Contents

1. Introduction & Definitions

NSU aims to establish a benchmark for building design and operation in alignment with its Energy & Sustainability Strategic Plan and Policy. The goal is for all facilities to achieve LEED Platinum or LEED Zero standards by developing energy-efficient, grid-interactive buildings using SMART technology to achieve Net Zero Energy consumption. The Nursing building, certified LEED Gold in 2015, will be the first building to be retrofitted to include smart technologies and integration into a building cluster, itself part of a microgrid. This project will serve as a prime example of how to integrate grid-interactive buildings utilizing smart technologies to achieve LEED Zero Energy certification.

Net Zero Energy Campus
An energy-efficient campus where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.

LEED Zero Energy
LEED Zero Energy recognizes a source energy use balance of zero over a period of 12 months. To obtain LEED Zero Energy certification, a project must achieve a source energy use balance of zero for the past year. **The net zero energy balance** is based on the quantity of source energy delivered and the quantity of renewable energy that displaces non-renewable energy on the grid. Renewable energy generated and used on site reduces the amount of energy delivered.

Source Energy Balance = (Total Source Energy Delivered) – (Total Non-Renewable Source Energy Displaced)
This equation can also be written as: **Source Energy Balance =** (Total Energy Delivered x Non-Renewable Source Conversion Factor) – [(Total **Renewable Energy Generated and Exported to Grid** x Non-Renewable Source Conv. Factor) + (**Offsite Renewable Energy Procured** x Nonrenewable Source Conv. Factor)]

Non-renewable energy displaced includes:

- **Onsite renewable energy** generated and exported to grid.
- **Offsite renewable energy procured**.
  If purchasing Energy Attribute Certificates (EACs), also known as Renewable Energy Certificates (RECs), the EACs must be Green-e Energy certified or equivalent. Carbon offsets must be Green-e Climate certified or equivalent.

After maximizing passive strategies and investing in energy efficiency to reduce overall energy demand, LEED recommends the following hierarchy for selecting renewable energy sources:

1. On-site generation
2. Local generation, such as community solar or wind, in instances where it will have a

beneficial decarbonizing impact.
3. Offsite generation projects, such as through power purchase agreements.

4. Energy attribute certificates (EACs), also known as Renewable Energy Certificates (RECs)

Note: Projects must be LEED certified under a BD+C or O+M rating system to participate and must provide 12 months of performance data to the Green Business Certification Inc. (GBCI).

US Department of Energy - Net Zero Energy Buildings
Zero Energy Building (also referred to as a "net zero energy" or "zero net energy" building) is "an energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy. This definition also applies to campuses, portfolios, and communities.

Net Zero Energy buildings focus on balancing energy consumption with renewable energy production.

2. Campus-Wide Key Strategies

Grid-Interactive Efficient Building and Flexibility:

- These buildings integrate energy efficiency, storage, renewable energy, advanced metering, and load flexibility technologies.
- Utilize Distributed Energy Resources (DER), Distributed Generation Technology (DGT), Sectionalized Grid-Interconnected Systems, and Advanced Metering Infrastructure (AMI).
- Optimize energy use, balance loads during peak demand, and reduce frequency deviations.
- Generate onsite energy equal to or greater than the total energy consumed, achieving net zero.
- Use surplus energy to offset future demand, exporting excess to the grid or storing it in Battery Energy Storage Systems (BESS).

SMART Technology/ Holistic Optimization:

- Employ AI, machine learning, and IoT to optimize energy use based on occupant patterns.
- Use real-time analytics for simulations and optimizations.
- Enable communication and control through smart, responsive devices.

Distributed Energy Resources (DERs):

- Implement on-site solar PV carports with EV charging stations, roof solar PV array, geothermal heat pumps.
- Integrate DERs with grid-interactive buildings and BESS.
- Use existing spinning generation or PEM fuel cells for additional support.

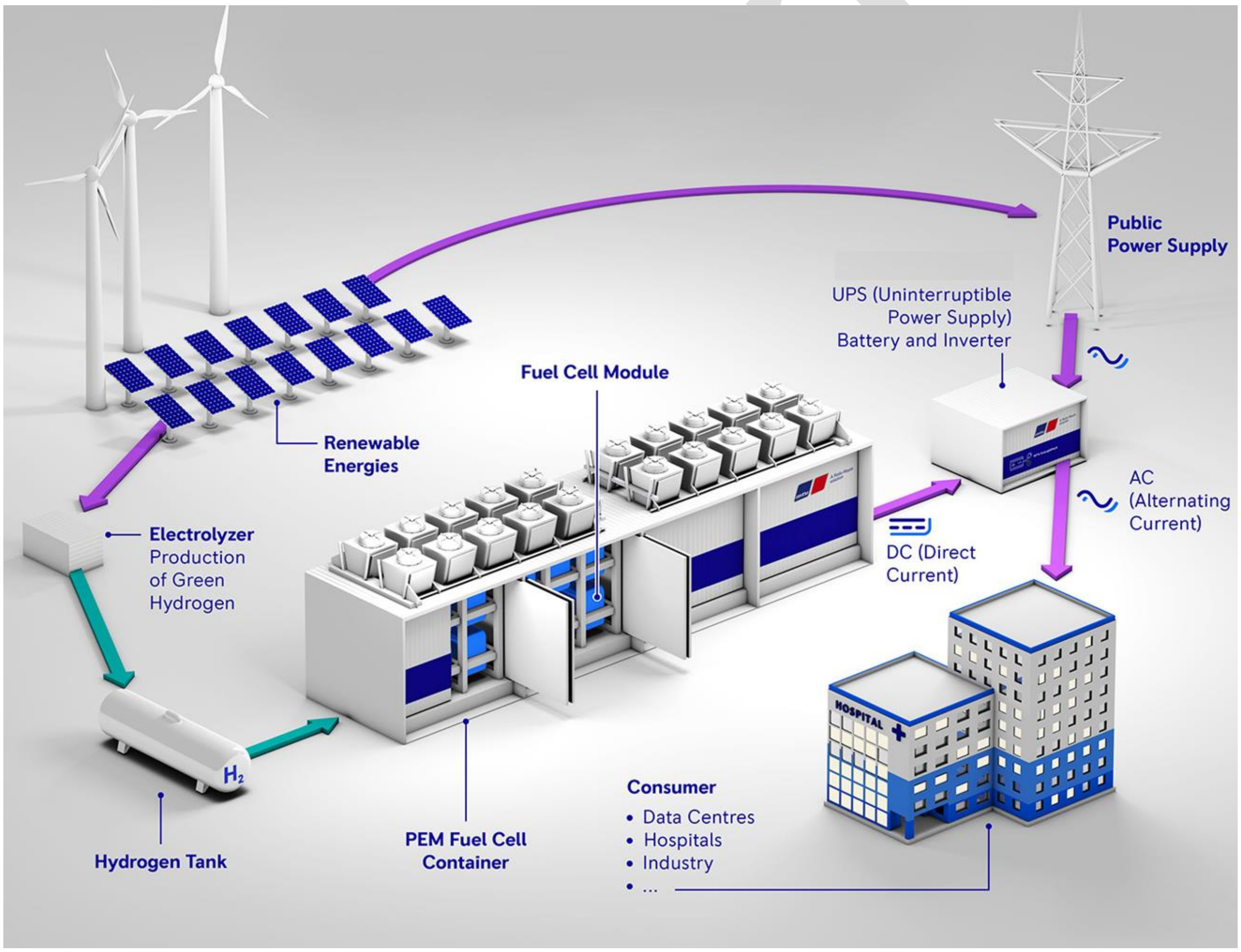
Distributed Generation Technology:

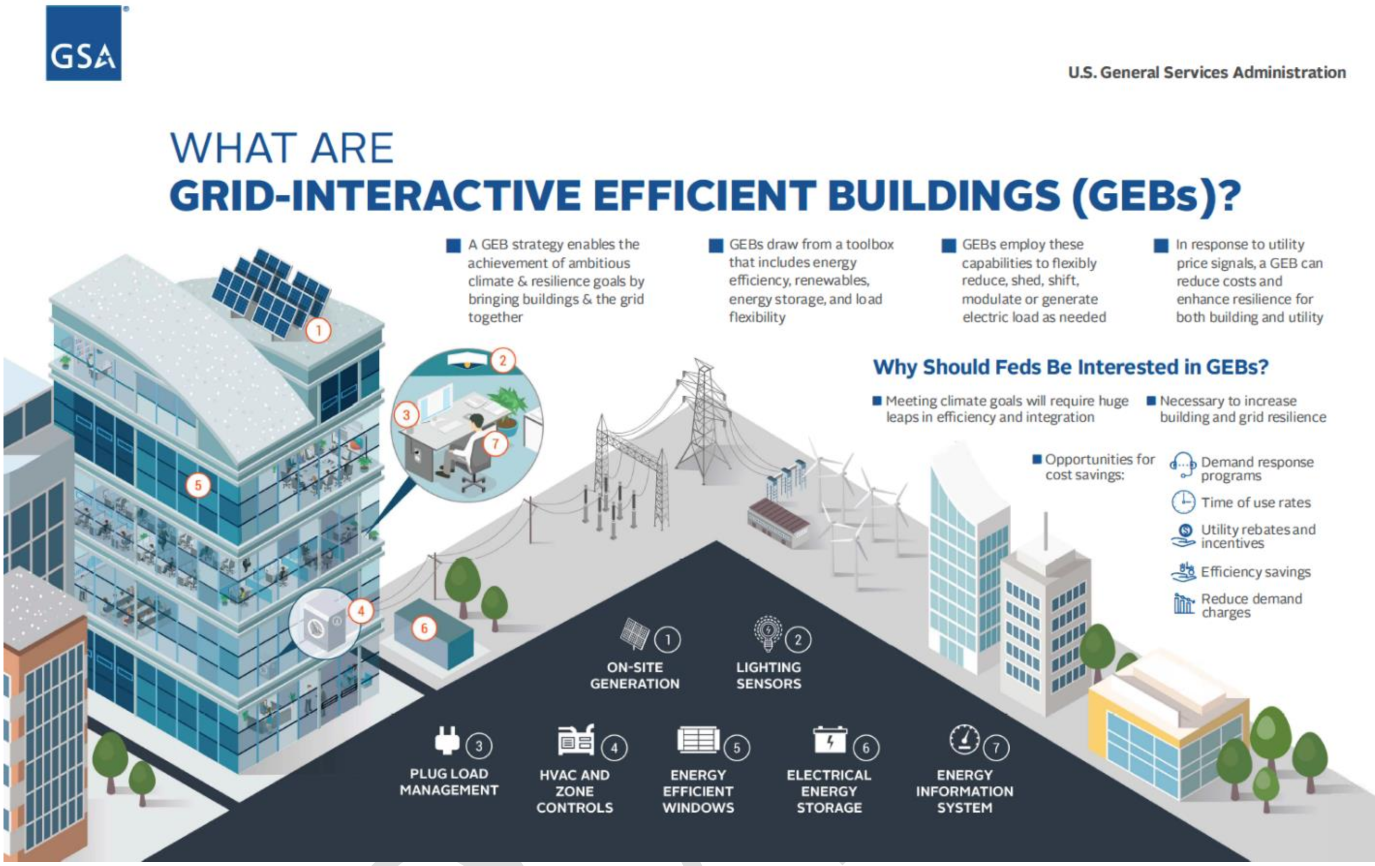
- Use PEM fuel cells for clean, reliable electricity, especially during peak demand or as backup power.

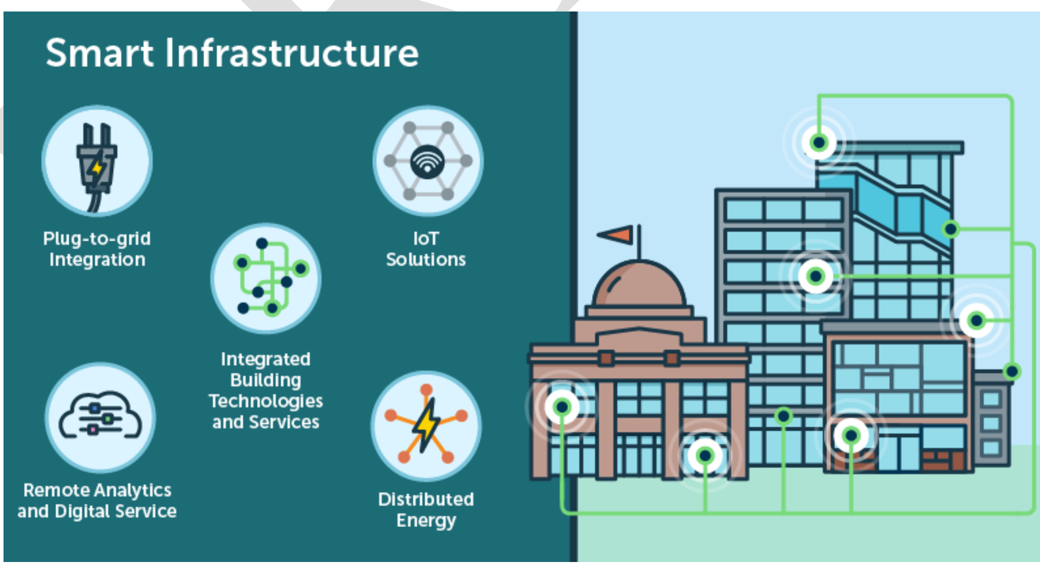
- Provide grid stability by regulating voltage and frequency.

