



University of Pittsburgh

The Pitt Center for Energy

EIC Facilities Up-date and the Energy GRID Institute

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The Pitt Center for Energy

- University-wide Research Center
 - ~\$30+ Million R&D portfolio
 - ~100 Faculty and ~250-300 Graduate Student Researchers
- Dedicated to improving energy technology development and implementation, including:
 - Energy and electric power delivery, reliability, and security;
 - Advanced materials for energy-related applications;
 - Clean energy development and integration;
 - Direct energy conversion and recovery;
 - Carbon management and utilization;
 - Energy efficiency and sustainability;
 - Unconventional gas resources; and
 - Energy workforce development





Pitt Center for Energy Off-Campus Research Facilities

Laboratory/Facilities Plans for the Pittsburgh Energy Innovation Center (EIC)

Establishing “The Energy GRID Institute”



Pittsburgh Energy Innovation Center

- **Old Connolly Trade School (Bedford Avenue)**
 - aka, the Energy Innovation Center
 - located adjacent to downtown Pittsburgh,
across the street from the former Mellon Arena site
- **Built in 1930 and closed as a school in 2004.**
- **Consists of a 5-story tower, with a 2-story high bay (former technical shop extension), gym, and aud.**
 - approx. 200,000 sq. ft. in total
- **Building under renovation by Pittsburgh Gateways**
 - non-profit entity, support from private and public funding
- **Pitt Center for Energy Labs/Facilities:**
 - over 20,000 sq. ft. of total space, with plans to expand
 - construction underway as of Dec. 2015



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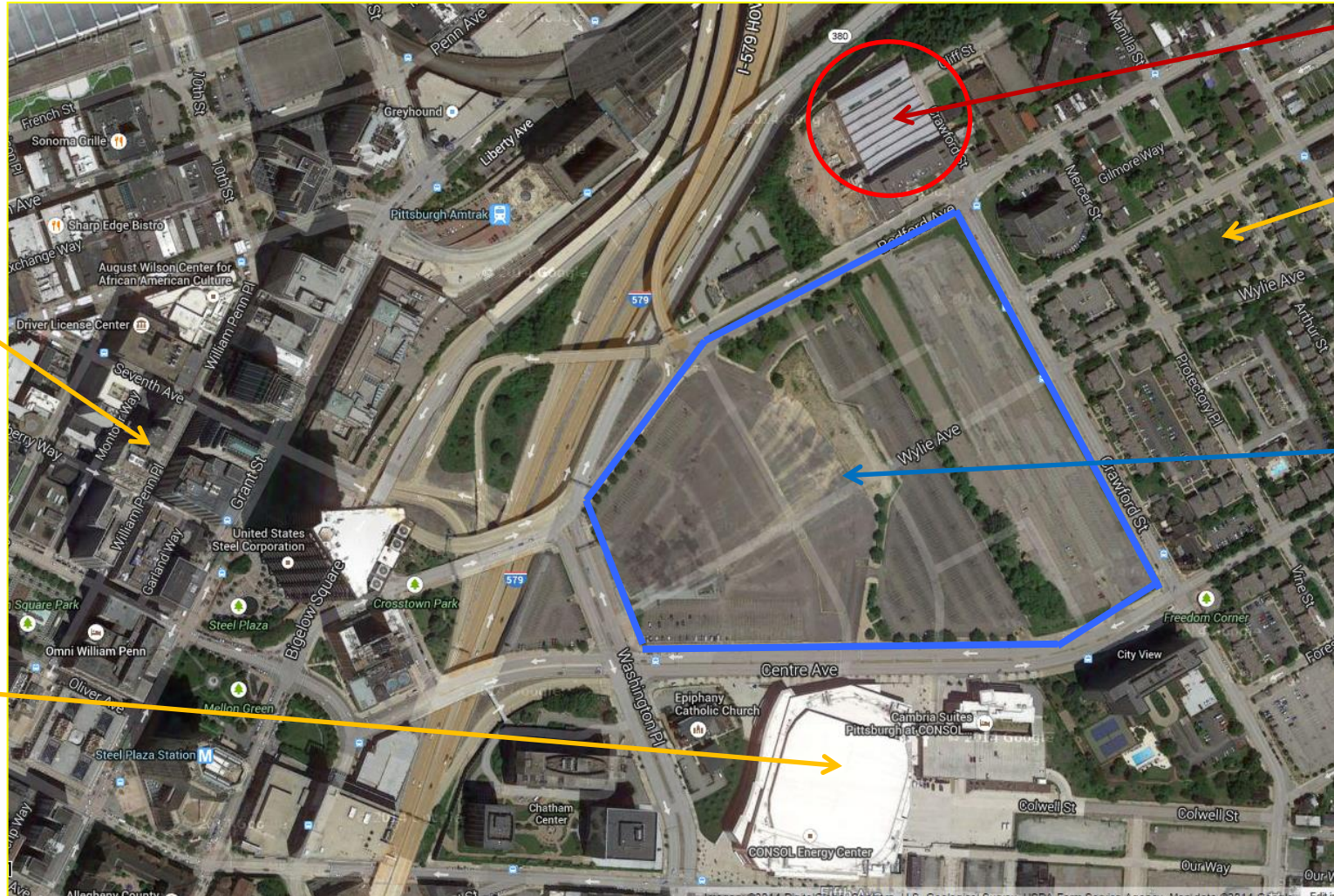
UNIVERSITY OF PITTSBURGH
Center for
ENERGY

