

Overview

The main program of UGIM focuses on how to run multifaceted shared-facility spaces - but the Sunday session adds to this by looking at how to design & build such facilities.

The Sunday Program consists of two themes: (1) **Building MIT.nano: A Journey from Concept to Reality** and (2) **Systems and Components of a Modern Lab: The Top Three Things You Really Need to Know / Consider**. The program starts with four short talks about building MIT.nano from the principal people who were responsible for building it followed by 12 micro-talks from industry experts addressing 12 different systems within MIT.nano. The session ends with a Panel Discussion with a selection of MIT.nano staff / Invited Speakers / Industry Experts who will address questions from the audience and the moderator.

In addition, we offer staff- and self-guided tours of MIT.nano, typically starting every 60 minutes and covering all building areas: Fab, Characterization, Infrastructure, Packaging & AR/VR Lab, and the MIT Campus.

Sunday Schedule

Venue: MIT.nano (Bldg. 12, 10-250, Lobby 13) - <http://whereis.mit.edu/?go=12>

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| 10 am - 6 pm | Registration desk open, MIT.nano West Lobby. Pamphlet for self-guided window-tours.
Storage for luggage available in the 3 rd floor conference room. |
| 11:00 | Welcome to first-time attendees & a roadmap to UGIM conferences |
| 11:10 | Building MIT.nano: A Journey from Concept to Reality
Building MIT.nano was a complex years-long process that involved the input of a multitude of contributors from across the MIT campus. The significant pre-build efforts resulted in a clear design intent and program which would serve the MIT community far into the future. These talks focus on results of that process, the build itself, and finally the complex start-up.

<i>Prof. Vladimir Bulovic</i> , Director, MIT.nano; Fariborz Maseeh (1990) Prof. of Emerging Technology
<i>Travis Wanat</i> , Director of Capital Projects for the Department of Facilities
<i>Dennis Grimard</i> , Managing Director, MIT.nano
<i>Nick Menounos</i> , Associate Director of Infrastructure, MIT.nano |
| 12:30 | Welcome lunch; Lobby 13, Sunday sponsor booths |
| 1:30 | Systems and Components of a Modern Lab: The Top Three Things You Really Need to Know / Consider
A perfect concept is nothing without skilled and experienced experts to turn those dreams into paper drawings and then into nuts and bolts. By bringing together industry experts (many of them actual contributors to MIT.nano) we are striving to add to the knowledge base of the normal cohort of UGIM participants. With the theme of “what are the three things you need to know about ...” we focus our experts on the questions rather than the answers of any specific build. We want the audience to leave with those “at least three things” firmly in their minds. Basically, you can’t recognize a good answer if you have no idea what the question is. In this way we hope to prepare the audience to be able to answer those questions for themselves when their specific challenge becomes a reality. |

Part 1: Core Infrastructure

- 1:30 Air Recirculation: *Harry Scott*
Method (plenum box, fan filters, ducted); Raised Floor v Low Return; Access; Maintenance; and Performance (noise, efficiency, cost)
- 1:45 Exhaust Air: *Abbie Gregg (AMTS)*
PROPOSED: Heat Recovery; Segregation; Static Pressure; Materials of Construction (fiberglass v PSP v Epoxy coated galvanized v SS)
- 2:00 Make-up Air: *Josh Michaud (BR+A)*
Capacity; Location; Pressure Control (measurement points and closed-loop SoO); SoO; Resiliency; Redundancy (including networking, fail-safe conditions, controls, UPS / BMS integration); and External Environmental v Internal Environmental (humidity control, dew point control, response time, actuator authority, sensor type)
- 2:15 Energy: *Jacob Knowles (BR+A)*
LEED (difficulty / process / metrics for CR); ROI; Benchmarking; Cost per Pound of CO₂e; and Maintenance / Installation
- 2:30 Noise & Vibration: *Jeff Zapfe (Acentech)*
Start Early; Procure Measurement Equipment (vibration, EMI, sound); Stay Vigilant (building noise increases over time); Details of Construction, Materials, and Environment; Siting (amplitude of environmental noise); and Isolation Schema (active v passive and plinth v no plinth)
- 2:45 Process Cooling Water (PCW): *Bill Neuburger (Hallam ICS)*
Resistivity; Reactivity of Materials of Construction (including contamination); Capacity; Pressure Supply and Return Differential; Closed Loop Control; and Atmospheric Return v Closed Loop Return
- 3-3:30 Break & Refreshments, Lobby 13, Sunday sponsor booths