Sectionalized Grid-Interconnected Systems:
- Create islanded and grid-connected mini-grids.
- Use automated switchgear to reroute power and restore circuits during faults.

Advanced Metering Infrastructure (AMI):
- Install AMI in each building and strategic locations.
- Collect detailed, real-time metering information for optimized energy management.




GSA
U.S. General Services Administration
WHAT ARE
GRID-INTERACTIVE EFFICIENT BUILDINGS (GEBs)?
A GEB strategy enables the achievement of ambitious climate & resilience goals by bringing buildings & the grid together
GEBs draw from a toolbox that includes energy efficiency, renewables, energy storage, and load flexibility
GEBs employ these capabilities to flexibly reduce, shed, shift, modulate or generate electric load as needed
In response to utility price signals, a GEB can reduce costs and enhance resilience for both building and utility
Why Should Feds Be Interested in GEBs?
Meeting climate goals will require huge leaps in efficiency and integration
Necessary to increase building and grid resilience
Opportunities for cost savings:
Demand response programs
Time of use rates
Utility rebates and incentives
Efficiency savings
Reduce demand charges
1 ON-SITE GENERATION
2 LIGHTING SENSORS
3 PLUG LOAD MANAGEMENT
4 HVAC AND ZONE CONTROLS
5 ENERGY EFFICIENT WINDOWS
6 ELECTRICAL ENERGY STORAGE
7 ENERGY INFORMATION SYSTEM


Smart Infrastructure
Plug-to-grid Integration
IoT Solutions
Integrated Building Technologies and Services
Remote Analytics and Digital Service
Distributed Energy

3. Technical Approach

The level of technical detail in a Concept Paper for Norfolk State University (NSU) applying for a state or federal grant should balance providing enough information to demonstrate the project's feasibility and alignment with state or federal priorities. Below are the recommended levels of detail for specific technical topics.

Telecommunication Infrastructure

- **Detail Needed**: Briefly describe the backbone infrastructure required for SMART technologies, such as high-speed fiber optics, 5G connectivity, and IoT device networks.
- **Example**: "The campus will deploy a robust IoT network supported by high-speed fiber-optic cabling and 5G connectivity, enabling real-time data exchange between SMART systems and building management platforms."

Electrical Distribution

- **Detail Needed**: Outline the enhancements to electrical distribution systems, such as microgrid integration, upgrades to handle renewable energy inputs, and dynamic load balancing.
- **Example**: "Upgrades to the electrical distribution system will include microgrid-ready substations and dynamic load balancing to integrate on-site renewables seamlessly with the campus grid."

Advanced Metering Infrastructure (AMI)

- **Detail Needed**: Describe the scope and purpose of advanced metering for real-time monitoring and data collection.
- **Example**: "Advanced metering systems will collect real-time data on energy use, enabling analytics to optimize energy consumption patterns and support demand response initiatives."

Energy Management Information Systems (EMIS)

- **Detail Needed**: Highlight the role of EMIS in monitoring, controlling, and optimizing energy use.
- **Example**: "An EMIS platform will centralize energy data from all buildings, providing predictive analytics and actionable insights to reduce energy consumption and improve operational efficiency."

On-Site Energy Generation (Solar PV)

- **Detail Needed**: Provide the capacity, layout, and expected output of solar PV installations.
- **Example**: "The project will deploy 2 MW of rooftop and carport solar PV systems across the campus, generating approximately 40% of the campus's energy needs annually."

Energy Storage (BESS)

- **Detail Needed**: Discuss the capacity, technology (e.g., lithium-ion), and integration of battery storage systems.
- **Example**: "A 1 MW/4 MWh Battery Energy Storage System (BESS) will store excess solar energy and provide backup power, enhancing grid stability and supporting demand-side management."

Connection to the Local Grid

- **Detail Needed**: Describe how the campus will interact with the local utility grid, including export of surplus energy.

- **Example**: "The campus will employ bidirectional grid interconnectivity, enabling surplus renewable energy export to the local grid during low-demand periods and grid power import during peak needs."

4. Building Cluster - Scope of Work

Architectural Design

- Design and layout of the buildings, including floor plans, elevations, and sections.
- Integration of sustainable materials and energy-efficient design features.

Mechanical Systems

- Design and specifications for HVAC systems, including energy-efficient equipment and controls.
- Plumbing systems with water-saving fixtures and rainwater harvesting.

Electrical Systems

- Electrical distribution system design, including main switchgear, distribution panels, and wiring.
- Implementation of advanced metering infrastructure (AMI) for real-time energy monitoring and management.

Telecommunication Infrastructure

- Network design for wired and wireless communication, data centers, and communication protocols.
- Integration of building management systems (BMS) and energy management systems (EMIS).

Energy Management Systems (EMIS)

- Overview of the EMIS, including software and hardware components, data acquisition, and control strategies.
- Integration with HVAC, lighting, and other building systems for optimized energy use.

On-Site Energy Generation and Storage

- Design and capacity of photovoltaic (PV) systems, including panels, inverters, and mounting systems.
- Energy storage solutions, such as batteries, including capacity, type, and integration with PV systems and the grid.

Connection to the Local Grid

- Details on grid integration, including interconnection agreements, grid-tied inverters, and safety measures.
- Interaction with the grid, including exporting excess energy and participating in demand response programs.

Distributed Energy Resources (DERs)

- Integration of on-site MW Solar PV Carport with EV Charging Stations.
- Use of MW/MWh Battery Energy Storage System (BESS) and PEM Fuel Cells for clean, reliable electricity.

Sectionalized Grid-Interconnected System

- Design of islanded and grid-connected mini-grids.
- Use of automated switchgear for rerouting power and restoring circuits in case of faults.

SMART Technology Integration

- Use of AI, ML, and IoT for optimizing energy use based on occupant patterns and preferences.
- Real-time analytics and simulations for detecting, preventing, predicting, and optimizing energy use.

Project Management and Implementation

- Project timeline, milestones, and deliverables.
- Roles and responsibilities of the project team and stakeholders.

5. Example - Nursing Building

5.1. Existing Conditions

The Nursing and General Education Building at Norfolk State University, designed by Moseley Architects, is a state-of-the-art facility dedicated to allied health, nursing, and academic instruction. The LEED Gold certified 140,000 square foot building was completed and opened in 2016. The first two floors are designed for liberal arts and graduate students, featuring a variety of classrooms, **computer labs,** seminar rooms, group study rooms, and a café. The top two floors are dedicated to the Nursing and Allied Health programs, **including specialized simulation labs,** interview rooms, a tutorial center, and offices for deans and faculty. Additionally, the building includes 32 classrooms, five computer labs, 20 group study rooms, 10 nursing and medical technology labs, 68 faculty and staff offices, three conference rooms, several lounges, and an IT help desk.

