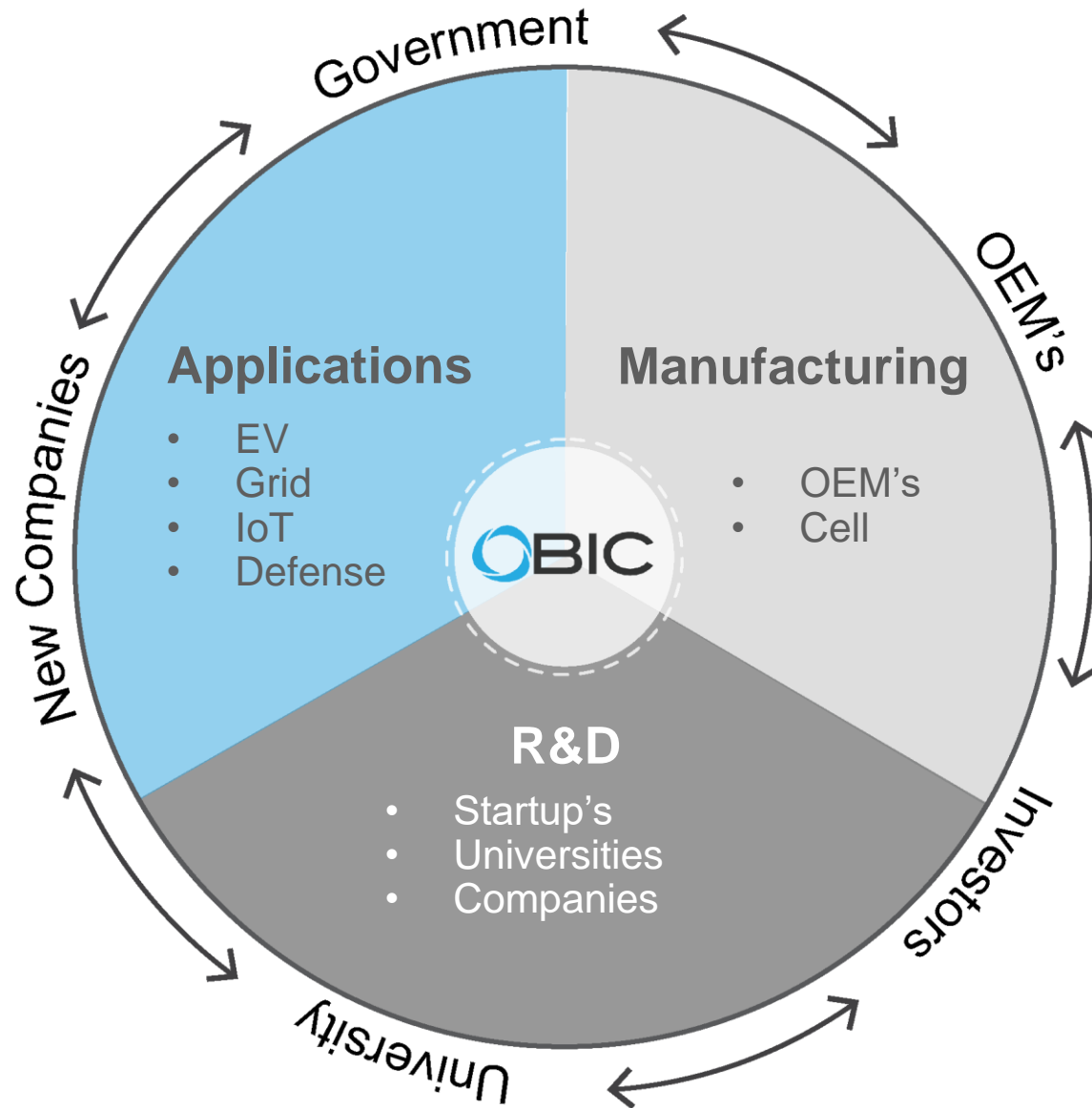




Battery Innovation Center Overview

“Leading the Charge for Innovation”





