

Alstom Microgrid System for Philadelphia Navy Yard

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ALSTOM
Shaping the future

ALSTOM Microgrid System for Philadelphia Navy Yard

PIDC – Owner and Manager of Philadelphia Navy Yard



REAL ESTATE

PIDC acquires, improves, plans, manages, leases, and sells real estate to support the next wave of industrial and commercial activity in Philadelphia.



FINANCING

- PIDC offers a wide range of loans, tax-exempt financing, and technical assistance to businesses, developers, and non-profits of all shapes and sizes.



KNOWLEDGE & NETWORKS

- PIDC brings together the public and private sectors in order to energize growth. We build relationships with clients and partners who are dedicated to Philadelphia's success.

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PIDC – Owner and Manager of Philadelphia Navy Yard

- Centralized location for regional workforce of more than 3 million employees
- Access to:
 - Major highways
 - Intermodal freight system
 - International Airport
 - Center City, University City, and 30th Street Station
 - Sports Complex



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Philadelphia Navy Yard - Today



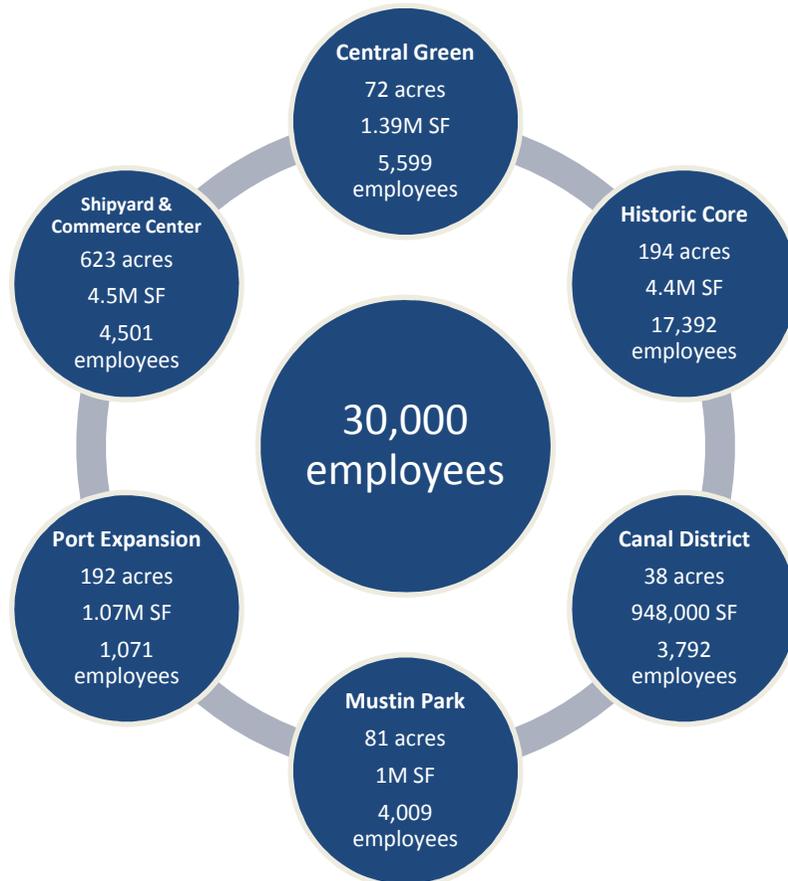
- More than 11,500 employees
- 145 companies; 3 Navy activities
- In excess of 7.0 million SF occupied
- \$750+ million of private investment
- \$150+ million of publicly-funded infrastructure improvements
- Office, R&D, and industrial campus





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Philadelphia Navy Yard @ Full Build Out

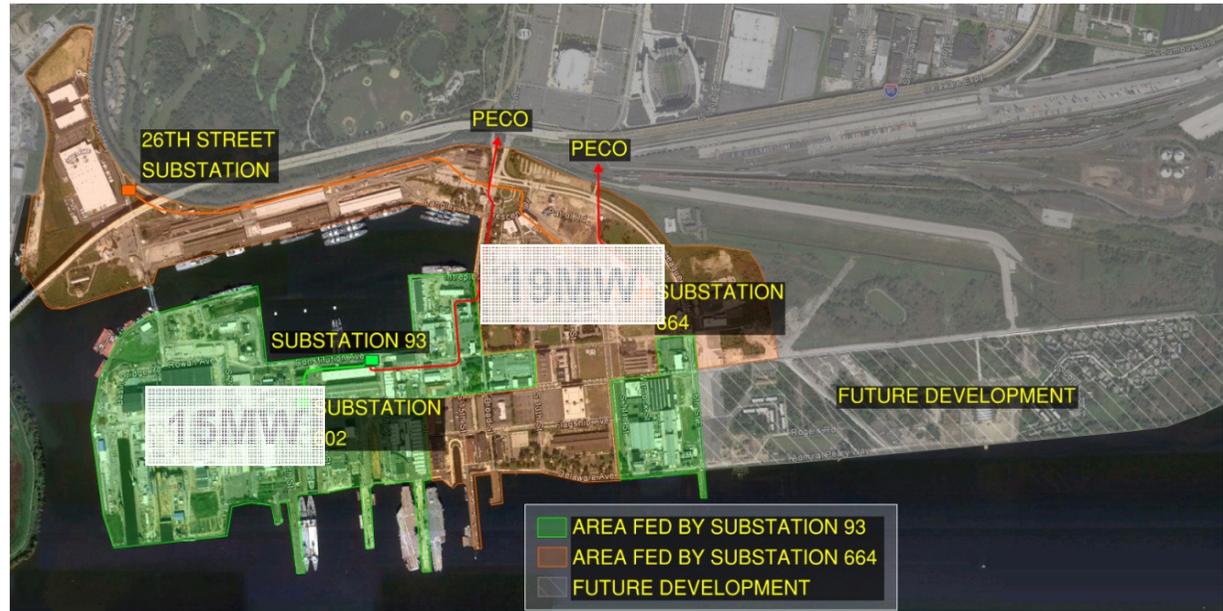


- 30,000 employees
- 1,500 residential units
- 15+ million SF
- \$4 billion of investment
- \$11 billion of local and state impact annually
- \$275 million of state and local tax revenue annually

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Current Electric Capacity

- Approximately 98% of the total electric usage is currently purchased externally from Constellation Energy and delivered to The Navy Yard by PECO
- PIDC's electric grid currently has capacity of 34 MW via two substations – SS93 and SS664