- Building Systems:
  - Chilled water-cooling plant with variable speed water-cooled chillers.
  - Heating hot water plant with variable speed pumps.
  - Variable Air Volume (VAV) systems controlled by a Direct Digital Control system connected to the university's Energy Management Department.
  - 100% emergency power to simulate a hospital environment.

- Energy Efficiency:
  - The building features a robust technology infrastructure for student access and state-of-the-art classrooms with virtual teleconferencing capabilities.
  - The design includes a mix of exterior façade materials such as brick veneer, metal panels, precast, and a curtainwall glazing system to enhance energy efficiency.



NSU Classroom & Nursing Building

LEED BD+C: New Construction (v2.2)

GOLD, AWARDED OCT 2015

SUSTAINABLE SITES — AWARDED: 8 / 14

SSp1	Construction activity pollution prevention	REQUIRED
SSc1	Site selection	1 / 1
SSc2	Development density and community connectivity	1 / 1
SSc3	Brownfield redevelopment	0 / 1
SSc4.1	Alternative transportation - public transportation access	1 / 1
SSc4.2	Alternative transportation - bicycle storage and changing rooms	1 / 1
SSc4.3	Alternative transportation - low emitting and fuel efficient vehicles	0 / 1
SSc4.4	Alternative transportation - parking capacity	1 / 1
SSc5.1	Site development - protect or restore habitat	0 / 1
SSc5.2	Site development - maximize open space	1 / 1
SSc6.1	Stormwater design - quantity control	0 / 1
SSc6.2	Stormwater design - quality control	0 / 1
SSc7.1	Heat island effect - non-roof	1 / 1
SSc7.2	Heat island effect - roof	1 / 1
SSc8	Light pollution reduction	0 / 1

WATER EFFICIENCY — AWARDED: 2 / 5

WEc1.1	Water efficient landscaping - reduce by 50%	0 / 1
WEc1.2	Water efficient landscaping - no potable water use or no irrigation	0 / 1
WEc2	Innovative wastewater technologies	0 / 1
WEc3.1	Water use reduction - 20% reduction	1 / 1
WEc3.2	Water use reduction - 30% reduction	1 / 1

ENERGY & ATMOSPHERE — AWARDED: 9 / 17

EAp1	Fundamental commissioning of the building energy systems	REQUIRED
EAp2	Minimum energy performance	REQUIRED
EAp3	Fundamental refrigerant Mgmt	REQUIRED
EAc1	Optimize energy performance	6 / 10
EAc2	On-site renewable energy	0 / 3
EAc3	Enhanced commissioning	0 / 1
EAc4	Enhanced refrigerant Mgmt	1 / 1
EAc5	Measurement and verification	1 / 1
EAc6	Green power	1 / 1

MATERIAL & RESOURCES — AWARDED: 6 / 13

MRp1	Storage and collection of recyclables	REQUIRED
MRc1.1	Building reuse - maintain 75% of existing walls, floors & roof	0 / 1
MRc1.2	Building reuse - maintain 95% of existing walls, floors & roof	0 / 1
MRc1.3	Building reuse - maintain 50% of interior non-structural elements	0 / 1
MRc2.1	Construction waste Mgmt - divert 50% from disposal	1 / 1
MRc2.2	Construction waste Mgmt - divert 75% from disposal	1 / 1

MATERIAL & RESOURCES — CONTINUED

MRc3.1	Materials reuse - 5%	0 / 1
MRc3.2	Materials reuse - 10%	0 / 1
MRc4.1	Recycled content - 10% (post-consumer + 1/2 pre-consumer)	2 / 1
MRc4.2	Recycled content - 20% (post-consumer + 1/2 pre-consumer)	0 / 1
MRc5.1	Regional materials - 10% extracted, processed and manufactured regiona...	1 / 1
MRc5.2	Regional materials - 20% extracted, processed and manufactured regiona...	1 / 1
MRc6	Rapidly renewable materials	0 / 1
MRc7	Certified wood	0 / 1

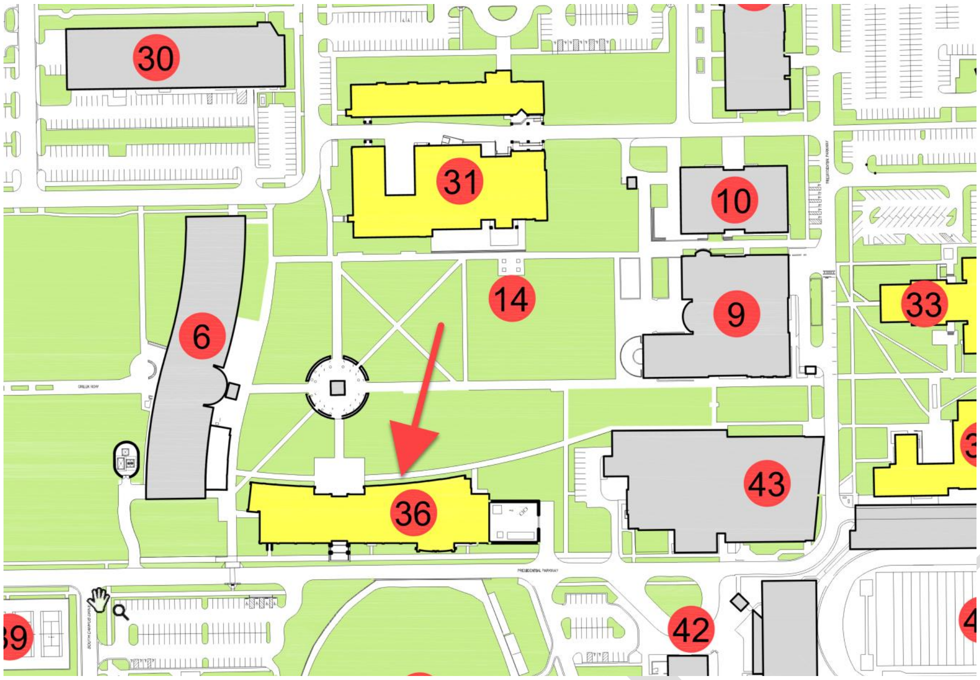
INDOOR ENVIRONMENTAL QUALITY — AWARDED: 9 / 15

EQp1	Minimum IAQ performance	REQUIRED
EQp2	Environmental Tobacco Smoke (ETS) control	REQUIRED
EQc1	Outdoor air delivery monitoring	0 / 1
EQc2	Increased ventilation	0 / 1
EQc3.1	Construction IAQ Mgmt plan - during construction	1 / 1
EQc3.2	Construction IAQ Mgmt plan - before occupancy	1 / 1
EQc4.1	Low-emitting materials - adhesives and sealants	1 / 1
EQc4.2	Low-emitting materials - paints and coatings	1 / 1
EQc4.3	Low-emitting materials - carpet systems	1 / 1
EQc4.4	Low-emitting materials - composite wood and agrifiber products	1 / 1
EQc5	Indoor chemical and pollutant source control	0 / 1
EQc6.1	Controllability of systems - lighting	1 / 1
EQc6.2	Controllability of systems - thermal comfort	0 / 1
EQc7.1	Thermal comfort - design	1 / 1
EQc7.2	Thermal comfort - verification	1 / 1
EQc8.1	Daylight and views - daylight 75% of spaces	0 / 1
EQc8.2	Daylight and views - views for 90% of spaces	0 / 1