Pittsburgh Energy Innovation Center





Energy Innovation Center - Location



EIC

Lower Hill District

56-Acre Development Site (former Mellon Arena)

Downtown Pittsburgh

Consol Center (Pittsburgh Penguins Arena)



The Energy GRID Institute (est. July 2016)

University research & development; and independent industry/community activities

- Focus will be on the ELECTRIC UTILITY INDUSTRY
- Key Facility/Lab: **High-voltage and high-capacity capability and multiple use facility**
 - Plan is for 15 kV-ac, 5 MVA and 1.5 kV-dc, 1 MVA capacity
 - Ring-Bus configuration and dedicated DC area
 - AC and DC Micro-Grid/Micro-Energy Environments at the **Utility Distribution Level**
 - Resource, **Distributed Energy Generation**, and **Load Integration**



The Energy GRID Institute Laboratories

- **Electric Power Technologies Lab**

- Dr. Gregory Reed – ECE
- High Voltage/Capacity AC and DC Grid Facility



- **Energy Storage Technologies Lab**

- Dr. Prashant Kumta – BioE, ChemE
- Nano-Materials for Conversion/Storage



- **High-Temperature Corrosion Testing Lab**

- Dr. Brian Gleeson – MEMS
- Current facility at Iowa State University



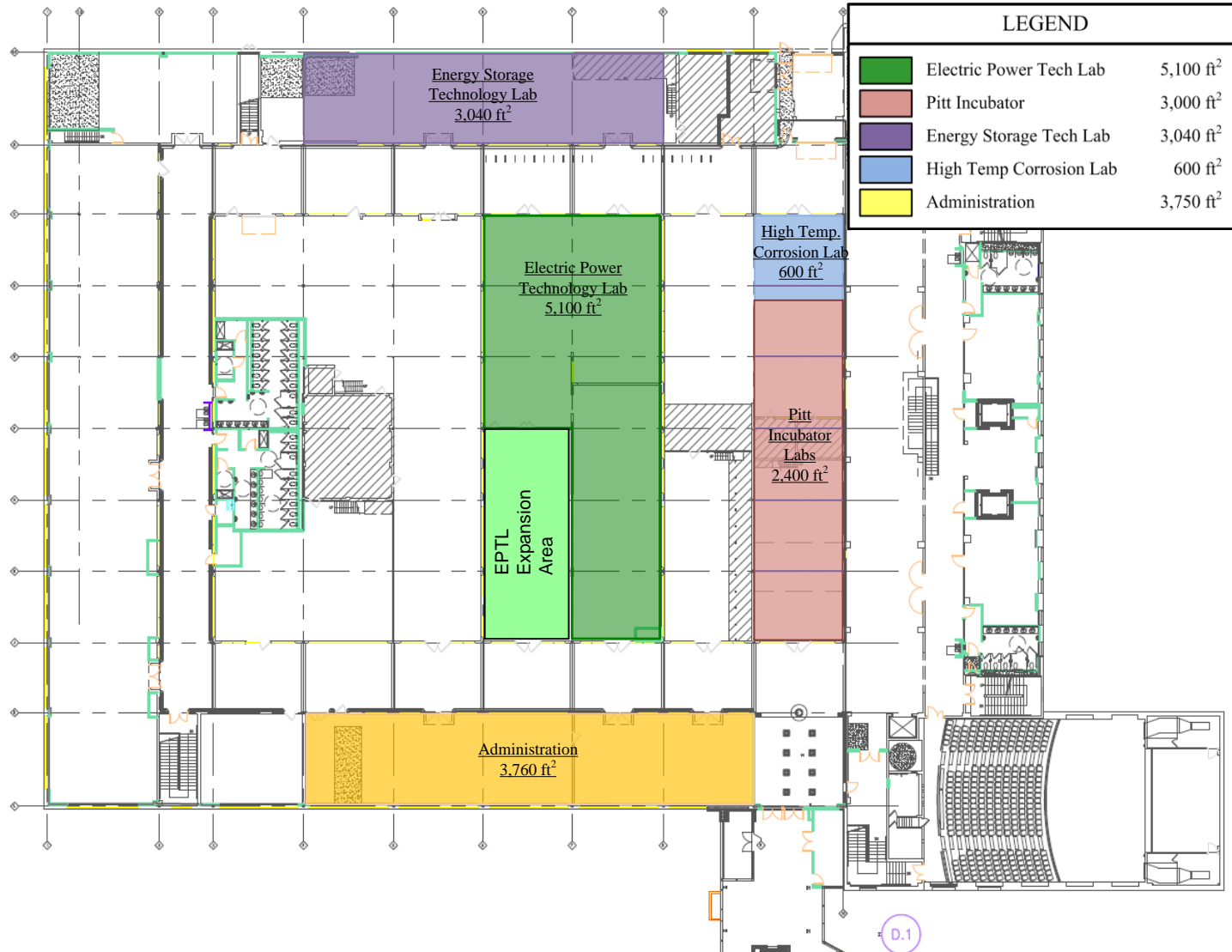
- **Energy-Related University Incubator Space**

- Dr. Mark Redfern – University
- Lab Spaces for Start-up/Commercialization Activities





University of Pittsburgh, Center for Energy/ GRID Institute
Energy Innovation Center – Facilities Layout





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The Energy GRID Institute

Vision and Community Engagement



Vision – Energy GRID Institute

The Challenge:

- 1- Legacy-based electrical power and energy infrastructure in U.S./OECD nations.
- 2- Dynamic period of change and uncertainty across the utility industry.
- 3- Proliferation and rapid growth of distributed and renewable energy resources; microgrids and related developments (DC, power electronics); increased consumer participation; and many other disruptive technological and regulatory paradigms that are affecting utility planning, design, operations, and policy.