- SS93 primarily serves the Navy, Shipyard and Urban Outfitters and has on high demand days been exceeding its capacity
- SS664 primarily serves the Corporate and Commerce Centers and at peak is running at 53% of capacity

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ENERGY MASTER PLAN - Goals

- The Navy Yard Energy Master Plan completed (co-terminous with the real estate 2013 Update) a comprehensive energy, infrastructure, technology, and business plan that has become the guide to address the future of PIDC's unregulated electric distribution system with the following goals:
 - **Goal 1: Provide a competitively priced energy supply to all customers**
 - **Goal 2: Provide a platform for customer engagement and energy choice**
 - **Goal 3: Attract a Continuing Diverse Base of Businesses to The Navy Yard**
 - **Goal 4: Attract Energy Innovation & Testing through growth of TNY Smart Energy Campus**
 - **Goal 5: Maintain Sustainable Self-Funding Business Models for Continuing Development**
- It establishes an overall approach for addressing the existing and rapidly increasing energy requirements at the site which not only includes electricity, but also the expanding use of natural gas, renewables and the marketplace's growing interest in improved resiliency (ie: grid independence)

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ENERGY MASTER PLAN – Action Plans

The Five Point Action Plan

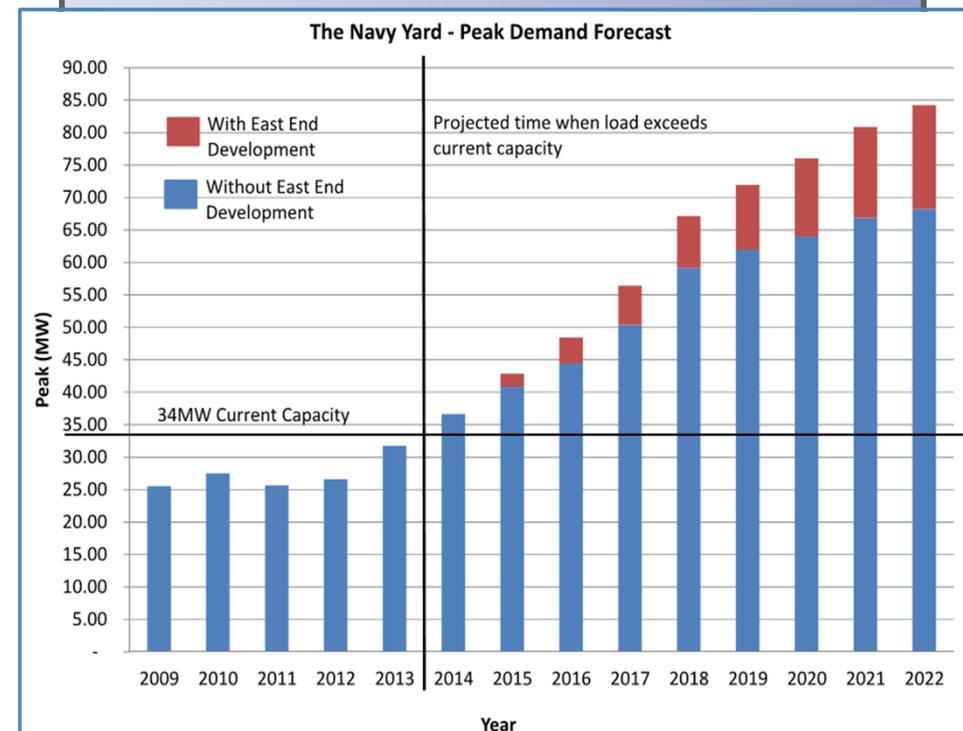
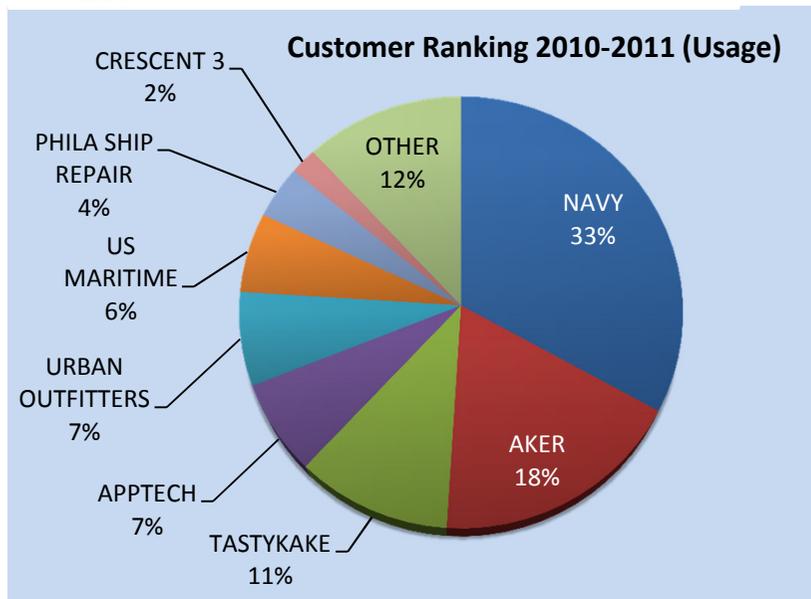
- **Infrastructure:** Capacity, Generation/Supply, Technology -
Microgrid
- **Business Model:** Forecasts, Tariffs, Procurement, O & M, Capital
- **Building Owner Opportunities:** DG, EE, DR – Programs &
Partnership
- **Test Bedding Outreach and Protocols:** Energy Innovation
Campus
- **Carbon Reduction and Sustainability:** Reduce Carbon Intensity

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ENERGY MASTER PLAN – Key Highlights