INNOVATION — AWARDED: 5 / 5

IDc1	Innovation in design	0 / 1
IDc2	LEED Accredited Professional	0 / 1

TOTAL 39 / 69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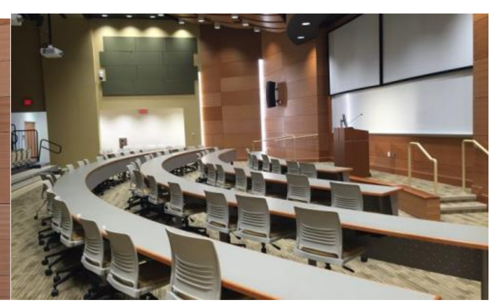
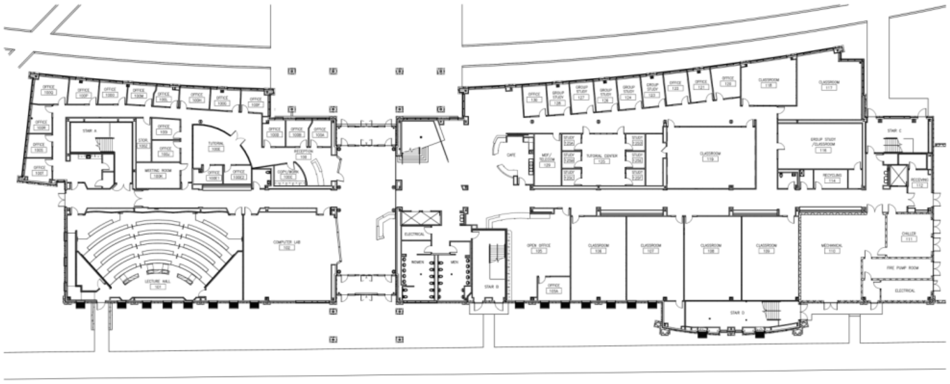
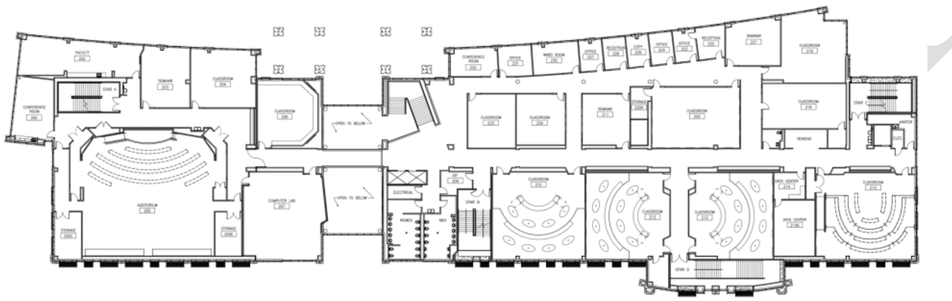
NSU

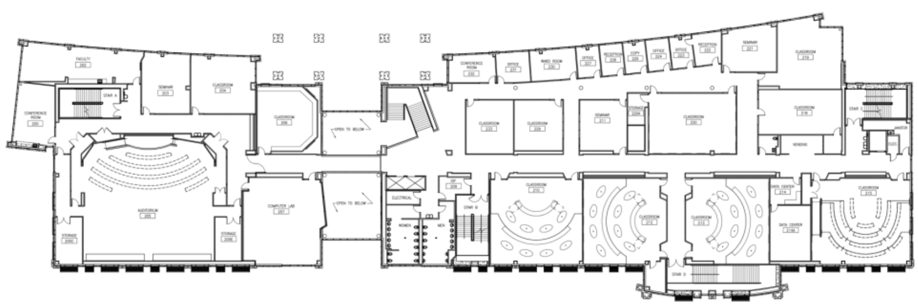




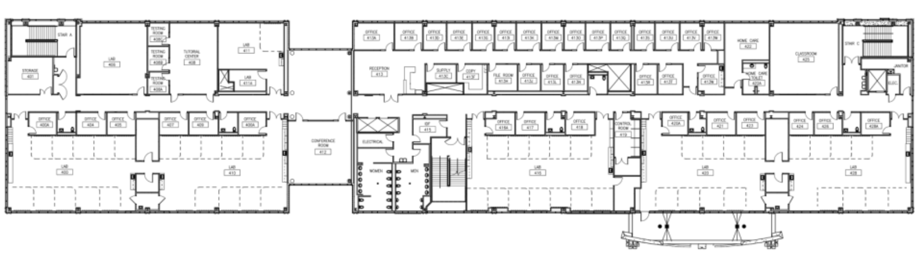
NURSING AND GENERAL EDUCATION BUILDING - FIRST FLOOR



NURSING AND GENERAL EDUCATION BUILDING - SECOND FLOOR



NURSING AND GENERAL EDUCATION BUILDING - SECOND FLOOR



NURSING AND GENERAL EDUCATION BUILDING - FOURTH FLOOR

5.2. Building - Retrofit

Retrofit the Nursing and General Education Building at Norfolk State University to incorporate key components of grid-interactive efficient buildings and contribute to a Net Zero Energy campus.

Energy Efficiency Upgrades

- Building Envelope Improvements: Enhance insulation, install high-performance windows, and seal air leaks to reduce energy loss.
- Lighting Systems: Upgrade to LED lighting with smart controls for occupancy and daylight sensing.

HVAC System Enhancements

- High-Efficiency HVAC Systems: Replace existing systems with high-efficiency heat pumps and variable refrigerant flow (VRF) systems.
- Advanced Controls: Implement smart thermostats and building automation systems to optimize HVAC operations based on occupancy and weather conditions.

Renewable Energy Integration

- Solar PV Installation: Install rooftop and/or carport solar photovoltaic (PV) systems to generate on-site renewable energy.
- Battery Energy Storage Systems (BESS): Integrate BESS to store excess solar energy and provide backup power.

