstract**
Welcome Note

**Biography**
As President of SEMI Europe, Laith Altimime leads SEMI's activities in Europe and the Middle East and Africa (EMEA). Altimime has P&L responsibility as well as ownership of all Europe region programs and events, including SEMICON Europa. He is responsible for establishing industry Standards, advocacy, community development, expositions, and programs. He provides support and services to SEMI members worldwide that have supply chain interests in Europe. He manages and nurtures relationships with SEMI members in the region and globally as well as with local associations and constituents in industry, government, and academia.
Altimime has more than 30 years of international experience in the semiconductor industry. Prior to joining SEMI in 2015, He held senior leadership positions at NEC, KLA-Tencor, Infineon, Qimonda and imec. Altimime holds an MSc from Heriot-Watt University, Scotland.

## Sustainability – Quo Vadis? The Journey to Sustainability

A. Curioni
IBM Fellow, Vice President Europe and Africa and
Director IBM Research - Zurich
IBM Zurich, Zurich, Switzerland

**Abstract**
The world hasn't run out of problems to solve. And today, the urgency of science is an indispensable tool to help solve pressing global problems - including mitigation and adaptation to the climate crisis and addressing sustainability as a whole. Only with the help of science and cutting-edge technology such as AI, quantum computing and hybrid cloud we can boost the pace of game-changing scientific discoveries to make our planet more sustainable - and fuel profound social impact and business transformation across industries. That includes technologies like AI-powered Deep Search for faster ingestion, structuring and reasoning on a growing corpus of scientific literature; quantum- and AI-enriched simulations, generative models for more efficient hypothesis generation, and faster experimentation with cloud-based AI-driven autonomous labs. Harnessing those technologies in a smart way will allow us to address needs in crucial domains such as sustainable semiconductor manufacturing, sustainable AI, drug development, and carbon capture to fight climate change.

**Biography**
Dr. Alessandro Curioni is an IBM Fellow, Vice President of IBM Europe and Africa and Director of the IBM Research Lab in Zurich, Switzerland. On top of being responsible for IBM corporate research in Europe, he leads global research in Security and the Future of Computing.
Dr. Curioni is an internationally recognized leader in the area of high-performance computing and computational science, where his innovative thinking and seminal contributions have helped solve some of the most complex scientific and technological problems in healthcare, aerospace, consumer goods and electronics. He was a member of the winning team recognized with the prestigious Gordon Bell Prize in 2013 and 2015. His reserch interests now include AI, Big Data and novel compute paradigms, such as neuromorphic and quantum computing.

Dr. Curioni received his undergraduate degree in Theoretical Chemistry and his PhD from Scuola Normale Superiore, Pisa, Italy. He started at IBM Research – Zurich as a PhD student in 1993 before officially joining as a research staff member in 1998, where he had several research and manager roles, including being the founding manager of the Cognitive Computing and Computational Sciences department. He is a member of the Swiss Academy of Technical Sciences

**Net-Zero: A Call to Action for the Semiconductor Industry**

A. Mohr
Managing Attorney, Business, Regulatory and Sustainability Legal (Europe, Middle East and Africa)
Intel Germany GmbH & Co. KG, Munich, Germany

**Abstract**
Intel will share its commitment and progress toward net-zero greenhouse gases (GHGs) and outline the key challenges ahead for the semiconductor industry and opportunities to work together toward a net-zero future.

**Biography**
Anneclaire is a senior attorney providing legal support in the fields of product regulations, environmental laws and sustainability in EMEA. She joined Intel in 1997 and focused in the last ten years primarily on product regulatory and environmental legislation, as well as, more recently, emerging sustainability legislation closely related to ESG disclosure, reporting and responsible business conduct. Anneclaire studied law at the Robert Schuman Law University of Strasbourg, France, and graduated from the Institute of Political Studies of the Robert Schuman University, Strasbourg.