LiBridge TRL/MRL Assessment



Readiness Assessment Framework

	Technology Rediness Level TRL		Manufacturing Readiness Level MRL		Military and Specialty 5000.2	Automotive and High Volume Process	Military and Specialty Volumes Specialty Materials		Automotive and High Volumes Main Materials		Commercial Readiness	
	Level	Description	Level	Description			Material Quantities	Cell Quantities	Material Quantities	Cells Quantities		
	TRL 0	Idea. Unproven concept, no testing has been performed	MRL 1	Basic concept but no proof available	Sample Level	Sample Level	gr - 1 Kg cm - 1 m	10 - 100 all formats	gr - 1 Kg cm - 1 m	10 - 100 all formats	Commercial Progress	
<p>Concept</p>	TRL 1	Basic Research, principles postulated and observed but no experimental proof available	MRL 1	Basic production model available with grounded data	Pre - MSA	Demonstration	gr - 1 Kg cm - 1 m	10 - 100 all formats	gr - 1 Kg cm - 1 m	10 - 100 all formats	R&D Sampling Levels JDA Engagements IP Landscape, FTO and Plan	
	TRL 2	Technology formulation Concept and application have been formulated		Identify production concept, cost model meets equipment/facility model								
	TRL 3	Applied research. First laboratory tests completed; proof of concept	MRL 2	Verify correctness of production concept								A
<p>Prototype</p>	TRL 4	Small Scale prototype, Built in a laboratory environment ("ugly" prototype)	MRL 3	Immitate prodction steps from identified concept with expected quality	Material Solutions Analysis	Concept Validation	1 - 100 Kg 1 - 100 m	100 - 1000 all formats	1 - 100 Kg 1 - 100 m	100 - 1000 all formats	Prototype Pricing Early Adoption Commitments	
	TRL 5	Large scale prototype Tested in intended environment	MRL 4	Test manufacturing prototypes in production-related circumstances	Technology Maturation and Risk Reduction							B
	TRL 6	Prototype manufactured and tested in intended environment with close to expected performance	MRL 5	data, plan steps of raw material supply	Engineering & Manufacturing Development							A
<p>Develop & Test</p>	TRL 7	in operational environment at pre-commercial scale	MRL 6	Test manufacturing prototypes and access quality risks	Production & Development	Design Validation	100 +Kg 100+m	Low Volume Manufacturing <10MWh/yr Production Format	100 Kg - 1KT 100 km - 1Mm	Pilot Manufacturing 1k - 10k Production Format	Large Scale Pricing and Volume Agreements Product Line P&L Established	
	TRL 8	First of a Kind commercial system. Manufacturing issues solved	MRL 7	Test in manufacturing real circumstance and test examine production quality								C
<p>Commercialize</p>	TRL 9	Full commercial application. Technology available for customers	MRL 8	Achieve the required quantity and standard required utilizing production system, assets and resources	Production & Development	Product Validation	Quantitiy As Needed	Quantities As Needed Production Format	1 - 20 KT or Mm	Low-Medium Volume Manufacturing 10-1000 MWhr Production Format with 1 Qtr Production		
			MRL 9	Develop dynamic and effective product capability utilizing production system assets and resources							D	
				MRL 10					High Volume Manufacturing	20 - 100s KT or Mm	High Volume 1 GWh/yr - 100 GWh/yr or as needed Production Format	



Rapidly develop, test, and help commercialize next generation energy systems that are safe, reliable, and lower-cost with partners from Industry, DoD/DoE, and Academia in a unique non-profit, public-private environment.