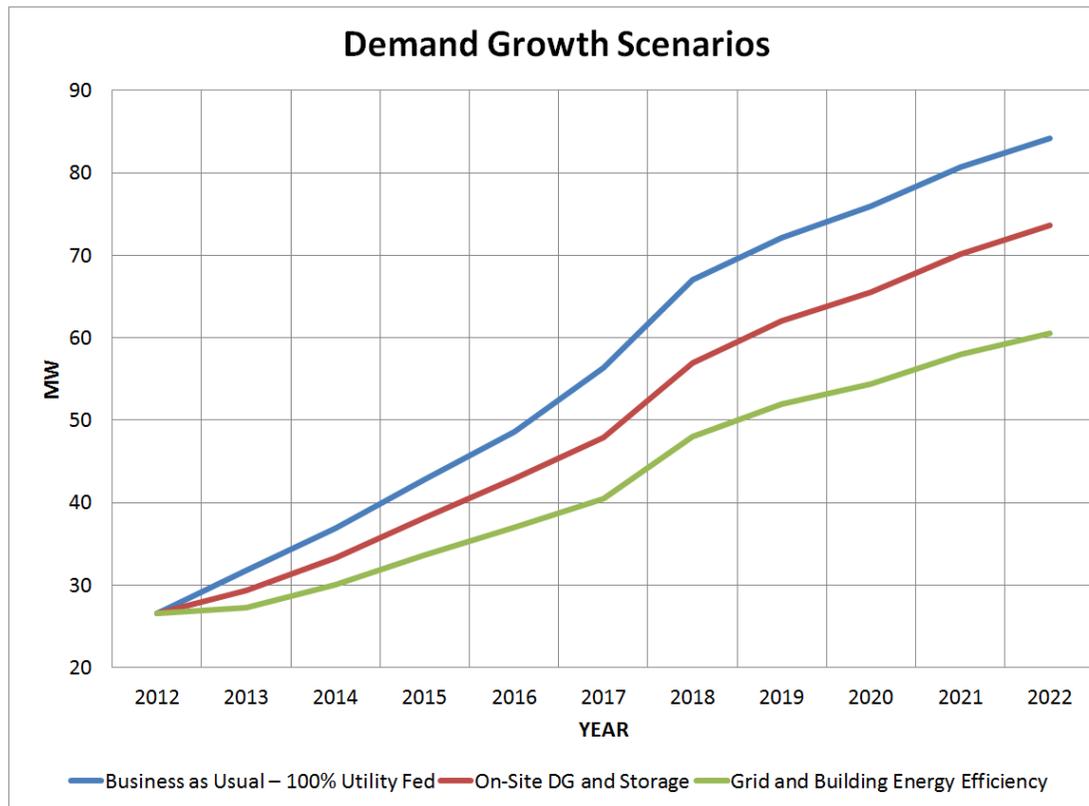


- **Rapid Growth**
- Vintage 1930s – 2 primary substations
- PJM → PECO → 13.2 KV Supply
- Current - 25 MW Peak Load
- Ambition of 10+ MW DER with 50+ MW



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ENERGY MASTER PLAN – Implementation Approach



Cumulative usage decrease – over 61,000 MWh

Business as Usual – 100% Utility Fed

- All PECO supply
 - No On-site generation (DG)
 - No proactive EE or DR effort
- Utility Demand - **82 MW**

On-Site DG

Grid Programs:

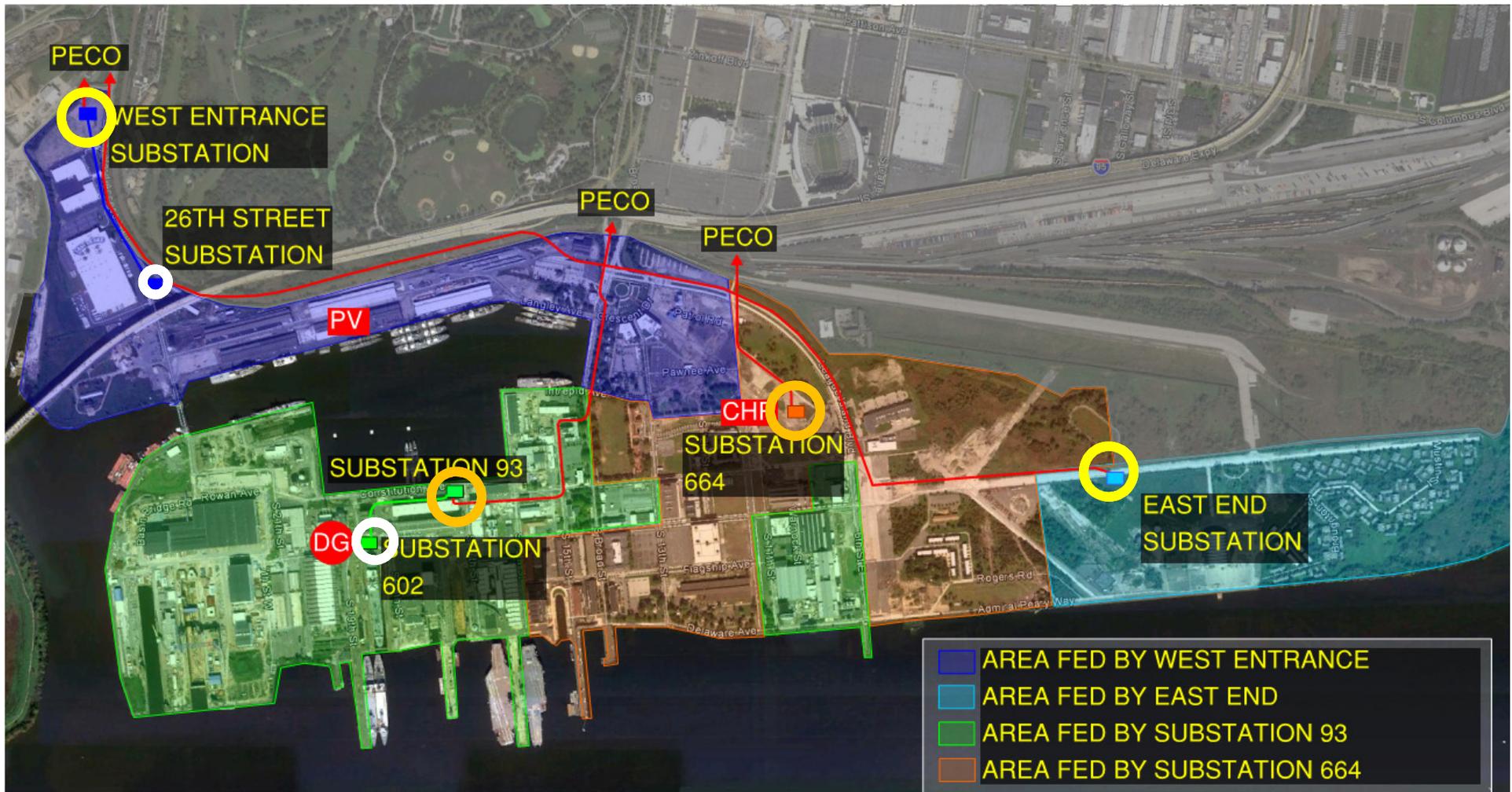
- Natural gas DG
 - 6 MW Peak Reduction
 - 3 MW CHP (data center)
 - 1 MW Solar PV
 - 600 KW Fuel Cell
- Utility Demand - **72 MW**