The Goal:

A modern reliable grid, innovative customer solutions, and clean energy technology.

The Vision:

- 1- Create a national/international consortium focused on the electric utility industry.
- 2- Evaluate and assess both major industry-wide and individual utility issues.
- 3- Work in collaboration with various partners towards the development, demonstration, and first-generation deployment of solutions across a broad area of grid technologies, systems, designs, operations, and regulation, as well as addressing market forces and business considerations.



Vision – Energy GRID Institute

Background:

Pitt Center for Energy and the Swanson School of Engineering investing over \$9-million towards renovations for establishment of new off-campus facilities and laboratories at the Pittsburgh Energy Innovation Center (EIC).

Includes an extensive high-power/high-capacity AC and DC networked Electric Power Technologies Lab, supported by various industry and community constituents through in-kind contributions and financial assistance.

Overview:

An expanded vision for this facility, beyond initial plans, is to establishing the “Energy GRID Institute” for energy and power grid related research, development, demonstration, and deployment – creating value-added impact and national/international prominence.

A world-class enterprise with comprehensive infrastructure and advanced capabilities for research, development, commercialization and related activities, in the form of expanded plans for the EIC labs and facilities, is instrumental in realizing this vision and creating opportunities the partner organizations.



Vision – Energy GRID Institute

Impact and Need:

Expand upon and attract significant industry participation and corporate engagement at the EIC, to work in close collaboration and partnership with University programs, faculty researchers and graduate students, and other supporting academic personnel.

Regional impact will be to leverage activities towards economic growth and job creation, as well as enhancing incubator, start-up, and technology commercialization potential.

National impact will be an opportunity to collectively move industry forward in key areas of energy and power grid related activities.

Comprehensive strategy requires large-scale funding from both public and private entities, including opportunities to partner with federal, state, and local government; regional, national, and global industry organizations; the foundation community; and the University.



Vision – Energy GRID Institute

Community Impact:

- **The EIC and the GRID Institute will be a community anchor for grid modernization activities; including community development, investment, and diverse workforce training.**
- **Cross-section of community engagement and public/private partnerships; co-location of industry and community partners.**
- **District Energy program will spur regional economic development and increase resiliency across Pittsburgh's most underserved areas/neighborhoods**
- **Significant corporate/community participation and investment from local, regional, and national organizations**



Pitt EPTL

Industry and Community Engagement – initial discussions and significant interest in participation/support:

* Initial partners/committed support

- **Eaton, Electrical Sector***
- **Universal Electric***
- **Dominion VP***
- **ANSYS***
- **EPRI (Electric Power Res. Inst.)**
- **OPAL-RT***
- **Pitt-Ohio Express***
- **U.S. Dept. of Energy**
- **ABB**
- **Aquion Energy**
- **Concurrent Technologies**
- **Hysosung Industries**
- **Schweitzer Engineering Labs (SEL)**
- **DNV GL – KEMA Laboratories**
- **Duquesne Light Co.***
- **Emerson Process Management***
- **Mitsubishi Electric**
- **FirstEnergy Corp.**
- **Siemens Energy and Industry**
- **Sargent Electric***
- **RK Mellon and HL Hillman Fdns.***
- **Quanta Technologies**
- **S&C Electric**
- **GE-Alstom / GE Power Conversion**
- **Robert Bosch**
- **OSISoft**
- **RTDS**
- **EMerge DC Alliance**



The Pitt Energy GRID Institute

Value Proposition for Partners and Users:

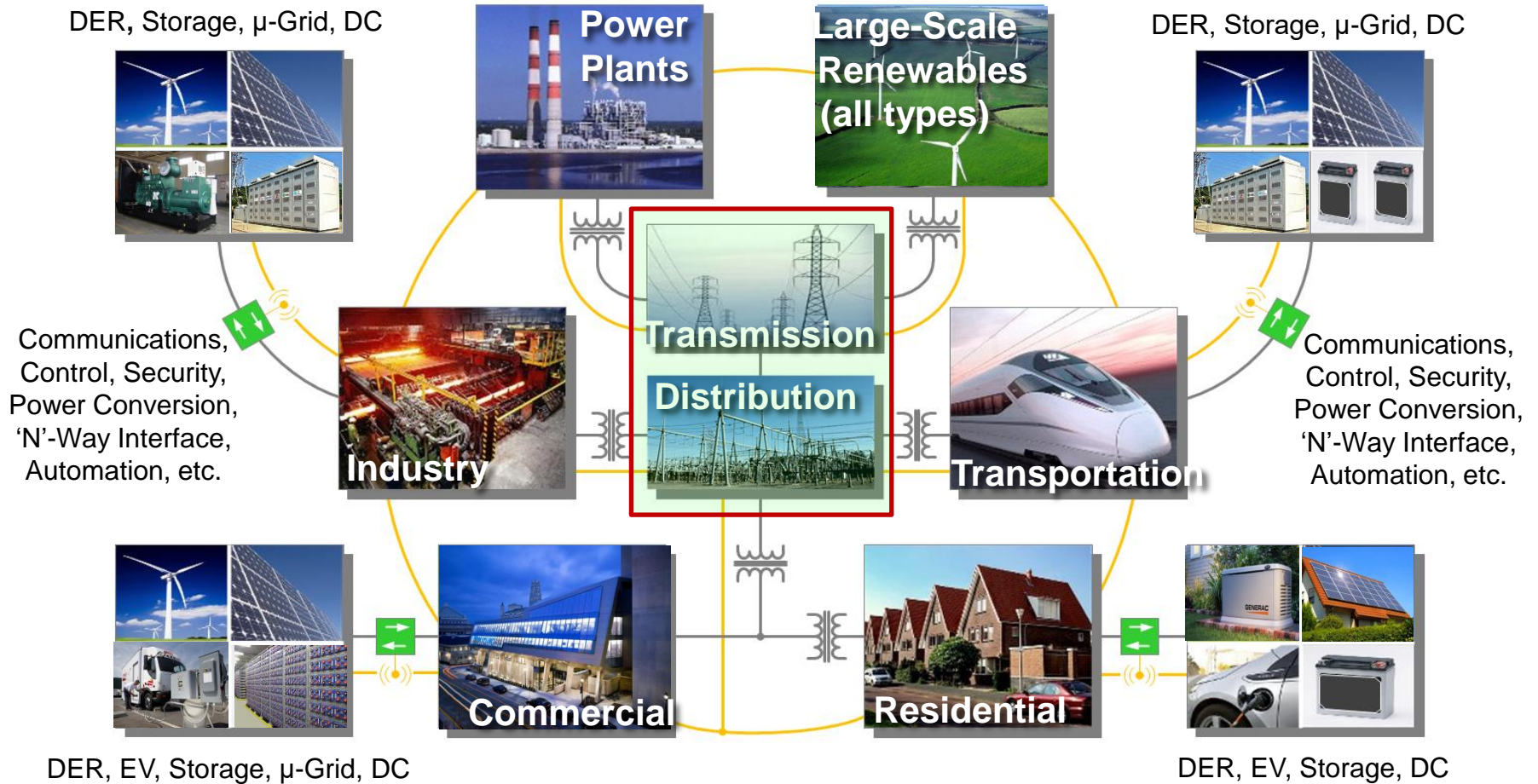
- **Collaborative R&D programs**
- **Utility investigations and testing**
- **Technology development, prototyping, and demonstration**
- **Commercialization opportunities**
- **Joint utility-vendor-government collaborations**
- **Various levels and constructs of partnerships**
- **Fee-for-service and contract R&D options**
- **Industry Standards Development**
- **Independent testing/certification and third-party operations**
- **Student development and access**
- **Education and training**