## Session chair

S. Raithel
COO Gas Treatment and General Manager US
DAS Environmental Experts GmbH, Dresden, Germany

**Abstract**
Session chair

**Biography**
Stephan Raithel joined DAS in 2016 and since then holds the position of the COO Gas Treatment. In his position he is overseeing all aspects of DAS' gas treatment products, such as development, engineering, product management, procurement, customer care and production. In parallel he also acts as General Manager for the US subsidiary.
From 2007 until 2016 he was working for SEMI, the global semiconductor equipment and materials association, where he held various positions within the association – from operations management, SEMI standards and PV Roadmap program to the role of the Managing Director of SEMI Europe.
Before his start in the semiconductor industry, he was employed as a project manager in the financial ,creative services and consumer goods industry.

**Technology that makes Technology Sustainable**

C. H. Seo
Corporate Vice President DS Corporate Sustainability Management Office
Samsung Electronics, Seoul, Republic of Korea (South Korea)

**Abstract**
Semiconductor continues to develop innovative core technologies and responsibly address the challenges we face in our environment today. It is through technology, we strive to minimize our impact on nature. As industry's global leader, we communicate with our stakeholders across the supply chain to build an eco-friendly value chain. From sustainable productions to providing low power technologies, Samsung Semiconductor actively participates and creates standards for our industry to act under one purpose. At Smart and Green Manufacturing Summit we share our eco-conscious efforts thus far as well as our environmental goals toward a sustainable future.

**Biography**
Claire HyunJung Seo, is Corporate Vice President at Samsung Electronics DS Division, Corporate Sustainability Management Office and leads corporate sustainability and ESG integration for the Division. Claire's expertise is in responsible investment and sustainability consulting and brings more than 20 years of experience from the field, mainly based in Asia and US.

## A Holistic Approach to Building a Sustainable Semiconductor Business

M. Bhat
VP Sustainability Programs
SEMI, Milpitas, United States of America

**Abstract**
Building a sustainable bisiness is more than Environmental Stewardship. It is about addressing the three Ps - Planet, People and Profit and it is about delivering to a company's triple Bottom Line. The triple bottom line is a business concept that posits firms should commit to measuring their social and environmental impact—in addition to their financial performance—rather than solely focusing on generating profit, or the standard "bottom line."

This discussion does a deep dive on how best to address all dimensions of sustainability with a semiconductor value chain

**Biography**
Dr. Bhat is a Semiconductor Expert who has held senior positions within the semiconductor industry in Frontend operations, Assembly and Test, Quality and customer and supplier management at corporations such as Micron, GlobalFoundries, Motorola and Texas Instruments. During her career she has lead Transversal, cross functional and multicultural teams across Asia, EU and US

She is passionate about creating sustainable business practices and uses her experience in creating an ecosystem of changemakers to accelerate social, environmental and economic parity by leveraging technological innovations. She serves as VP of Sustainability Programs at SEMI

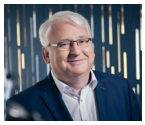
## Collaboration - The Challenge to Reduce Emissions during a Period of Growth

C. Jones
Environmental Solutions Business Development Manager
Edwards Vacuum, Burgess Hill, United Kingdom

**Abstract**
A credible reduction in both direct and indirect, specifically energy-related, greenhouse gas emissions is needed to meet the global warming goals outlined by the Paris Agreement. This is one of the many environmental sustainability challenges the semiconductor industry must face. This reduction must be achieved during a period of substantial growth for our industry and must be met by innovation and unprecedented collaboration.
We will describe the scale of the challenge, the specific issues that need to be overcome, and outline some approaches to halve our emissions on a decadal basis, whilst the industry expects to double in size by 2030. We all must understand the magnitude of the challenge.

**Biography**
Christopher Jones is a PhD-qualified chemist with more than 30 years of experience in the environmental protection arena. He has designed and implemented processes to manage wastes generated by the semiconductor, nuclear, military, and pharmaceutical industries and developed analytical methods for air and water quality monitoring. He is the Environmental Solutions Business Development Manager at Edwards. He aims to help owners of fabs better understand the local and broader environmental sustainability implications associated with the operation of their facilities.

**The Road To A Zero-Emission Subfab**



G. Davies
Director Business Development Global
DAS Environmental Expert GmbH, Dresden, Germany

DAS Environmental Experts.

**Abstract**
The semiconductor industry has made a rather mixed response to the carbon neutral requirements as demanded by our current climate challenges. Semiconductor companies have relative conservatively committed to carbon neutrality by 2050 while others have been much more aggressive in their timelines. The subfab and its associated equipment has a considerable impact on the overall eCO2 emissions. This short presentation will discuss the opportunities, potentials and challenges to a carbon neutral footprint particularly focusing on the abatement requirements in the subfab and the interactions with the surrounding equipment.