Demand Response & Energy Efficiency

Customer programs:

- 20% EE goal by 2022
 - Navy DOD mandates
 - B-T-M Demand Reduction
- Utility Demand - **60 MW**

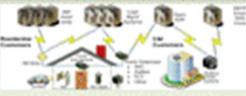
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ALSTOM – PIDC - DOE Project

Project - Overall Objectives & Methodology

<u>Project / Community Objective</u>	<u>DOE Objective</u>	<u>Project Methodology and RD&SD scope of work</u>
<p><u>PIDC service reliability objective</u> support agreement for 100% guaranteed supply to URBAN (3MW load) a C&I Client</p> <p><u>PWD service reliability objective</u> 100% guaranteed supply to waste water plant</p>	<p><u>DOE (98%)</u> <u>Grid Resilience</u></p> 	<p><u>PIDC</u> -Network 6MW DG and 1 MW solar /storage and support islanded operation</p> <p><u>PWD</u> - Network CHP & BIO-Gas Plant and support islanded operation</p> <p>RDSD for MG Ops-Planning, Islanding Reconnection Protection Dispatch</p>
<p><u>PIDC and PWD Sustainability Objective</u> Develop renewable portfolio for <u>local generation and storage</u> as economical viable alternative</p>	<p><u>DOE (20%)</u> <u>Emission Reduction</u></p> 	<p><u>PIDC</u> –Operate 1 MW community solar / 300 KW storage in the community microgrid</p> <p><u>PWD</u> – Operate Biogas plant together with CHP</p> <p>RD&D for MG Ops-Planning, Portfolio Dispatch Ops & Control</p>
<p><u>PIDC Capacity Expansion Objective</u> Develop 20% of local generation as economical viable alternative to meet capacity needs per Energy Master Plan</p>	<p><u>DOE (20%)</u> <u>System Energy Efficiency</u></p> 	<p><u>PIDC</u> – Optimize import and local generation consisting of 6MW DG, 1 MW solar , 600 KW Fuel cell, 300KW storage, and 3 KW CHP</p> <p>RD&D for MG Ops-Planning, Portfolio Dispatch Ops & Control</p>

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Project - Technical Objectives

C1: MG Islanding Management Module Based on Voltage & Frequency Ranges

Voltage (V) range in per unit (pu)	Maximum islanding time in seconds (s)	Frequency (f) range in Hertz (Hz)	Maximum islanding time (s)
$V < 0.5$	0.16	$f > 60.5$	0.16
$0.5 \leq V < 0.8$	2	$f < \{59.8-57.0\}$ (adjustable set point)	Adjustable 0.16 to 300
$1.1 \leq V < 1.2$	1	$f < 57.0$	0.16
$V \geq 1.2$	0.16		

C2: MG Resynch & Reconnection Management Module Based on ANSI/NEMA/IEEE 1547

Microgrid rating (MVA)	Frequency difference (Δf , Hz)	Voltage difference (ΔV , %)	Phase angle difference ($\Delta \theta$, °)
1.5-10	0.1	3	10

C3: Frequency and Voltage Management Module (Islanded Ops) Based on ANSI 84.1-2006

C4: Microgrid Protection Management Module (Islanded Ops) Based on IEEE1547

- Adaptive Protection for Islanding Ops
- Fault Detection & Clearing Islanding Ops

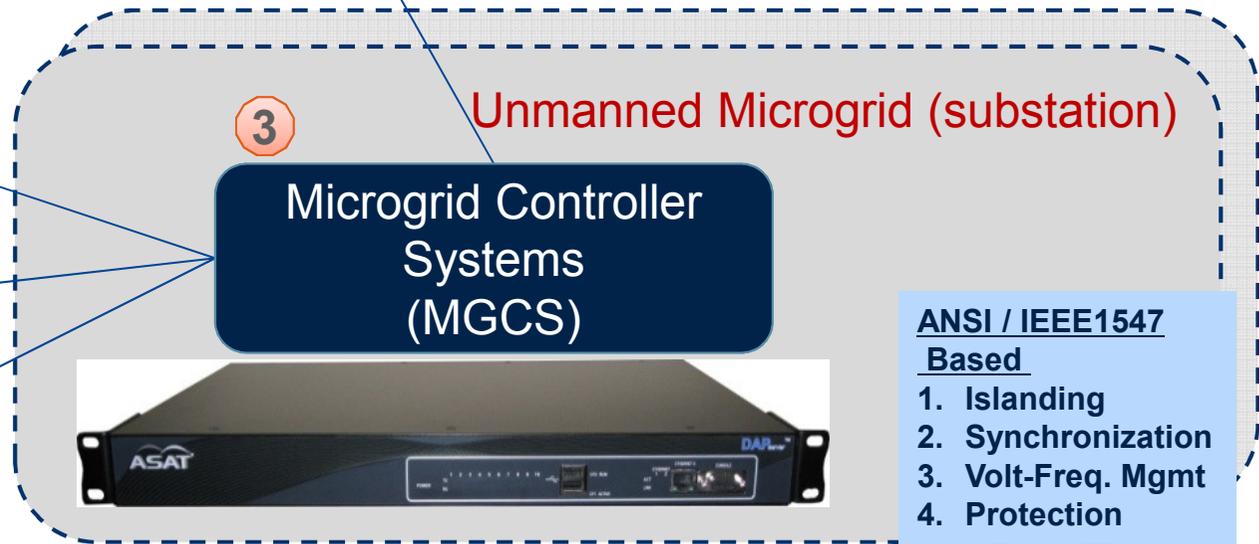
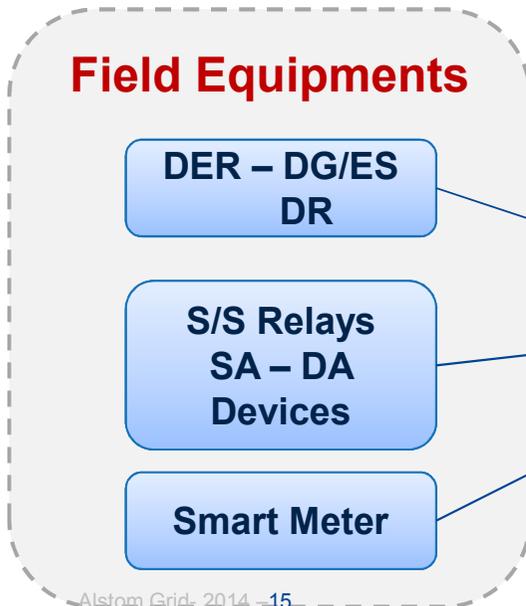
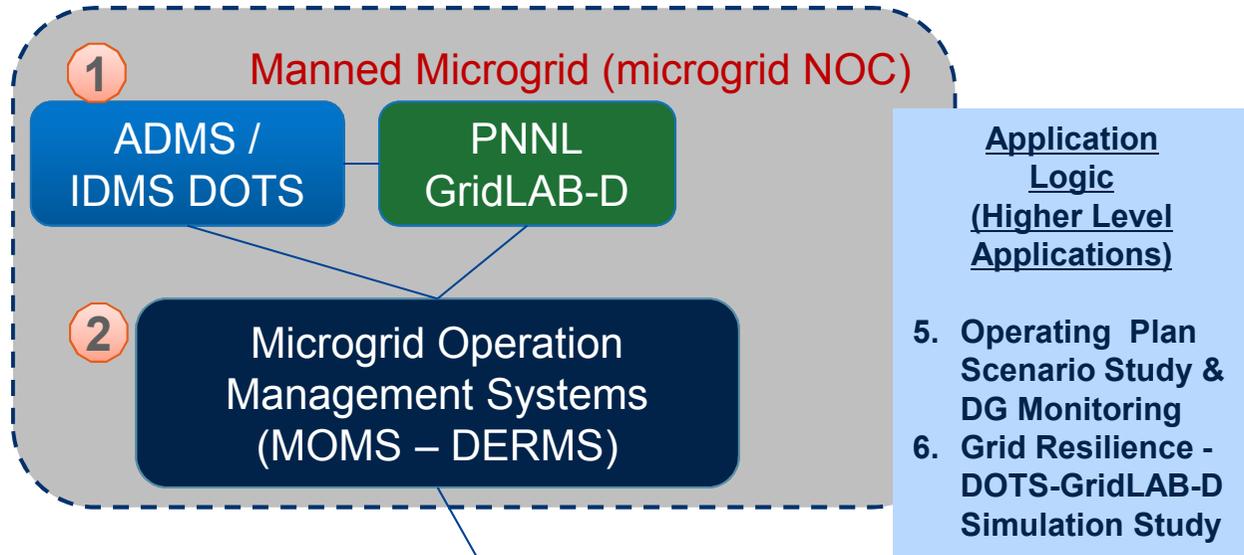
C5: Microgrid Portfolio Optimization & Dispatch Management