Core Capabilities

- **Advanced Cell Manufacturing**
 - Materials processing to electrochemical testing
 - R&D, Applied Services
- **Testing, Evaluation & Certification**
 - Cells, Modules, Small/Large Pack & Containerized
 - Engineering Review
 - AC/DC Microgrid and Cybersecurity
- **Accredited Training & Short Courses**
- **Technical Consulting**

Distinguishing Features



Catalyze technologies to streamline, shorten innovation-to-commercialization cycle and cut development costs



Do not hold patent rights



Collaborate & jointly develop IP



IP-secure, U.S. ITAR facility generating reliable data using leading techniques and equipment

Low Volume Cell & Pack Production

- <1% Relative Humidity/10K Class Dry Rooms
- Coin, Cylindrical, Pouch & Prismatic cells
- Proof-of-Commercialization expertise
- R&D-scale cell manufacturing equipment
 - Slurry mixing
 - Slip and R2R coating
 - Calendering
 - Slitting
 - Automated cylindrical wrapping
 - Electrolyte filling & degassing
 - Formation

Material & Process R&D

- Novel use of industry-leading materials & technologies
- Direct partnerships with industry suppliers
- Factory demo center for equipment OEMs



Battery Testing & Validation

- From single cells through to full systems
 - Large format and outdoor testing capabilities
- Environmental, Hazards, and Safety
- Crush, Propagation, Drop, External Fire, and more
- UL, MIL, UN-DOT, SAE, IEEE standards
- Comparative Analysis

Micro-Grid & Vehicle-to-Grid Testing

- Integrated solar and wind renewables
- Plug-n-Play with various ESSs, inverters, PCSs
 - AC utility-scale grid simulators (180kW+ scalable)
 - >6MW of available power with net metering (MISO High Voltage Node) agreement
- Cybersecurity Program/Hackathons
- MESA
- 500kW V2G
 - 4x125kW Level 3 HVDC Fast Chargers
 - Push-pull



Expert Feedback and Analysis

- Facility Processes, Safety, Auditing, and Design
- Engineering Review
- Cell, Module, Pack, and System Design
- Battery Management Systems
- Vendor management and support
- Handling and Transportation
- Battery Second Use and Remanufacturing
- EV/PHEV, Consumer/IoT, Medical, Military, and Grid

Comparative Analysis

- Manufacturing & Test Equipment and Software
- Battery Components to System Operations
- Cell Dissection and Lab Analysis



CEU's Accredited By:



Battery Energy Storage Short Course (CEU)

- Industry leading experts teaching 3-4 Day Sessions
- Course Outline: Chemistry, Fabrication, BMS, Module/Pack/System Design, Manufacturing, Validation/T&E, Cybersecurity, Second Life, Standards, and other key areas!
- Hands-On, Virtual & Hybrid-Hybrid formats available