**Biography**
**Dr. Guy Davies**
**Director Business Development Global**

Dr. Guy Davies is Director Business Development Global and member of the management board of DAS Environmental Expert GmbH. He joined DAS in 2011 and since then is focussed on the company's strategies for product development, innovation management and internationalisation.

Prior to his employment with DAS he had 6 years experience working in Semiconductor Manufacturing at Qimonda. Between 1994 and 2003 he worked for ASML, a leading semiconductor equipment manufacturer in a variety of roles worldwide including Research and Development, Customer Support and Strategic Marketing. He completed his Doctorate in optical metrology in 1995 at the University of Edinburgh, a Masters degree at the University of Durham in 1990 and his undergraduate degree in Applied Physics and Electronics in 1989 at Lancaster University.

**The Environmental Footprint of Si Chip Manufacturing**

C. Rolin
Program Manager
Imec, Compute and Memory Technologies,
Leuven, Belgium

**Abstract**
The climate crisis calls for urgent actions towards sustainability as an integral component of businesses and regulations. With its large and growing environmental footprint, the Information and Communication Technology sector is arguably a large part of the problem, but also a part of the solution. Fabrication of integrated circuits is an energy and resource intensive process and the drive towards higher performance and increased functionality increases the process complexity dramatically from node to node. Traditionally, the improvement between technology nodes is evaluated using Power, Performance, Area and Cost (PPAC) metrics in a Design Technology Co-Optimization (DTCO) completely neglecting sustainability. However, this established framework provides an opportunity to do early sustainability assessments of future technologies all the way from material sourcing and fabrication to end of life. To demonstrate this approach, we evaluate the environmental impact, more specifically the energy, ultra-pure water (UPW) and mineral consumption as well as the greenhouse gas (GHG) emissions from manufacturing logic, DRAM and NAND technologies from past to future nodes. Our analysis of logic scaling reveals how the environmental metrics normalized per transistor evolve along with improvements in performance and reduction in cell area.

**Biography**
**Cédric Rolin** is Manager for the Sustainable Semiconductor Technologies and Systems (SSTS) Program at imec. He received his M.S. degree and his PhD degree in materials science from the Université Catholique de Louvain in 2004 and 2009 respectively. During the first 13 years of his career (including 2 years postdoc at University of Michigan), Cedric grew his expertise in the thin film growth and manufacturing of devices based on organic semiconductors. Then, from 2018 to 2021, he led a R&D team developing solutions to move flexible thin film circuit and display technologies from the Lab to the Fab. Part of this effort focused on the upscaling of the nanoimprint lithography patterning technology to a 300mm Fab tool. Since November 2021, Cédric has joined the sustainability effort of imec as Program Manager, focusing on the assessment and improvement of the environmental footprint of the semiconductor manufacturing industry.

**Beyond ESG: How can we Maximise the Impact of our Actions Using Integrated Approaches to Enhance and Amplify Action to Achieve the Sustainable Development Goals**

E. Michalopoulou
Research Associate
Stockholm Environment Institute, York, United Kingdom

**Abstract**
Coming Soon

**Biography**
Dr Eleni Michalopoulou joined Stockholm Environment Institute's York Centre in 2020 as a member of the Air Pollution group where she contributes to Climate and Clean Air Coalition (CCAC) projects and the Supporting National Action and Planning (SNAP) on Short-Lived Climate Pollutants (SLCPs) initiative. She is a member of the World Economic Forum's Global Future Council on Clean Air and she is working with the Alliance for Clean Air on quantifying air pollutant emissions in value chains. She is a co-author in the IPCC's 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories working closely with the aluminium, semiconductor and gas abatement industries. Eleni completed her undergraduate studies in the National and Kapodistrian University of Athens where she received a degree on Physics with a major on Environment, Meteorology and Oceanography. In 2019, she completed her PhD on 'Quantifying perfluorocarbon emissions using bottom-up and top-down methods' with the Department of Chemistry of the University of Bristol.