Part 2: Process Chemicals & Systems

- 3:30 DI-Water: *Glen Sundstrom (Xylem)*
Water Source (make-up quality); Cleanliness Level (ASTM standards D1527); Capacity; Redundancy; On-going Maintenance Costs; and Reclaim
- 3:45 Acid Waste Neutralization: *Gary Broberg (Practical Applications)*
Turbulent Mixing; Remote Monitoring; Record Keeping; Controls; Actuation; Span of Control; SoO; Capacity; Shut-Down; Storage; Materials of Construction; and Lifetime
- 4:00 Gas Delivery, *Steve Buerkel (Applied Energy Systems)*
LVPG Delivery; Components; Automation; Personnel; and TGMS Integration
- 4:15 Toxic-Gas Monitoring & Fire Alarm: *Dan Maxwell (Hallam ICS)*
Notification (kiss principle); Access; Interface; Integration to FAS; Testing; Verification; Hardware Selection Criteria; Set Points; Alarms; Designer Experience; and Sustainable Maintenance
- 4:30 Abatement: *Chris Jones (Edwards)*
Application (source effluents, mixing of effluents, compatibility); Energy Consumption; Self-Emissions from System; Utility Needs (water, gas feeds, fuel, CDA); and Connectivity
- 4:45 Code: *Jeremy Lebowitz (Jenson Hughes)*
Compliance in Design; Facilitating Stakeholder Communication; Balancing Connectivity and Separation; and Bringing Operational Considerations into the Design Process
- 5-5:30 Break & Refreshments, Lobby 13, Sunday sponsor booths

Part 3: Putting it all together & navigating tradeoffs

- 5:30 Panel discussion moderated by *Nick Menounos*
A panel discussion consisting of the speakers, focusing on interactions between systems and the design decisions and tradeoffs.
- 6:30-8:30 Reception throughout the building and outside (“Improbability Walk” behind MIT.nano). Food trucks dinner. Sponsor booths in Lobby 13.

Ongoing throughout the day...

- 1:30-7:30 Staff-guided Lab Tours, different flavors (signup required for some)
Fab, Characterization, Infrastructure, Packaging & AR/VR, MIT campus. **Additional tours will take place Wednesday afternoon** (to help those attending the full Sunday program), and we will offer some opportunities of tours early on Tuesday and Wednesday morning.

Speaker Bios

Vladimir Bulović (MIT.nano)

Vladimir Bulović is a Professor of Electrical Engineering at the Massachusetts Institute of Technology, holding the Fariborz Maseeh Chair in Emerging Technology. He directs the Organic and Nanostructured Electronics Laboratory, co-leads the MIT-Eni Solar Frontiers Center, leads the Tata GridEdge program, and is the Founding Director of MIT.nano, MIT's nano-fabrication, nano-characterization, and prototyping facility. He is an author of over 250 research articles (cited over 60,000 times and recognized as the top 1% of the most highly cited in the Web of Science). He is a fellow of the National Academy of Inventors and an inventor of over 120 U.S. patents in areas of light emitting diodes, lasers, photovoltaics, photodetectors, chemical sensors, programmable memories, and micro-electro machines, majority of which have been licensed and utilized by both start-up and multinational companies. The start-up companies Bulović co-founded jointly employ over 350 people, and include Ubiquitous Energy, Inc., developing nanostructured solar technologies, Kateeva, Inc., focused on development of printed electronics, and QD Vision, Inc. (acquired in 2016) that produced quantum dot optoelectronic components. Products of these companies have been used by millions. Bulović was the first Associate Dean for Innovation of the School of Engineering and the Inaugural co-Director of MIT's Innovation Initiative, which he co-led from 2013 to 2018. For his passion for teaching Bulović has been recognized with the MacVicar Fellowship, MIT's highest teaching honor. He completed his Electrical Engineering B.S.E. and Ph.D. degrees at Princeton University.