Battery Technician Training

High Voltage Training Fall 2024

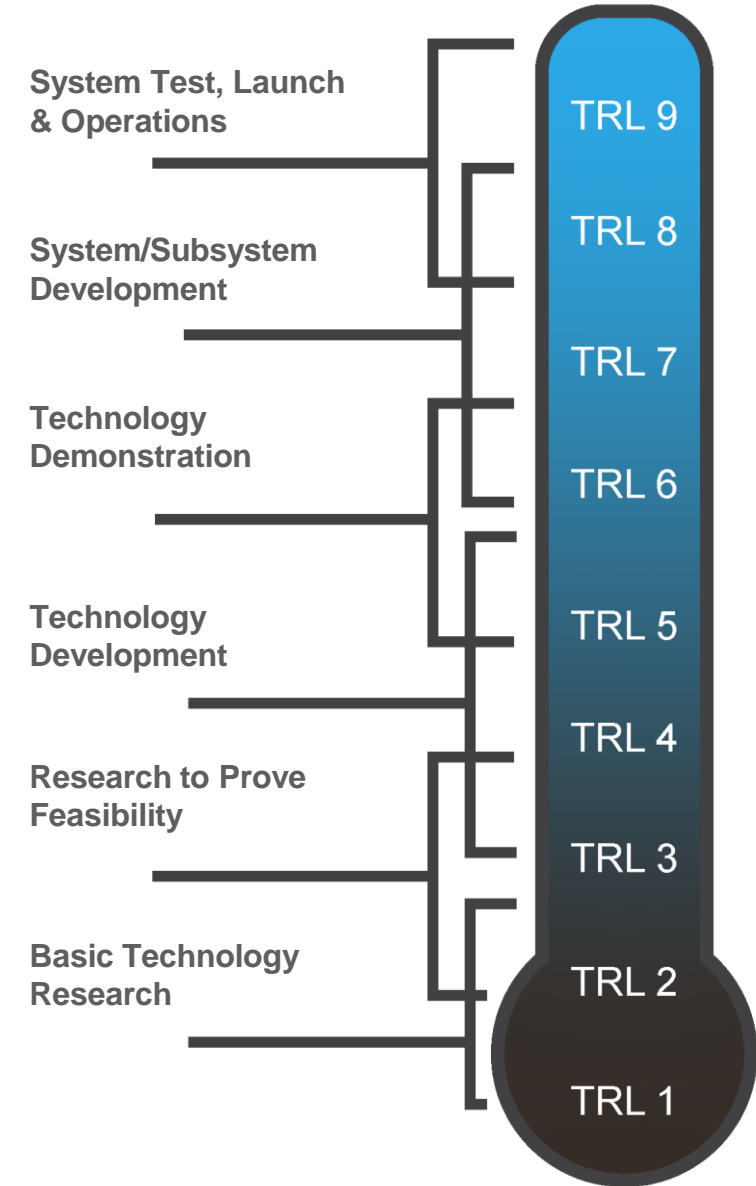
On-Site and Remote Training

- Customized per client interest
- Individual modules including hands on practical application
- Group and member discounts available



BIC/Indianapolis will address customers approaching TRL 4-6

- Allow customer to evaluate larger quantities in a relevant manufacturing environment on pilot scale manufacturing equipment
- Provide equipment maker's the opportunity to engage technology developers and work with their products for qualification and manufacturing
- Provide test and manufacturing data for customers to expedite technology evaluation and acceptance
- Continue to strengthen alliances with energy storage startups, companies with new product development and OEMs
- **BIC, Newberry will continue to address customer needs in TRL-1-3**



What is EMC²?