**Electricity 4.0 : Towards a World More Digital and More Electric**

D. Gheno
Chief Technology Officer of Energy Management Business
Schneider Electric, Dresden, Germany

**Abstract**
Comign soon

**Biography**
Daniel has been spending 27 years in the energy management world, accumulating a rich experience from motor management to electrical distribution, with his career split between 14 years in the R&D and industrial domains and 12 years focusing on global offer management. Throughout his journey at Schneider Electric, Daniel spent 3 years in Japan being part of the first joint-venture between Schneider Electric and Toshiba for low voltage variable speed drives. From 2009 he also spent 4 years in India managing Schneider Electric Global Technology Center in Bangalore. Daniel holds a Master of Science and an Engineering Degree in mechatronics.

Until September 2021, Daniel has been leading the Medium Voltage Switchgear line of business of Schneider Electric. Since 2021, Daniel is the Chief Technology Officer of the Energy Management Business, driving the innovation and technology dynamic across our various businesses to tackle our key challenges : sustainability, resilience and talents.

Married and father of 2 sons, Daniel is currently living in Grenoble (in the French Alps) and is keen on cycling and military history of the 20th century.

**Green ICT**

N. Nissen
Head of Department
Fraunhofer Institute for Reliability and
Microintegration IZM, Dresden, Germany

**Abstract**
The presentation will cover production aspects of Green ICT in the context of a new competence center launched this year in Germany. The focus will be on the relative and absolute relevance of production in a product lifecycle perspective. Decarbonisation and climate neutrality of the example product types require much more than reducing energy consumption and buying green energy, as the embedded carbon footprint from semiconductor processes and component manufacturing is dominant in these environmental lifecycle profiles. This means changes to processes and technologies that we use in future electronics.

**Biography**
Dr. Nils F. Nissen is head of the department Environmental and Reliability Engineering at the Fraunhofer Institute for Reliability and Microintegration (IZM) in Berlin, Germany.
The Environmental and Reliability Engineering department of this microelectronics institute is supporting technology development by integrating environmental and reliability aspects right from the start. This means dealing with all environmental facets of new electronic technologies, from eliminating toxic substances to improving the recycling of products, from screening the latest process technologies in electronics to the ecodesign and environmental assessment of products and systems.
He is the Technical Chair of the Electronics Goes Green conference series, taking place every four years in Berlin.

**Green ICT – Plasma Process Alternatives to Substitute PFCs, $SF_6$ and $NF_3$**

R. Wieland
Project Manager, Fraunhofer EMFT, Division Silicon Technologies and Devices
Fraunhofer Research Institution for Modular Solid State Technologies EMFT, Dresden, Germany

**Abstract**
The Green ICTatFMD Project, funded by the BMBF in Germany, provides new approaches for green and environmental-friendly semiconductor manufacturing methods in order to minimize the current carbon foot print.
This talk focuses on dry-etching- and cleaning processes to reduce or avoid the exhaust of waste gases and to lower the waste water amount in semiconductor fabrication. An insight to the status of achievements with the new Fluorine-based chemistry is given as well as an outlook to future possibilities for environmental-friendly DRIE and PECVD processes.

**Biography**
Robert Wieland is responsible for the CMOS -cleanroom operations at Fraunhofer EMFT in Munich since 2018. In 2010 he started developing environmental-friendly, Fluorine-based plasma processes, focusing on PECVD-cleaning, together with the Solvay AG. Managing the development part of the successful “ecoFluor” project, funded by the BMBF, resulted in the nomination for the “German environmental price 2019”. He has several patents in the area of fluorine-based applications. He holds an diploma in physical engineering and started his career 1985 at Applied Materials in USA, responsible for plasma-etching and PECVD processes. He joined Fraunhofer in 1996, where he developed 3D-integration technologies and CMOS technologies for MEMS-based sensor devices.