C6: Microgrid – System Simulation - Utility Interface & Grid Resiliency Management

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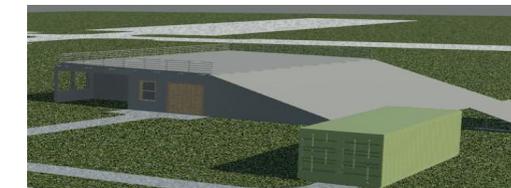
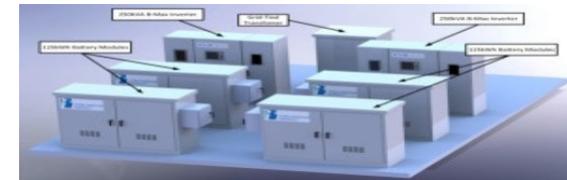
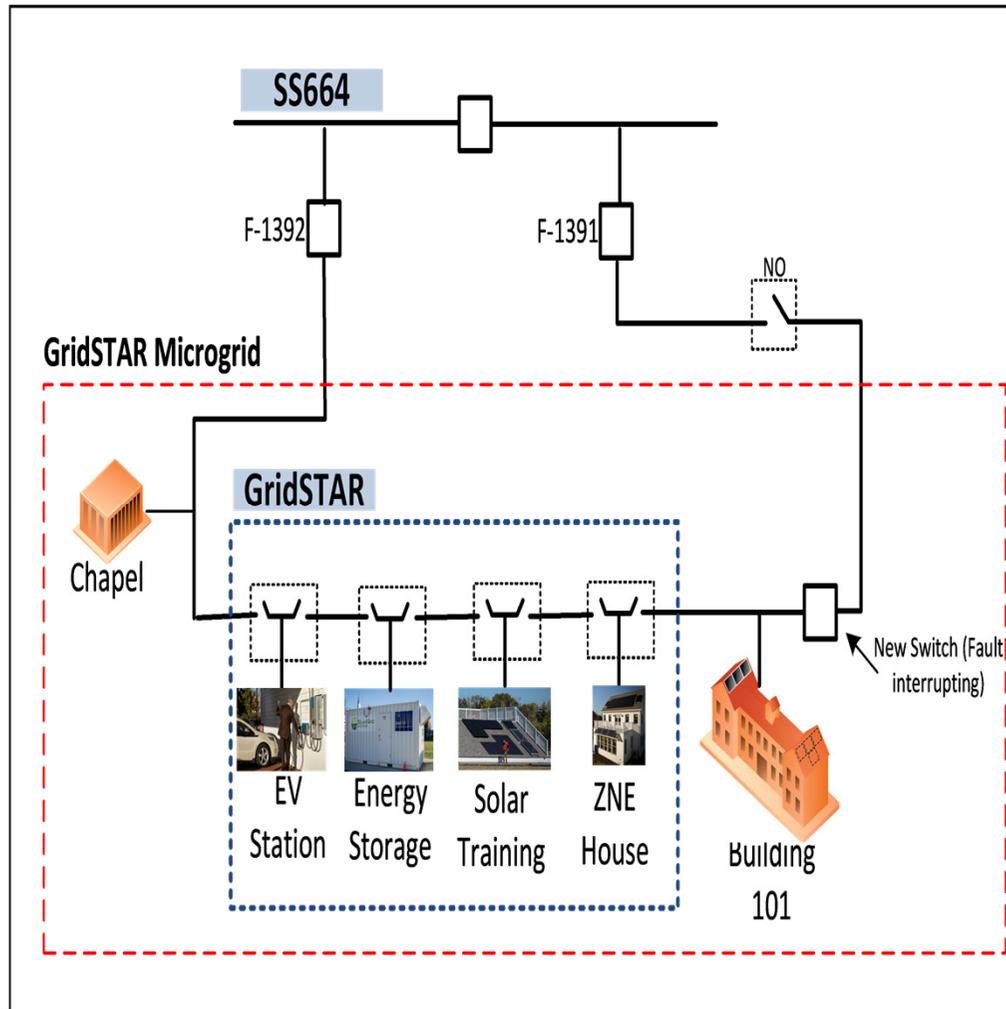
ALSTOM Microgrid System Components