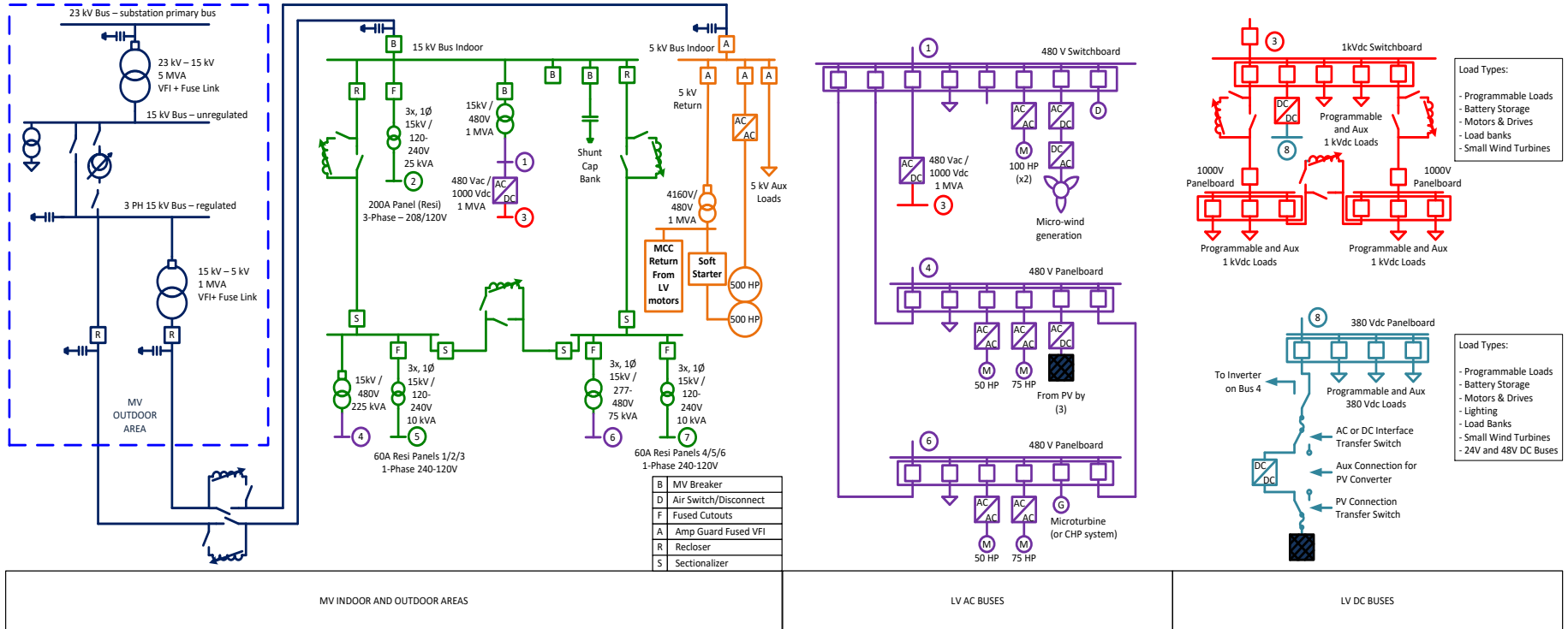


The Energy GRID Institute

Electric Power Technologies Lab – Plan

The 21st Century Grid – RD&D is Imperative





Electric Power Technologies Lab: One-Line Diagram of Grid Infrastructure Plan

(AC network: 23-kV/15-kV/4.16-kV/480-V > system)

(DC network – 1.5-kV/380-V > system)



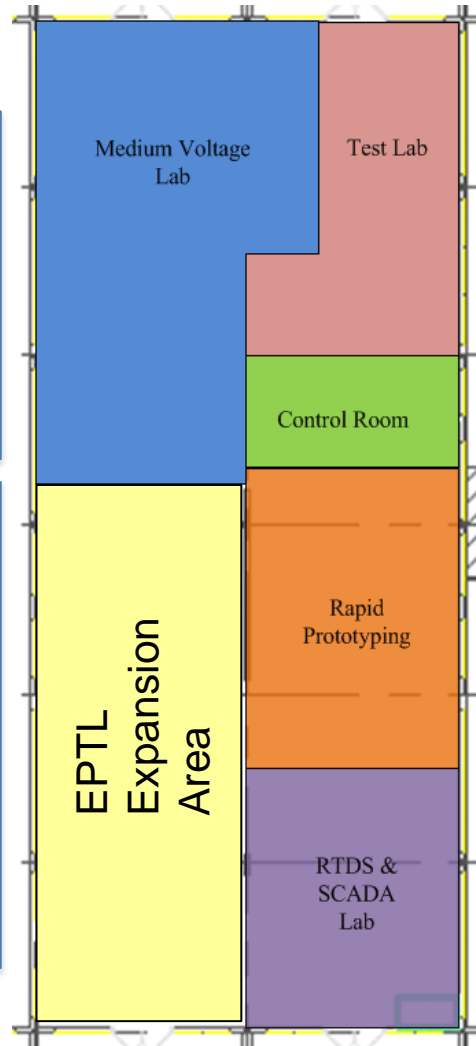
Proposed EPTL Layout

Power Distribution Areas

- **MV Grid Lab:** Reconfigurable lab for traditional or microgrid projects. Designed using utility-grade distribution equipment.
- **Test Lab:** Isolated testing facility for safe testing of industry technologies, and EPTML research projects.
- **AC and DC:** Flexible power architecture capabilities – AC, DC, and hybrid systems

Specialty Areas

- **Rapid Prototyping:** Advanced machine shop for development of professional grade components and projects.
- **SCADA Center:** Automation, metering, and control for distribution network.
- **Relaying and Controls:** Protective relaying technologies, Phasor-measurement, and advanced control
- **RTDS Center:** Real-Time Digital Simulator and hardware in the loop capabilities – research and testing on industry leading equipment.



Laboratory Ratings and Features

- 15 kV-ac, 5 MVA and 1 kV-dc, 1 MVA capacity
- Micro-Grid/Micro-Energy Environment at Electric Utility Distribution Level
- Distributed Energy Resource and Load Integration
- Renewable Technologies (Solar PV, Wind, etc.)
- Energy Storage, Electric Vehicle-2-Grid
- Distribution Feeder Infrastructure
- Real Time Digital Simulator (RTDS)
- SCADA and Systems Operations
- Protective Relaying and Substation Automation
- Advanced Control and Communications, PMU
- Modeling, Simulation, and Analysis
- FACTS and HVDC Control Systems
- Power Electronics Converters (and other power technologies development, prototyping, and testing -- e.g., IEEE 1547 certification)
- DC standards development (IEC SG 4)
- Integration of feeder analytics
- Technology testing and certification