M. Bhat
VP Sustainability Programs
SEMI, Milpitas, United States of America

**Biography**
Dr. Bhat is a Semiconductor Expert who has held senior positions within the semiconductor industry in Frontend operations, Assembly and Test, Quality and customer and supplier management at corporations such as Micron, GlobalFoundries, Motorola and Texas Instruments. During her career she has lead Transversal, cross functional and multicultural teams across Asia, EU and US

She is passionate about creating sustainable business practices and uses her experience in creating an ecosystem of changemakers to accelerate social, environmental and economic parity by leveraging technological innovations. She serves as VP of Sustainability Programs at SEMI

## Green AI: Reducing the Environmental Cost of AI

J. Kelleher
Professor
TU Dublin, Dublin, Ireland

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**Abstract**
Artificial Intelligence (AI) has become a pervasive technology in modern societies. Naturally, this has raised questions regarding the ethical use of AI. However, a relatively under-studied aspect of modern AI is the relationship between AI and the environment. Used correctly AI has the potential to help our societies become more environmentally sustainable. At the same time the lifecycle of AI systems, and in particular the development and deployment of large Deep Learning models, has a direct environmental cost. In this talk, I will highlight the environmental cost of modern AI and describe some of the ongoing research that is attempting to make AI more environmentally sustainable.

**Biography**
Prof. John D. Kelleher
Technological University Dublin, Ireland.
Prof. John Kelleher is the academic leader of TU Dublin's Information, Communication, and Entertainment (ICE) research institute. He is the TU Dublin lead for the Science Foundation Ireland funded ADAPT research centre (https://www.adaptcentre.ie) and PhD Centre for Research Training in Digitally Enhanced Reality (https://d-real.ie), and the H2020 project PRECISE4Q which focuses on using Artificial Intelligence to develop clinical decision support systems for the treatment of stroke (https://precise4q.eu). He has published three books on Machine Learning: Deep Learning (https://mitpress.mit.edu/books/deep-learning-1), Data Science (https://mitpress.mit.edu/books/data-science), and Fundamentals of Machine Learning for Predictive Data Analytics (https://mitpress.mit.edu/books/fundamentals-machine-learning-predictive-data-analytics-second-edition)

**Driving Efficiency of Energy and Emission-intensive Fabrication Processes with the Next-Generation Optimization-Based Platform**

J. Potter
Co-founder and CEO
Flexciton Ltd, London, United Kingdom

**Abstract**
coming soon

**Biography**
Jamie is an expert in mathematics and statistics and a top-of-year graduate from the University of Oxford. He is passionate about solving the hardest industrial problems. After working for several years in a consultancy, developing optimization solutions for industrial applications, Jamie co-founded Flexciton in 2016. In addition to his role as Flexciton CEO, he leads the commercial and product development teams. In 2018, Jamie was featured in Forbes' 30 under 30 list.

# Sustainability Improvements in Semiconductor Manufacturing Using Smart Manufacturing Technologies

A. Neuber
Director Environmental Services
Applied Materials, Dresden, Germany

**Abstract**
Coming Soon

**Biography**
Andreas Neuber, Ph.D. has been a Senior Director at Applied Materials since 2008. He has published 80+ papers related to semiconductor fab and facility design, sustainable design and energy savings, water management and recycling, contamination control, and industrial engineering.
Prior to joining Applied Materials, Andreas Neuber was Vice President for M+W Zander. During his 18 years at M+W Zander, was involved in semiconductor fab construction and operation/optimization in many locations.
Andreas Neuber received a PhD degree in Chemical Engineering from University of Technology Dresden. He is co-chair of the SEMI ESEC task force and the IRDS EHS/S Energy and water reduction roadmap.

# Treading Lightly: How a Pandemic Pivot to Remote Integrations Helped Reduce our Carbon Footprint

D. Suerich
Product Evangelist
PEER Group, Kitchener, Canada

**Abstract**

When the pandemic hit its disruptive peak in 2020-21, the airline industry took a record-breaking tumble as countries restricted travel to limit the spread of COVID-19. For PEER Group, a company that supplies automation software to semiconductor OEMs and factories around the world and relies on onsite discovery, integration, and inspection to deliver and maintain its products, the limitation on international travel forced an immediate pivot to alternative ways of performing these critical functions.

As the business world moved to remote work and virtual communication platforms to stay connected with colleagues and customers, so too did PEER Group's integration and services team to ensure clients and partners continued to receive the same high level of service they were accustomed to pre-pandemic.