Travis Wanat (MIT)

Travis Wanat is the Director of Capital Projects for the Department of Facilities campus construction at the Massachusetts Institute of Technology. With over 24 years of experience in the construction industry, Travis is responsible for strategically planning and managing all phases of capital projects on campus. Oversight of budgeting, financial management, contract negotiations, engagement with project stakeholders and leading project teams to execute and deliver capital projects at MIT.

Dennis Grimard (MIT.nano)

Dennis Grimard received his Associates of Engineering (A.E.) degree in Mechanical Engineering Technology from Vermont Technical College in 1977 and his Bachelor of Science (B.S.) degree in electrical engineering from Worcester Polytechnic Institute in 1982. His postgraduate work includes both a Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees in electrical engineering (majoring in Solid-State Physics and minoring in Circuits) from The University of Michigan at Ann Arbor in 1984 and 1990, respectively. Dr. Grimard worked in both industry

(Cincinnati-Milacron, Ford Motor Company, Techware Systems, and IBM) and academia (post-doc, research scientist, and Managing Director of the Lurie Nanofabrication Facility) for more than 24 years. In addition, Dr. Grimard has served as an expert witness (Kirkland & Ellis) and consultant (IBM, Applied Materials, KLA-Tencor, Pivotal Systems, Watlow, Novellus, Veeco, Intavac, and PlasmaTherm) for more than 19 years. For the past 10 years Dr. Grimard has been the Managing Director of MIT.nano. Dr. Grimard has co-authored numerous peer-reviewed papers addressing the theoretical and practical limitations of RF metrology and feed-forward control of complex systems. His consultancy has produced more than 20,000 hours of technical output and 1.5 million miles of travel resulting in more than 37 patents covering every aspect of semiconductor tool technology.

Nick Menounos PE, LEED AP (MIT.nano)

Nicholas P. Menounos received his Bachelor of Engineering (B.E.) degree in Mechanical Engineering from McGill University in 2008, LEED Associate Professional in 2009 and has held a Professional Engineering (P.E.) license in the state of Massachusetts since 2012. Over the course of his career he has worked on a wide range of industrial, commercial and infrastructure projects, including; nuclear, defense, biopharmaceutical, higher education R&D and semiconductor manufacturing. Nicholas was the lead process engineer on the MIT.nano building design team and officially joined MIT in 2017, to support building startup and turnover. As the Associate Director of Infrastructure for MIT.nano, he is responsible for tool installation projects within the facility, safety systems, and ensuring the environmental conditions and utilities meet the research needs of the community.

Harry Scott (HME Sales, LLC)

Harry Scott received his Associates Degree in HVAC Design from Ferris State University in Big Rapids, MI and his Associates Degree in Marketing from Grand Rapids Community College in Grand Rapids, MI. With over 35 years of experience with architectural and mechanical system designs for university, research, manufacturing and industrial cleanrooms. Harry has worked for Comp-Aire Systems a design / build firm for over 12 years, Plascore a cleanroom wall manufacturer, Performance Contracting a large cleanroom contractor throughout the United States and Nortek Air Solution; formally Cleanpak / Huntair manufacturing cleanroom laminar flow equipment and air handlers. He currently is President of HME Sales a consultant for several large semiconductor projects and a manufacturer's representative for several cleanroom product lines. His experience with university cleanroom projects across the U.S. is extensive with projects at MIT nano, Harvard, University of Michigan, University of Minnesota, Tulane, Notre Dame, Brown University, UMASS-Lowell, SUNY, USC, ASU, Duke, University of Delaware, University of Illinois, Northwestern, University of Iowa, UC Davis, University of Washington, Rice University, University of Arkansas and Penn State.