SMART Technology Implementation

- AI and IoT Integration: Deploy AI and IoT devices to monitor and manage energy use, including smart meters, sensors, and analytics platforms.
- Real-Time Analytics: Use machine learning algorithms to optimize energy consumption based on real-time data and predictive analytics.

Distributed Energy Resources (DER)

- On-Site Generation: Incorporate distributed generation technologies such as PEM fuel cells for reliable, on-site power generation.
- EV Charging Stations: Install EV charging stations powered by on-site solar PV systems.

Sectionalized Grid-Interconnected Systems

- Microgrid Development: Create islanded and grid-connected microgrids to enhance resilience and flexibility.
- Automated Switchgear: Install automated switchgear to manage power distribution and reroute electricity during faults.

Advanced Metering Infrastructure (AMI)

- Smart Meters: Install smart meters throughout the building to collect detailed energy usage data.
- Data Management Systems: Implement systems to analyze and report energy

Commissioning and Verification

- Envelope Commissioning: Conduct thorough commissioning of the building envelope to ensure it meets performance standards.
- System Testing: Perform comprehensive testing of all upgraded systems to verify their efficiency and functionality.

LEED v4.1 for Operations & Maintenance: Existing Buildings
Scorecard

Y	?	N			
0	0	0	**Location and Transportation**		14
6			Prereq	Transportation Performance	14
0	0	0	**Sustainable Sites**		4
			Credit	Rainwater Management	1
			Credit	Heat Island Reduction	1
			Credit	Light Pollution Reduction	1
			Credit	Site Management	1
0	0	0	**Water Efficiency**		15
6			Prereq	Water Performance	15
0	0	0	**Energy and Atmosphere**		35
Y			Prereq	Energy Efficiency Best Management Practices	Required
Y			Prereq	Fundamental Refrigerant Management	Required
13			Prereq	Energy Performance	33
			Credit	Enhanced Refrigerant Management	1
			Credit	Grid Harmonization	1
0	0	0	**Materials and Resources**		9
Y			Prereq	Purchasing Policy	Required
Y			Prereq	Facility Maintenance and Renovations Policy	Required
3			Prereq	Waste Performance	8
			Credit	Purchasing	1
0	0	0	**Indoor Environmental Quality**		22
Y			Prereq	Minimum Indoor Air Quality	Required
Y			Prereq	Environmental Tobacco Smoke Control	Required
Y			Prereq	Green Cleaning Policy	Required
8			Prereq	Indoor Environmental Quality Performance	20
			Credit	Green Cleaning	1
			Credit	Integrated Pest Management	1
0	0	0	**Innovation**		1
			Credit	Innovation	1
0	0	0	**TOTALS**	Possible Points:	100

Certified: 40-49 points, **Silver:** 50-59 points, **Gold:** 60-79 points, **Platinum:** 80+ points

These upgrades will transform the Nursing and General Education Building into a model of energy efficiency and sustainability, supporting NSU's goal of achieving a Net Zero Energy campus. The integration of advanced technologies and renewable energy sources will not only reduce energy consumption but also enhance the building's resilience and operational efficiency.

6. Electrical Design – Example of Key Metrics

Note: rough orders of magnitude below are for reference only. To be confirmed by electrical engineers.

Electrical design metrics breakdown based on a **2.5 MW PEM fuel cell system** instead of the original 500 kW system, incorporating the campus-wide strategy of sectionalized microgrids and spinning generation backup:

1. **Estimated Power Demand for Nursing Building**:
   - Average load: ~800 kW
   - Peak load: ~1.2 MW
   - Contribution from PEM fuel cell: The 2.5 MW system supports the Nursing building as part of a cluster on a sectionalized microgrid, providing a significant share of its power needs during peak demand.
2. **Annual Measured Energy Consumption**:
   - Nursing building annual consumption: ~6,000 MWh/year

- Cluster-wide annual consumption: ~15,000–18,000 MWh/year, assuming inclusion of nearby buildings such as administration and general education spaces.

3. **PEM Fuel Cell Output and Contribution**:
   - Fuel cell system capacity: **2.5 MW** (continuous output for 24/7 operations, barring maintenance).
   - Annual energy generation: ~21,900 MWh (assuming 100% uptime, reduced slightly for realistic operating conditions).
   - Surplus power: Excess energy exported to the utility grid or stored in BESS during low-demand periods, balancing with other campus clusters.
4. **Battery Energy Storage System (BESS) Capacity**:
   - BESS cluster capacity: ~2 MW/8 MWh, supporting the PEM fuel cell in load shifting and demand response.
   - BESS discharge duration: Provides ~4 hours of peak demand coverage for the cluster, with a focus on balancing loads during utility outages or low solar PV generation periods.
5. **On-Site Energy Generation and Storage**:
   - Solar PV carport system: ~1 MW capacity, generating ~1,500 MWh/year for daytime loads.
   - PEM fuel cell ensures consistent power for critical systems and peak demand periods, especially during low solar PV output.
6. **Distribution and Microgrid Design**:
   - Sectionalized microgrid: Integrates PEM fuel cell, BESS, and solar PV to serve a cluster of buildings, optimizing load distribution and resiliency.
   - Spinning generation: Acts as backup for clusters not supported by the PEM fuel cell, with rapid-start capability for emergency power (e.g., diesel/natural gas generators).
7. **Advanced Metering and Demand Response**:
   - Advanced metering infrastructure (AMI): Monitors real-time load and energy flows across the cluster and sectionalized microgrid.
   - Demand response strategies: Includes dynamic load staging to reduce energy use during peak demand on the utility grid.
8. **Interaction with the Local Grid**:
   - Export capacity: PEM fuel cell exports surplus power during low demand, up to 1 MW to the grid or stored in BESS.
   - Islanding capability: Microgrid can operate independently during grid outages, maintaining power to critical facilities.
9. **Energy Efficiency Metrics**:
   - Combined efficiency (PEM fuel cell + waste heat recovery): ~85% when capturing thermal energy for heating applications.
   - Net Zero contribution: Cluster-wide generation exceeds annual consumption, balancing through grid export, on-site storage, and demand response.
10. **Integration with Campus-Wide Energy Strategy**:

- PEM fuel cell clusters: Supports resiliency goals by serving distinct building groups with sectionalized microgrids.

- Flexibility: Enables use of spinning generation in clusters where PEM fuel cell deployment is not feasible due to cost, fuel supply, or other constraints.

The PEM fuel cell capacity allows it to power an entire cluster of buildings, reducing reliance on external grid supply or spinning generation. Surplus generation enables greater contribution to campus wide Net Zero goals, improving energy independence and resiliency. Battery storage requirements remain proportional to cluster needs, focusing on load balancing and peak shaving.

This strategy ensures that the Nursing building and its associated cluster are highly resilient, energy-efficient, and capable of meeting Net Zero objectives.