In this presentation, we'll share lessons learned from two years of performing remote discoveries, integrations, and inspections and how, in some instances, these lessons have become best practices for our customers going forward. We'll show how pivoting specific functions to remote platforms has decreased our reliance on air travel, reducing PEER Group's carbon footprint during the pandemic and, as we continue to improve and develop our remote capabilities, into the future.

**Biography**

**Doug Suerich, Director of Marketing & Product Evangelist, PEER Group**

*Doug combines more than 20 years of experience creating manufacturing software with a deep desire to help customers find the best solutions to solve their biggest challenges. A passionate advocate for smart manufacturing, Doug is an active member of the SEMI SMART Manufacturing Technology Community, Americas Chapter, and co-chairs the Advanced Process Control Smart Manufacturing Conference.*

# Effect of Gas Abatement Selection and Destruction Efficiency on Carbon Neutrality Goals

A. Stover
Chief Technology Officer
centrotherm Clean Solutions, Blaubeuren, Germany

**Abstract**
Process gas abatement is the backbone of any fab's environmental stewardship program. Proper abatement minimizes not only toxic and hazardous gas release to the environment, but also particulate matter and waste water. Increasingly, gas abatement is measured against its carbon footprint for the input power source, be it electrical or fuel. There is currently a push to go for "carbon free" abatement, using either hydrogen as the fuel gas or electrical systems powered by renewable energy. This goal is indeed laudable, however any carbon footprint calculation should also include the input fuel gas destruction, as they can have extremely high global warming potentials, far above and beyond the input electricity or methane.

To that end, this paper makes a full comparison of the carbon footprint for various abatement technologies, taking into account various process gas destruction efficiencies to determine if the power carbon footprint outweighs the non-abated process gases. Additional analyses for regional power generation carbon footprint are also performed.

**Biography**
Dr. Stover is currently the Chief Technology Officer for centrotherm Clean Solutions USA, based in Albany NY. After completing his bachelors degree in chemistry from Haverford College and PhD from The Johns Hopkins University, he has spent the last 8 years in the semiconductor industry, focused on abatement and achieving sustainability goals.

**Smarter, Sustainable and More Resilient Supply of Ultra High Purity $NH_4OH$ with Reduced Environmental Impact.**

K. Urquhart
Director of R&D | Chemical Product Technology Manager
Diversified Fluid Solutions, Semiconductor Equipment and Technology, Boise, United States of America

**Abstract**
A Commercial model that provides cost savings, desired quality and more environmentally friendly, enabling a more sustainable Semiconductor industry. Fabs material demand for some molecules such as $NH_4OH$ are increasing faster than the supply capacity. Exyte with its various subsidiaries can deliver state-of-the-art turnkey solutions for on-site generation of the molecule, reducing cost, waste, and transportation requirements.
The DFS $NH_4OH$ Fusion Blending System produces ultra-high purity (UHP) Ammonium Hydroxide ($NH_4OH$) that can meet and exceed all Semi C21-0618 grades and tiers. This is accomplished by combining any incoming source of Ammonia Gas ($NH_3$) gas with a customer or factory's Ultra-Pure Water (UPW) supply. Removing the logistical difficulties of this chemical supply chain and improving purity. Ensuring this critical material keeps pace with growing chip supply and demand. Accomplished in a closed loop process, on-site at a customer's location, with onboard in-situ metrology, it ensures there is no undiscovered contamination in the supply to the factory. Process has little to no waste affluent in the production and supply cycles by design. The DFS systems are proven to produce the highest process grade, and tier chemical with less than 10 ppt impurity levels. This is regardless of incoming source gas quality due to built-in gas purification. Simply the purist chemical product you can get for your applications.

**Biography**
Karl Urquhart is Director of R&D and Technology for Exyte's Diversified Fluid Solutions (DFS). He is an innovative experienced process engineering expert with 37 years of experience in the Advanced Electronic, Chemical Processing, and Semiconductor industries. He has numerous patents, and awards in chemical processes, handling, and associated equipment applications.

Exyte's Diversified Fluid Solutions (DFS) specializes in Ultra High Purity (UHP) chemical and gas systems for the semiconductor industry. Our product portfolio includes blending, and delivery equipment for all required applications in gas, precursor materials, aqueous chemicals, and CMP slurries. We engineer and manufacture precise, reliable, and space efficient systems with advanced monitoring and control through a state-of-the-art user interface.