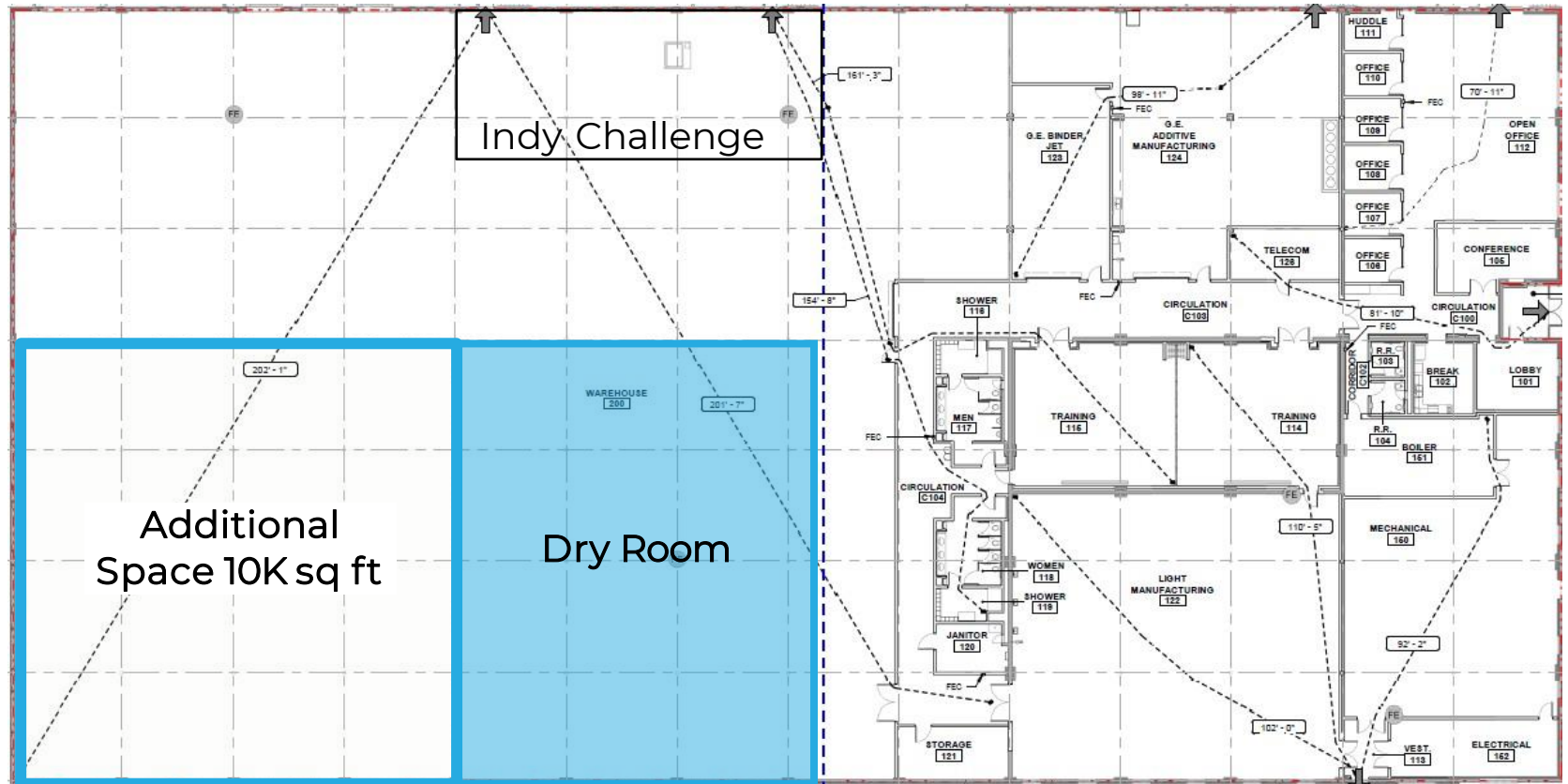


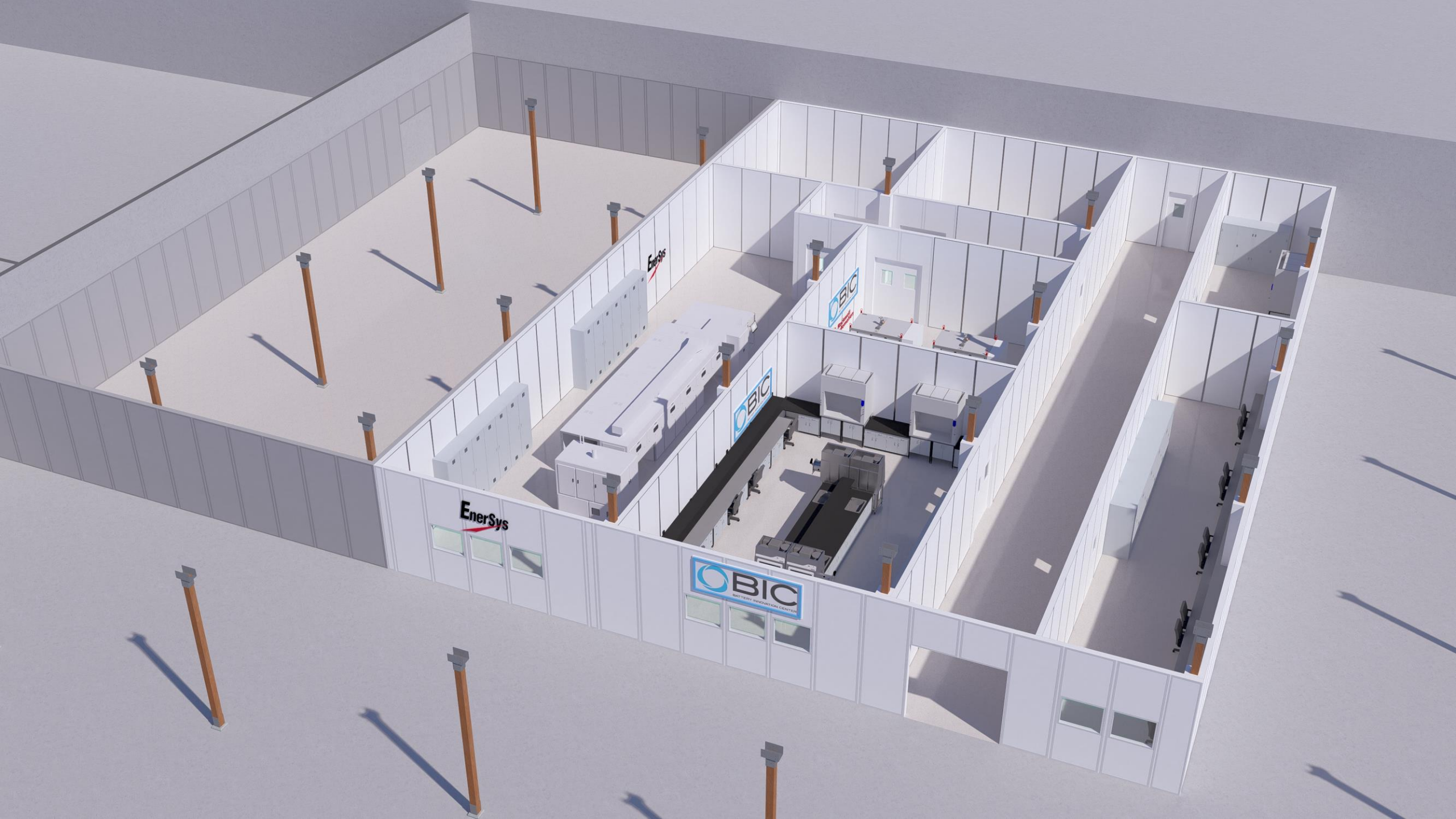
- The Emerging Manufacturing Collaboration Center (EMC²) is a **cross-sector manufacturing innovation center** that enables its members to design and deliver cutting edge manufacturing technologies.
- Founded through a public-private-partnership (P3), the center operates a functioning 60,000 ft² manufacturing floor that will serve as a showcase for new capabilities as well as a platform for collaborative research and development, especially **focused on technology insertion and adaption**.
- EMC² also consists of offices, shared office space, **collaboration environment**, and a 100-person training/workshop classroom that can be divided into two 50 person rooms. The center will support not only practical innovation in manufacturing but also the development of relevant workforce to meet the needs of the industrial base.

Only 20-minutes from Indianapolis Airport



- BIC
- GE Additive
- Lilly + Ivy Tech
- IAC
- IEDC
- AT&T / Verizon
- AWS networked





EnerSys

BIC
BATTERY REGENERATION CENTER

BIC

BIC

Foundation

BIC

Integrator

Fulfillment

Operation

Infrastructure

Training

Rockwell Automation

Automation

Smart Manufacturing Design & Trainer

???? Final Commitment

Pilot Scale Equipment Manufacturer

Test Equipment

Equipment Install & Training

Growth

State of Indiana

IEDC

Universities and Colleges

Commercial Industry: Cummins, Star Plus,

Federal Agencies

DOE (Libridge)

DOD (NSWC Crane, In)



- Battery and Energy Storage Technology test center - exclusive large-format
- US ESS test facility
- ISO 17025 accredited
- Direct collaboration with UL expertise and experience



- Highly customizable flexible batteries
- Scale-up for flexible electronics, smart textiles, soft robotics, IoT, medical/fitness wearables



- Micro-grid simulation and grid-level control algorithm development
- Leveraging installed and new renewable generation



- Crush, shock, drop, vibe, rapid disassembly, intrusion, EMI, among others
- Testing Collaboration

➤ **Advance Cell Development & Cell and Product Testing**

- Currently Four-Five subcontract arrangements with Government focused applications
- Opportunities to collaborate on application driven battery designs that have cell maturity challenges
- Assist in TRL and **MRL** maturity (Assistance in crossing the valley of death)
- Prototyping and Production Process Validation
- Low volume production (mid 2024)
- **Training** (Battery 101, High voltage, battery technician, Quality (Cell, Pack and Module)

Partners