Here is a summary table of the estimated electrical design values:

Category	Value	Units	Notes
Estimated Power Demand	1.0 - 1.5 MW	MW	Approximate peak demand range for the Nursing and General Education Building.
Annual Energy Consumption	8,760 - 13,140 MWh	MWh/year	Estimated based on typical utilization and campus energy efficiency goals.
Peak Load Demand	~1.5 MW	MW	Reflects peak building load during high-occupancy or operational periods.
On-Site Solar PV Generation	1.5 - 2.0 MW capacity	MW	PV systems contribute to daytime load reduction.
Battery Energy Storage Capacity	2.5 - 3.0 MW / 10 - 12 MWh	MW/MWh	Sized for demand response, backup power, and smoothing renewable generation variability.
PEM Fuel Cell System	2.5 MW	MW	Supports sectionalized microgrid; provides clean and reliable power for a cluster of buildings.
Energy Surplus/Export	Up to 1.0 MW surplus to grid during low-demand periods.	MW	Excess power exported to the utility grid or stored in BESS.
Advanced Metering Infrastructure	Comprehensive across microgrid and sectionalized clusters.	-	Real-time energy data collection and management for optimization and reporting.
Microgrid Load Balancing	5.0 - 6.0 MW	MW (cluster capacity)	Includes Nursing building and adjacent buildings within sectionalized microgrid.

Category	Value	Units	Notes
Demand Response Capability	~20-30% of peak demand	% of peak demand	Enabled by AMI, load flexibility, and smart building systems.

Note: All electrical design values provided above are for information only. To be confirmed by electrical engineers.

7. Funding Opportunities

US Department of Energy / General Services Administration
"RFI for Technologies That Increase Sustainability of Buildings."
Develop and implement technologies that enable energy efficiency and decarbonization in commercial buildings and contribute to a more efficient electric infrastructure.
FY25 Technology Focus Areas

- Deep Energy Retrofits
- All-Electric Buildings and All-Electric Vehicle Fleets.
- Net-Zero Operations
- Packages of Emerging and Sustainable Technology Solutions

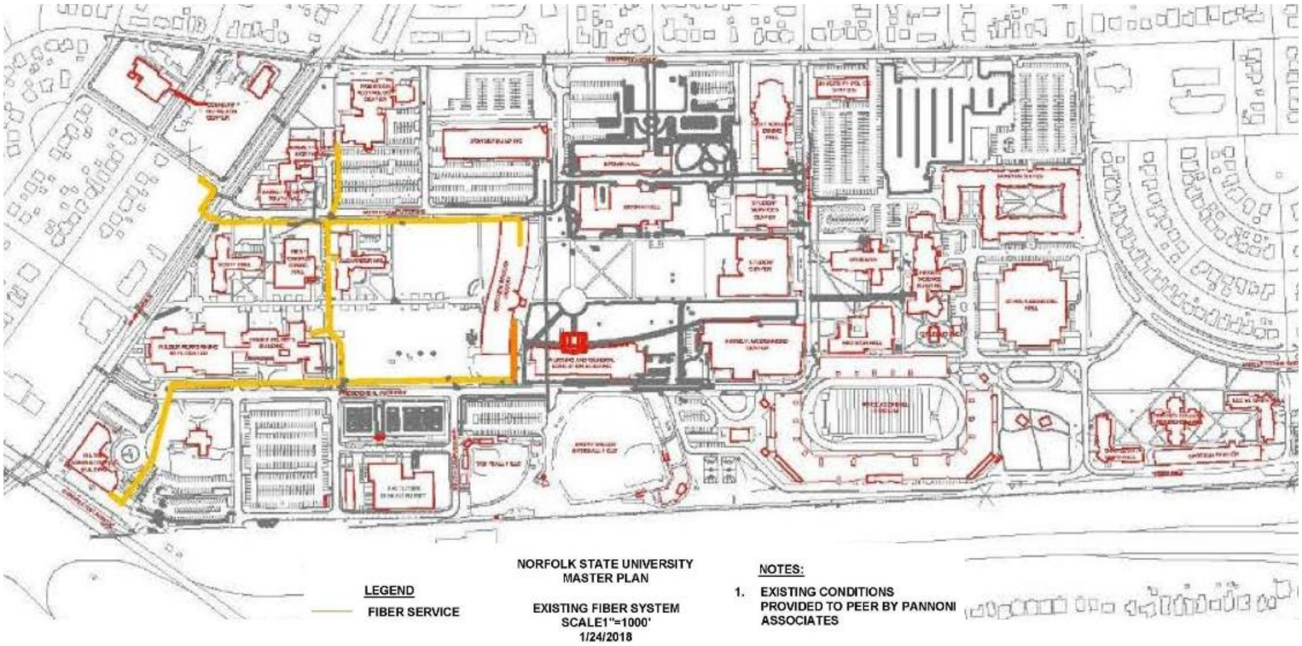
"Submissions must be technologies and solutions that are technically and commercially ready for evaluation in occupied, operational buildings."