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Microgrid Topology – GridSTAR Picogrid

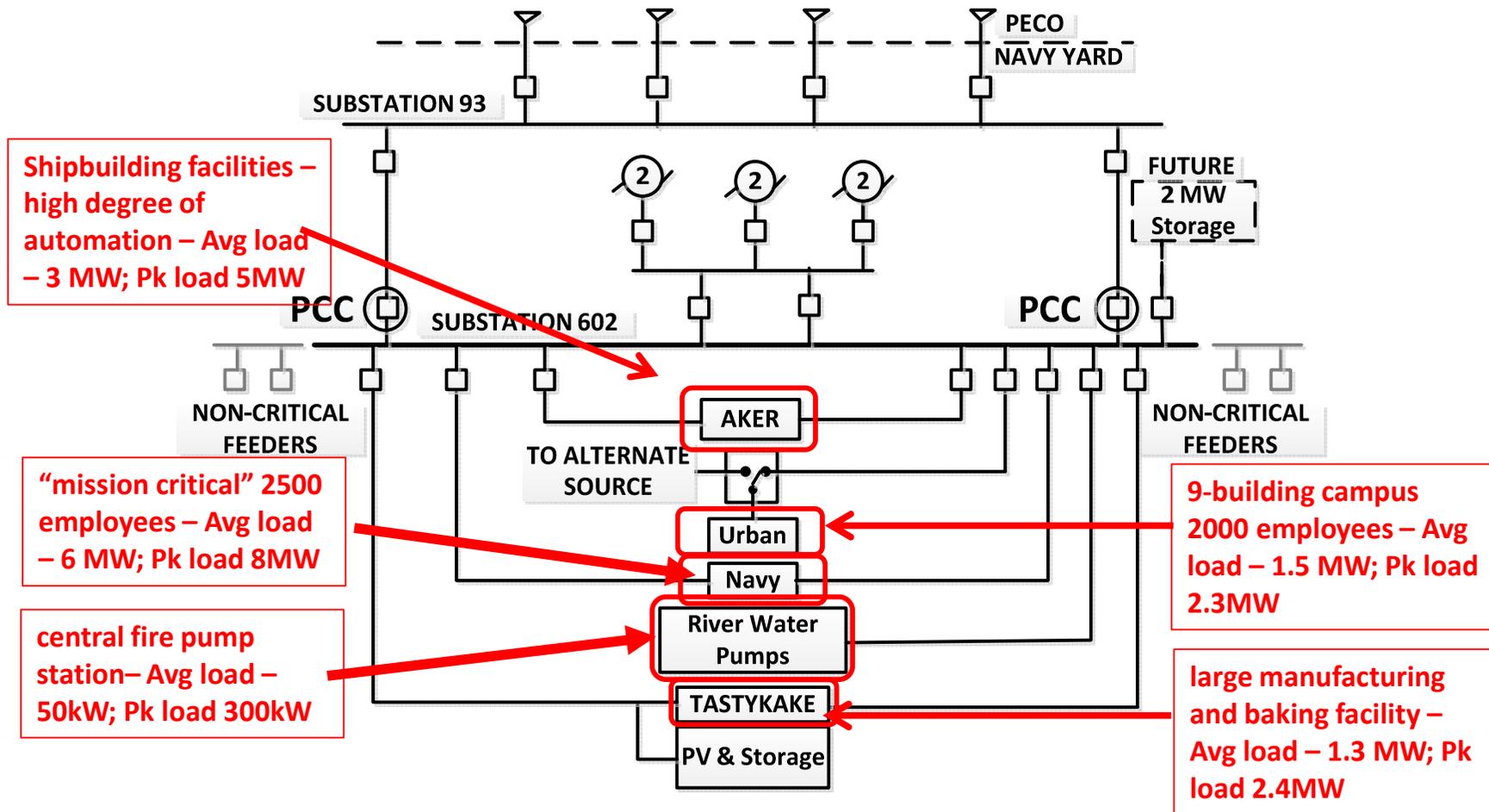


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Microgrid Topology – Substation Level Minigrid