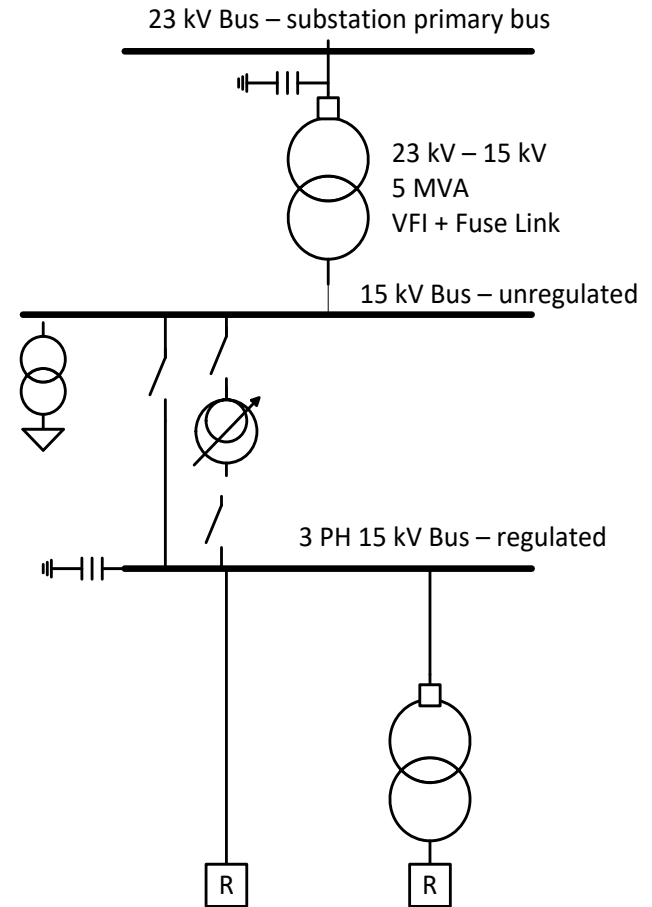




Outdoor Location of HV Interconnection – MITS



**Modular Integrated Transportable Substation
(MITS)**

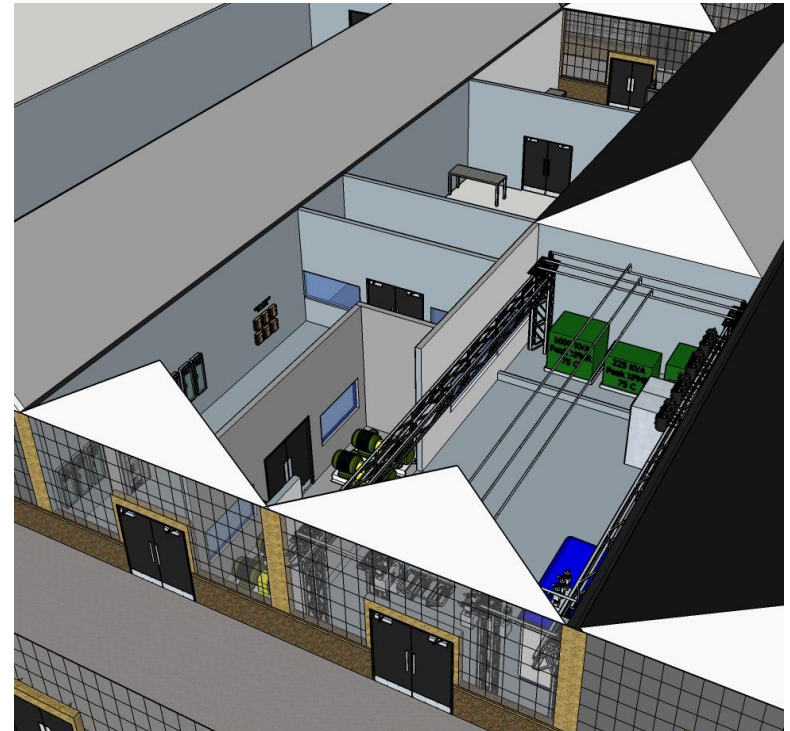


Electrical One-Line of MITS

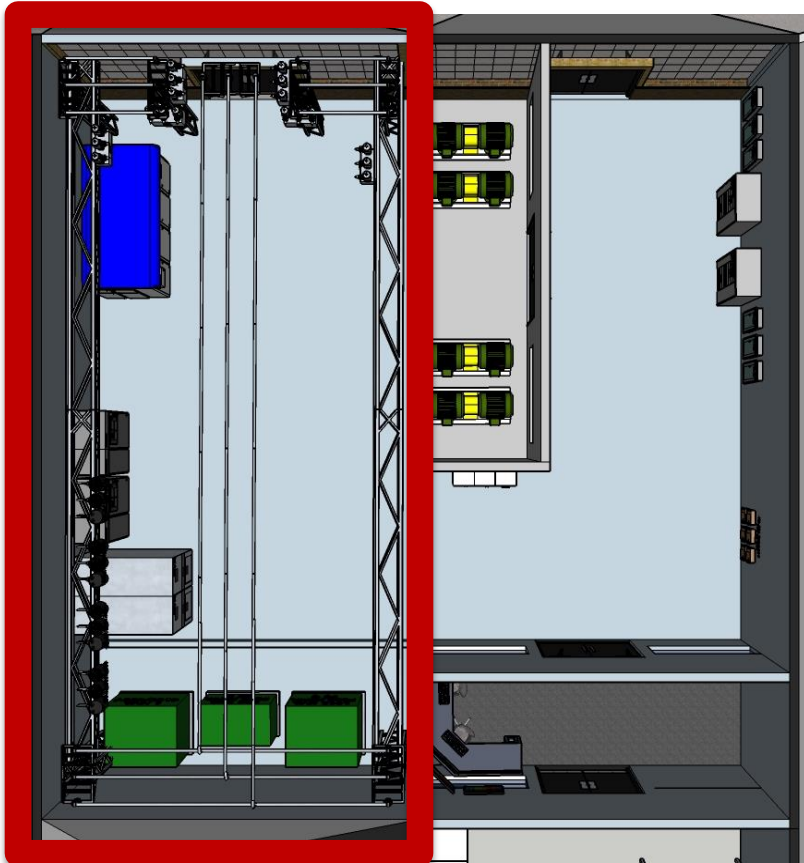




View from Administration Hallway



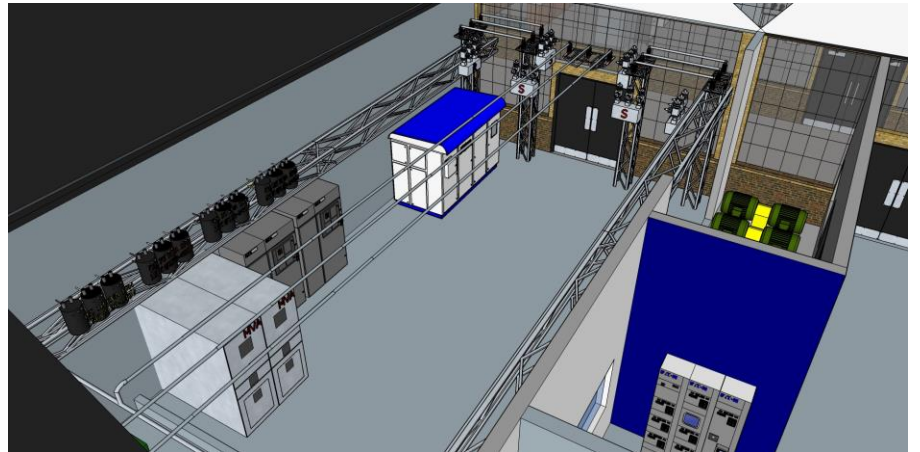
View from Loading Dock Hallway