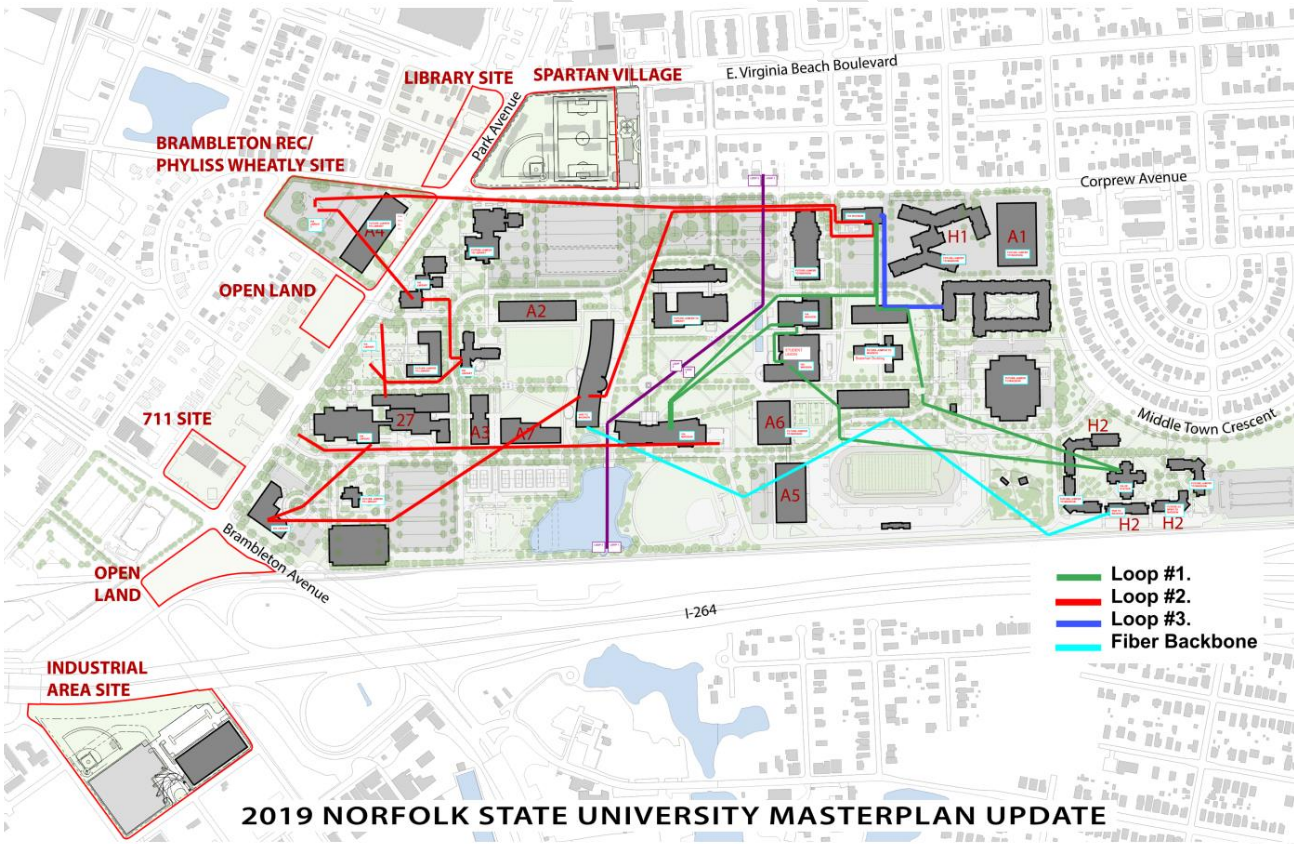
Congressional Community Funding Requests/Earmarks

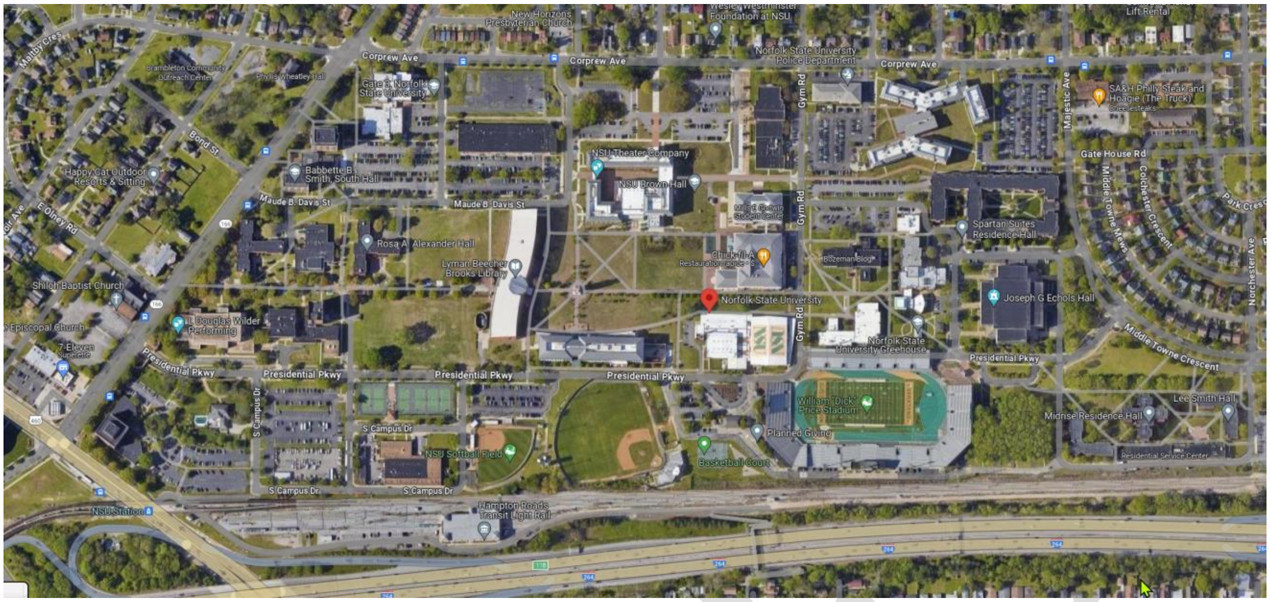
- Budget: $25M
- Woolpert will add this project to its list of Congressional Community Funding Requests/Earmarks for 2025. (One-Pager)
- NSU is not targeting any specific Grant now.
- Develop concept paper to respond to Planning Grant vs/ Implementation Grant

Other

- Inflation Reduction Act (IRA)
- Green and Resilient Retrofit Program (GRRP)
- Better Buildings Initiative
- Retro-commissioning
- Re-commissioning


LEGEND
FIBER SERVICE
NORFOLK STATE UNIVERSITY
MASTER PLAN
EXISTING FIBER SYSTEM
SCALE1"=1000'
1/24/2018
NOTES:
1. EXISTING CONDITIONS PROVIDED TO PEER BY PANNONI ASSOCIATES


LIBRARY SITE
SPARTAN VILLAGE
E. Virginia Beach Boulevard
Park Avenue
BRAMBLETON REC/
PHYLISS WHEATLY SITE
Corprew Avenue
OPEN LAND
711 SITE
Middle Town Crescent
Brambleton Avenue
OPEN LAND
I-264
Loop #1.
Loop #2.
Loop #3.
Fiber Backbone
INDUSTRIAL AREA SITE
2019 NORFOLK STATE UNIVERSITY MASTERPLAN UPDATE



8. Conclusion

The implementation of these strategies at Norfolk State University will serve as a cornerstone in the journey toward achieving a Net Zero Energy campus, where annual energy consumption is offset by renewable energy generation and optimized energy use. By leveraging a 2.5 MW PEM fuel cell system, extensive solar PV arrays, battery energy storage systems (BESS), and sectionalized microgrids with advanced metering infrastructure (AMI), NSU will optimize energy generation, distribution, and consumption across its campus.

These systems enable real-time energy management, demand response, and operational resiliency, aligning with the university's sustainability goals. The integration of SMART technologies, artificial intelligence (AI), and machine learning (ML) ensures that energy systems adapt to occupant behaviors and preferences, improving efficiency and user experience while reducing greenhouse gas emissions.

The Nursing Building will be the first to be tested for the integration of these building and campus strategies. This approach positions NSU to pursue LEED Zero Energy certification, demonstrating leadership in sustainability and excellence in energy performance. As a result, NSU will serve as a model for higher education institutions nationwide, showcasing how grid-interactive efficient buildings can transform campuses into resilient, sustainable, and innovative living laboratories.