Critical Loads



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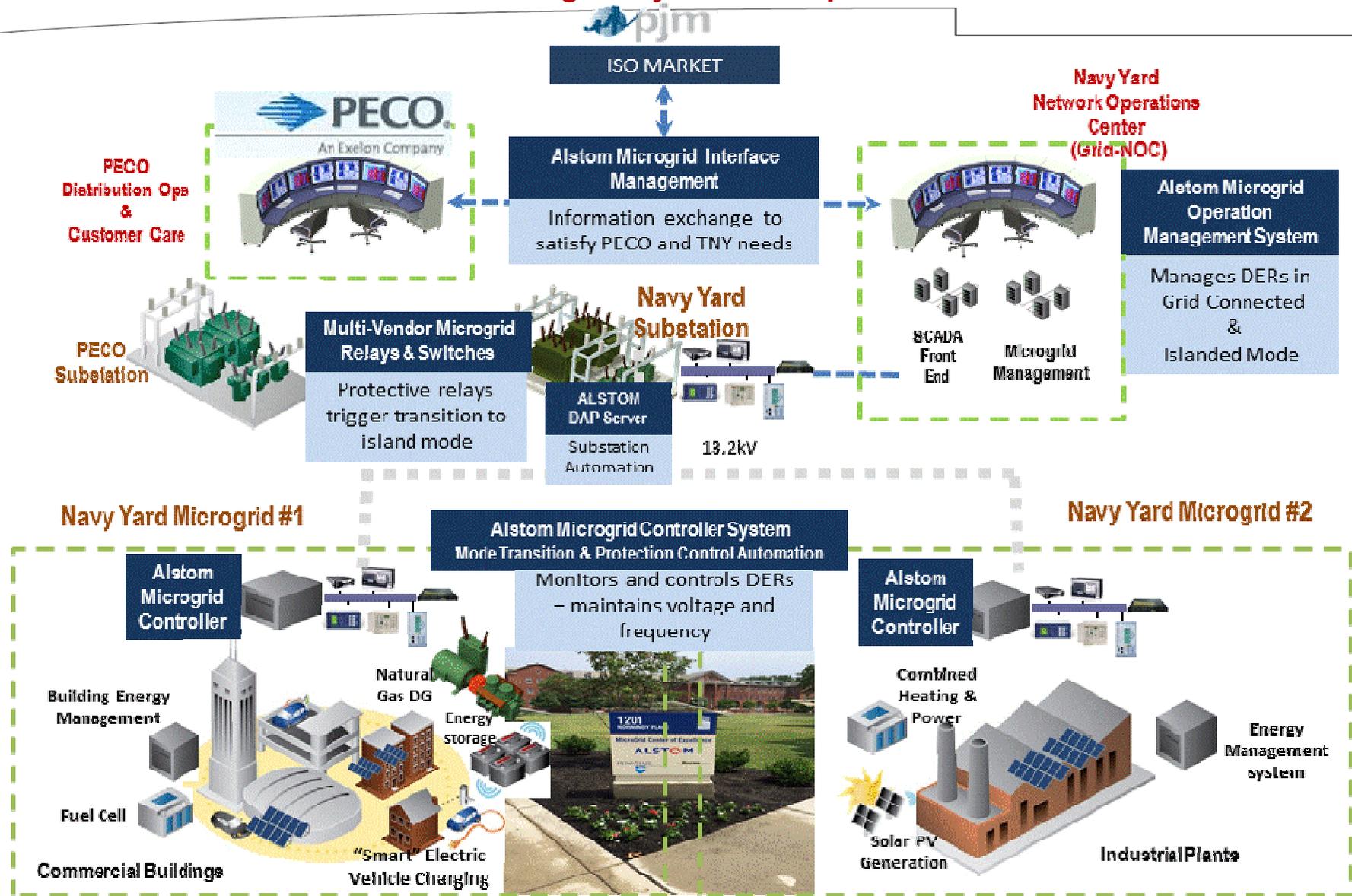
Microgrid Topology – Multiple Microgrids



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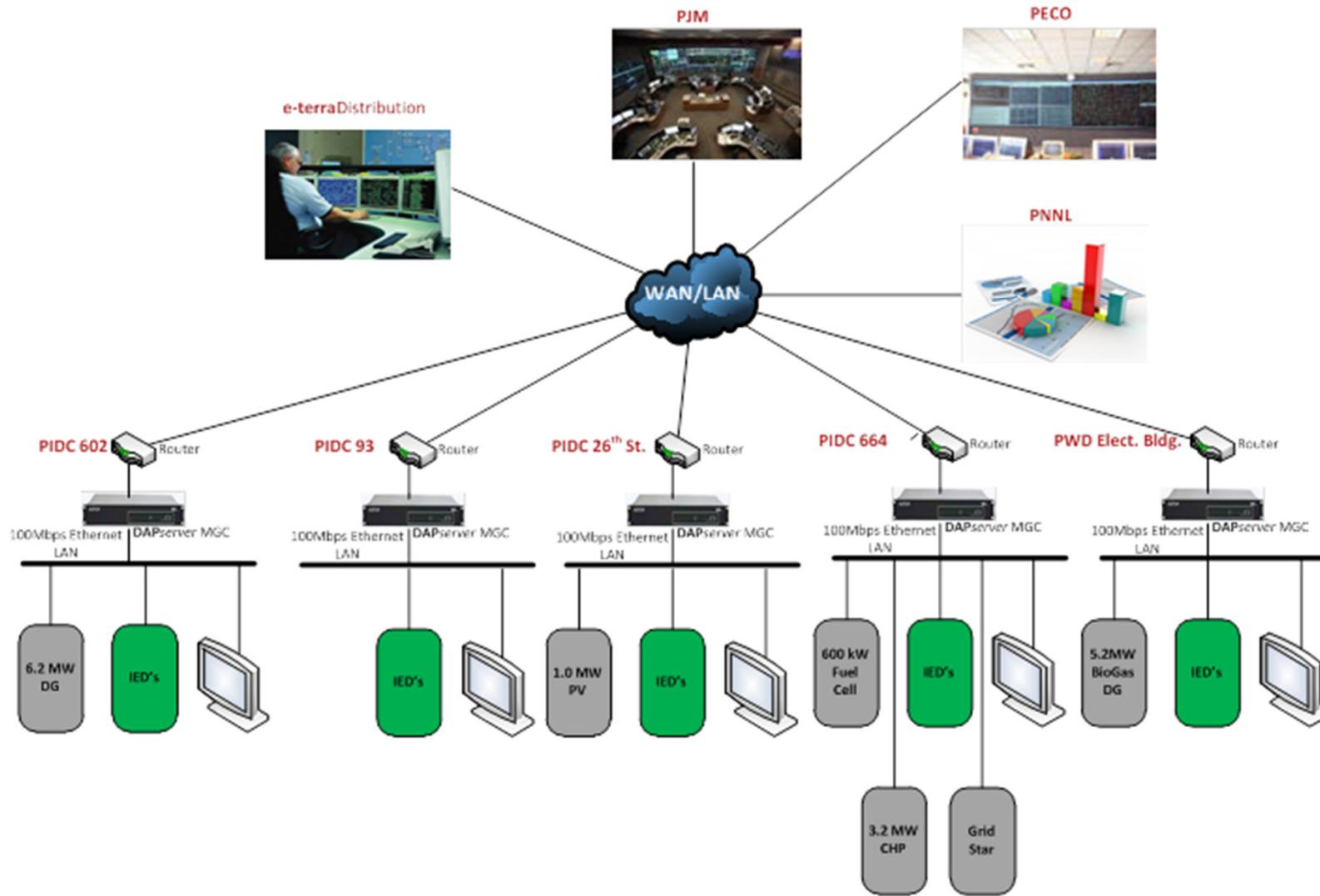
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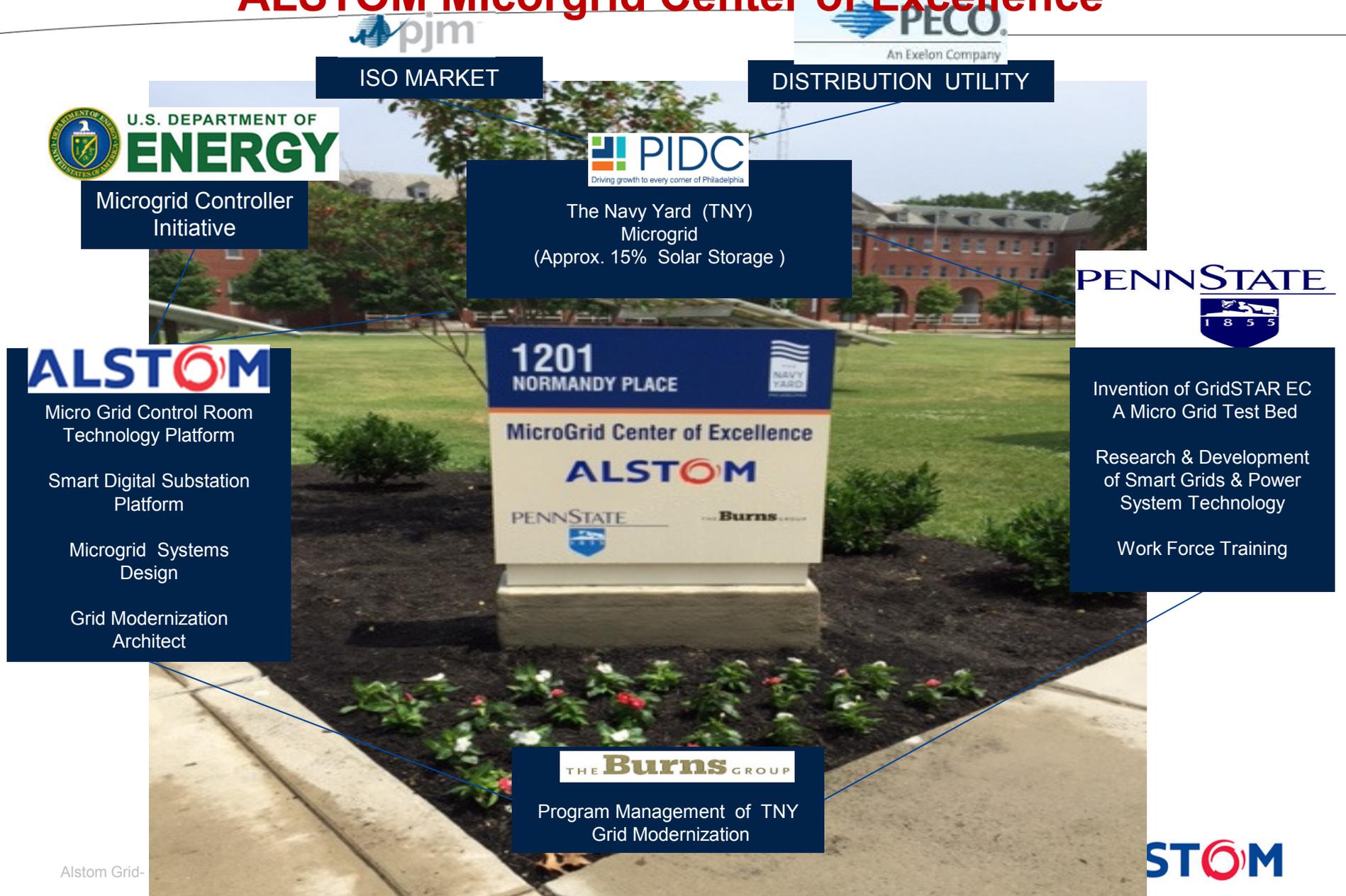
Vision & Pathway