Abbie Gregg (AMTS)

Abbie Gregg, Chief Technology Officer of AM Technical Solutions, is an industry expert and cleanroom consultant with more than 40 years of experience in engineering consulting. She specializes in microelectronics process analysis and the design, startup and operations of cleanrooms, advanced laboratories and manufacturing facilities. Abbie is a graduate of MIT and was part of the MIT.nano design team. Abbie is a member of the SEFA Advisory board. Her previous firm, Abbie Gregg, Inc. has been a Lab of the Year Award winner 3x. (MIT.nano, KAUST, AZ Biodesign). She served on the ASU Chemical Engineering Accreditation Advisory Board.

Josh Michaud PE, LEED AP BD+C (BR+A)

Josh Michaud is an Associate Principal at BR+A with over 19 years of experience in the design and engineering of HVAC systems, modification and analysis on a broad range of projects for clients nationwide. Josh is a Registered Professional Mechanical Engineer, a LEED Accredited Professional, as well as an active member of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, and the U.S. Green Building Council. Josh is a graduate from the University of Massachusetts Lowell with a Bachelors in Science of Mechanical Engineering. Expertise in a broad range of markets including laboratory, higher education, healthcare, manufacturing, infrastructure upgrades and decarbonization projects. With a background stemming from installation of HVAC prior to attending college, he provides a hands-on real-life perspective to the work he engineers today. Most recently he

lead a team within BR+A to design the largest carbon neutral net zero building in Boston at the Boston University Center for Computing and Data Sciences.

Jacob Knowles (BR+A)

Jacob Knowles is the Chief Sustainability Officer at BR+A Consulting Engineers. He has championed over sixty million square feet of carbon neutral buildings and campus master plans. His work has resulted in numerous grants and awards, including three AIA COTE Top Ten awards. Most recently, Jacob advised the City of Boston and the State of Massachusetts in the development of zero carbon zoning and a net zero code, offering practical solutions so that all future buildings will be carbon neutral.

Jeff Zapfe (Acentech)

Jeffrey Zapfe is a Principal at Acentech, a world-class acoustics, noise, vibration, and technology consulting firm based in Cambridge, Massachusetts. He has more than 37 years of consulting expertise in the areas of vibration, structural dynamics, vibration-sensitive facilities and equipment, and vibration isolation. He conducts analyses of structures at the design stage and measures, analyzes, and develops vibration mitigation solutions in occupied buildings. Jeffrey has worked on many prestigious research facilities across the United States including MIT.nano and Harvard LISE. Jeffrey earned a Ph.D. in Aerospace Engineering from Penn State University and a Bachelor and Master of Science from the University of Toronto. Jeffrey is also the former President of Acentech and served in that role for 12 years.

Bill Neuburger (Hallam ICS)

William Neuburger, PE is the Director of Engineering at Hallam-ICS. Bill joined Hallam-ICS in 2010, before Hallam-ICS, he worked in wind turbine manufacturer and commercial energy efficiency. He leads a group of 13 engineers in the Vermont office and is the firm's semiconductor subject matter expert with a focus on hazardous materials, specialty gas storage and distribution, liquid chemical distribution, and process infrastructure. Bill graduated from the University of Buffalo with a BS in civil engineering in 1994. Bill has reviewed, designed, or modified process cooling water systems at Cornell University, GE Aviation, MIT.nano, and other manufacturing facilities.

Glen Sundstrom (Xylem)

Glen Sundstrom is the UPW Technical Director for Evoqua Water Technologies (a part of Xylem). In this role, he is responsible for process development, optimization, troubleshooting and technical support of high purity water systems within the semiconductor, nanotechnology, and photovoltaic markets. He is also responsible for operating and maintaining an ASTM E-1.2 UPW system in the Evoqua Microelectronics Technology Suite. Mr. Sundstrom has been with Evoqua (starting with IWT) for over 40 years in various technical leadership roles responsible for developing, growing, and supporting products and technologies. These roles include Product Manager, Process Development Manager and Applications Engineering Manager. Glen holds a Bachelor of Science degree in Chemical Engineering from the University of Wisconsin, Madison, and is located at the Evoqua office in Rockford, Illinois. He is an active member of the SEMI UPW Task Force and has authored and co-authored papers on topics including nanofiltration, reverse osmosis, ultrafiltration, advanced oxidation, particle removal, system design and sustainability for the microelectronics industry presented at the IWC (International Water Conference), UPM (Ultrapure-Micro) conferences and Institute of Electronics and Nanotechnology at Georgia Tech.