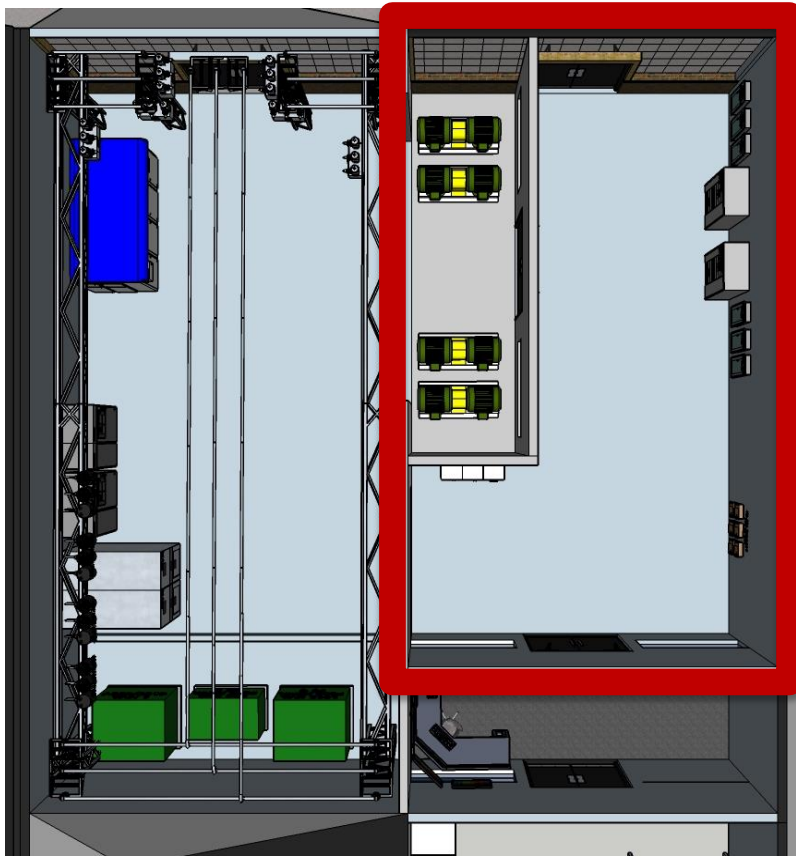
Medium Voltage Area



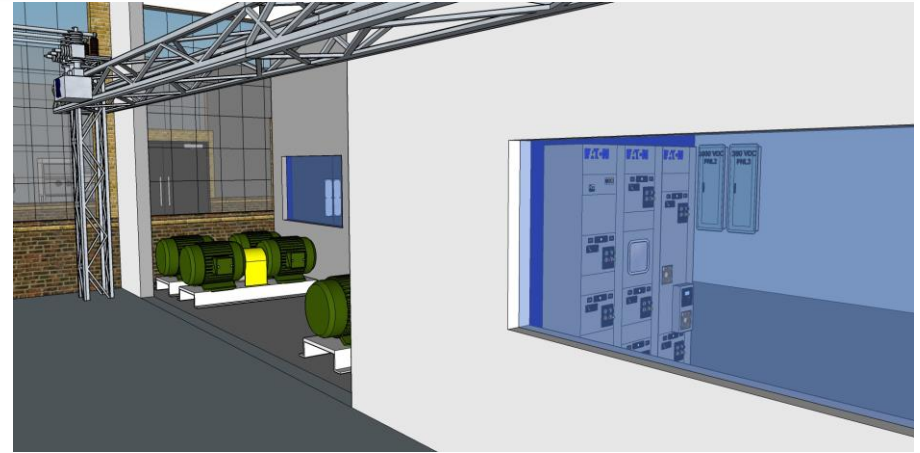
View from Lab Entrance



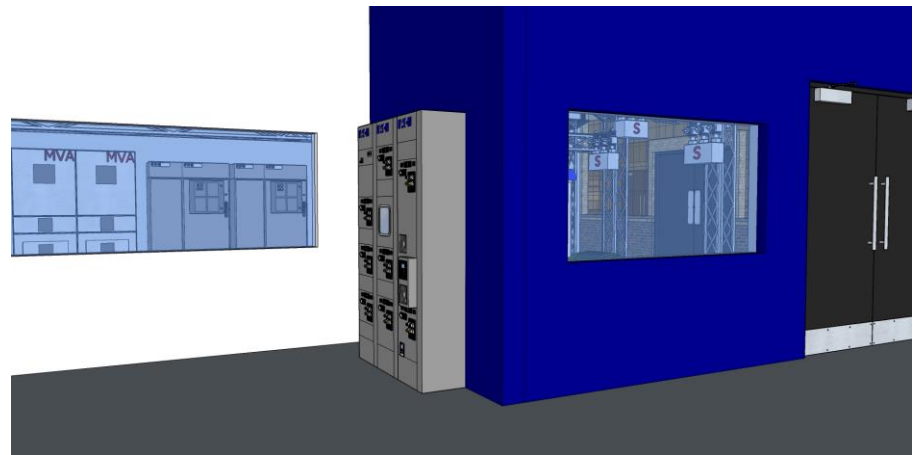
View from Mezzanine



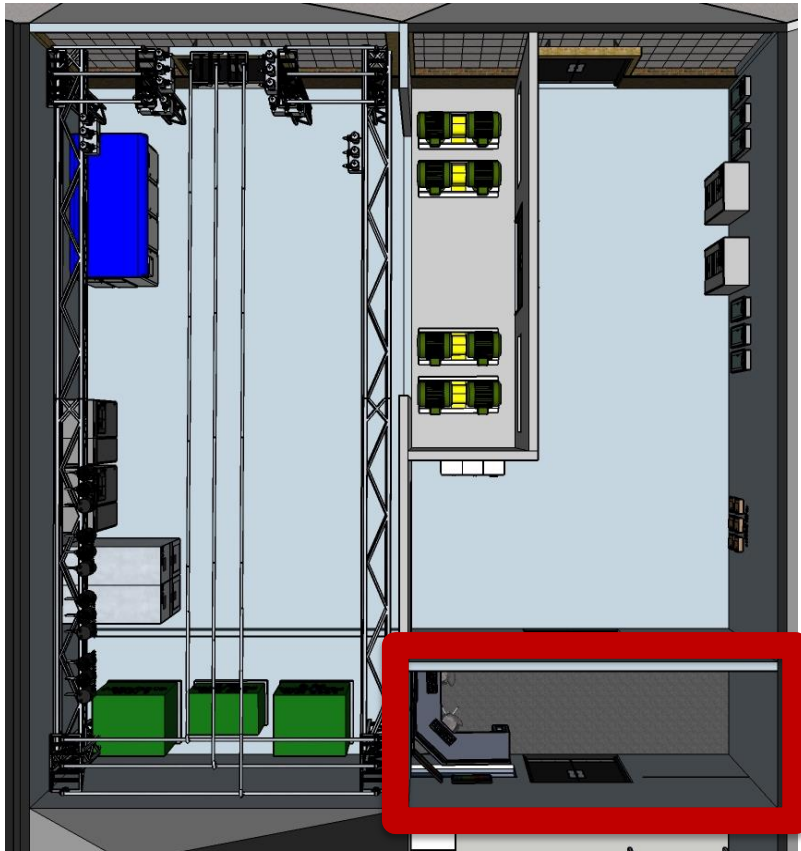
Testing and Motor Areas



View from Medium Voltage Area into Testing Area



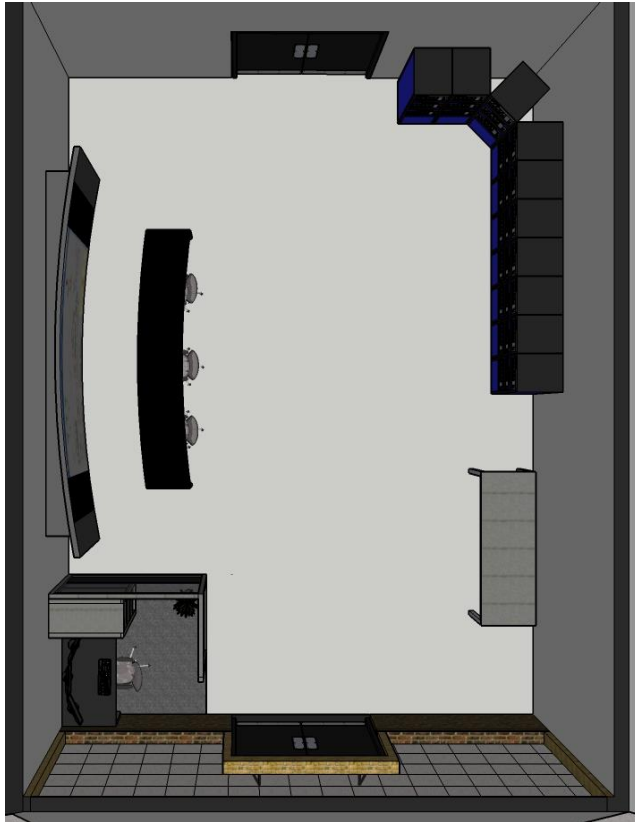
View from Testing Area into Medium Voltage Area



**Laboratory Monitoring Area
(Isolation while Testing)**



View into Testing Area and Medium Voltage Area



**Real Time Digital Simulation (RTDS),
EMS/SCADA, System Operations and
Relaying/Automation/PMU Area**



View from Entrance into Lab



View from Prototype Area Door Entrance





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