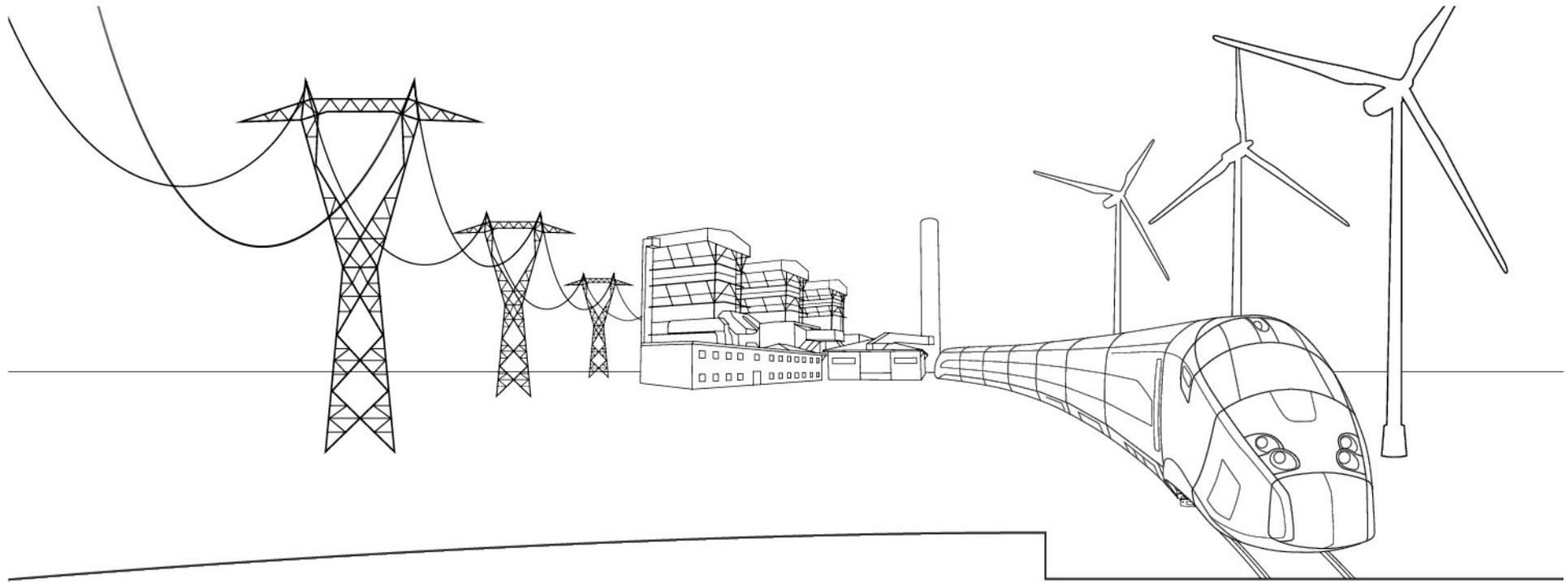


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ALSTOM Microgrid Center of Excellence





THANK YOU !

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