Gary Broberg (Practical Applications)

Chief Executive Officer at Practical Applications, Inc. with over 30 years of experience in industrial water treatment, wastewater treatment, and regulatory compliance. Bachelor of Science in Chemical Engineering, Northeastern University, Boston, MA. Massachusetts Licensed Professional Engineer (PE), Board Member - MassDEP Certification of Operators of Wastewater Treatment Facilities.

Steve Buerkel (Applied Energy Systems)

Steve Buerkel has been President of Applied Energy Systems, Inc. since 1985. AES, Inc. is a manufacturer of specialty gas and liquid delivery systems under the SEMI-Gas[™] and VERSA-Gas[™] banners for the semiconductor, solar and

R&D markets. Steve holds a Bachelor of Science degree in mechanical engineering from Case Western Reserve University and a Masters in Business Administration from Drexel University. In 2017 AES, Inc. acquired ARM, Inc. which is a specialty gas purification company. All purifier manufacturing occurs in our Malvern, Pa. complex with all R&D efforts in our Colorado Springs, CO laboratory.

Dan Maxwell (Hallam ICS)

Dan Maxwell is a Senior Project Manager with Hallam-ICS. He has been with Hallam since 1999. For the past 18 years, Dan has led a talented group of Engineers, Designers, Integrators, and Technicians in the design and construction of Toxic Gas Monitoring systems for Research and Industry. Dan and Hallam-ICS believe everyone who uses hazardous gases deserves a safe work environment. Sharing knowledge today is a small step towards that goal.

Chris Jones (Edwards)

Chris Jones has nearly four decades of experience in environmental protection and R&D, focusing on the semiconductor industry, among others. His work involves developing methods to maintain air and water quality and integrate sustainable practices into business operations. Currently, he is the Environmental Solutions Business Development Manager at Edwards, where he supports semiconductor fab owners in understanding and mitigating the environmental impacts of their operations. Chris is actively involved in key industry working groups dedicated to sustainability in semiconductor manufacturing. Chris Jones, a chemist with a BSc and PhD from Imperial College, worked with Professor John Albery on Electroanalytical Chemistry. He has significantly contributed to environmental solutions within various industries, including semiconductors, nuclear, and defence. His illustrious career spans over 37 years. From his early days at UKAEA and AEA Technology, where he led a team developing technologies for treating nuclear and military waste, to his current position as the Environmental Solutions Business Development Manager at Edwards, Chris has been at the forefront of innovation. His pivotal role in developing tools for wastewater and air quality management, integral to semiconductor manufacturing, is a testament to his expertise. Beyond his immediate roles, Chris's active participation in several sustainability-focused industry working groups has helped shape environmental strategies through his expertise in regulatory compliance and technology application. He is the Society of Chemical Industry Electrochemical Technology Technical Group secretary.

Jeremy Lebowitz PE (Jenson Hughes)

Jeremy Lebowitz, PE is a Market Leader, specializing in laboratory and hazardous material safety. He has been with Jensen Hughes for his 16+ year career. He is a registered fire protection engineer with a background in chemical engineering which he leverages to help users identify hazards and prioritize corrective actions related to building, process and operational safety in the industrial, laboratory, clean room and chemical sectors. He serves on numerous NFPA technical committees including NFPA 318 for the protection of semiconductor fabrication facilities and NFPA 30, Flammable and Combustible Liquids code. He has a master's degree in fire protection engineering and a bachelor's degree in chemical engineering, both from Worcester Polytechnic Institute.