



**Guidelines and Industry trends  
of  
Electrification, Decarbonization & Sustainability for  
Healthcare Buildings**



# Agenda

**Overview of Electrification & Decarbonization**

**Sustainable HVAC Healthcare Design**

**Decarbonize with Resiliency – A Guide for Hospitals**

**Battery Energy Storage Solutions**

**Create a Roadmap & Plan**





**Electrification/Decarbonization**

## Collaboration of EPA, DOE & ASHRAE

The MOU was signed by 2021-22 ASHRAE President Mick Schwedler, P.E., Fellow ASHRAE, LEED AP and DOE Principal Deputy Assistant Secretary, Kelly Speakes-Backman, in early June. The agreement defines parameters on how ASHRAE and the DOE will collaborate more closely to continue to advance and promote mutual interests.

“With ASHRAE’s focus on building decarbonization and resilience, we are pleased to continue our partnership with the Department of Energy as we share our knowledge base in the built environment on a larger scale and work towards a more sustainable world.” said Schwedler.

ASHRAE and DOE seek to work cooperatively on the following:

- Advance decarbonization of the building sector by increasing the energy efficiency and reducing the carbon footprint of buildings beginning with the construction phase throughout the building’s life, including operation and maintenance;
- Increase the grid-interactivity of buildings by advancing grid-flexibility, flexible energy storage, and renewables integration into buildings;
- Promote more resilient, efficient buildings through the adoption of advanced building standards and codes, including supporting innovative code approaches in the model code development, building performance standards, and zero energy codes;
- Increase compliance with the latest building energy codes by supporting States in understanding the latest codes;
- Improve building resiliency and keeping occupants safe;
- Develop the workforce of the HVACR and associated sectors including through increasing diversity and advancing training to support decarbonization; and
- Improve overall building performance, including for occupants’ health and well-being.



### Memorandum of Understanding Between The United States Department of Energy And The American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

By this memorandum of understanding (MOU), the U.S. Department of Energy (DOE) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) agree to further their long-term relationship by working cooperatively:

- To improve the efficient use of energy,
- To improve building resiliency, and
- Improve building performance, including for occupants.

DOE’s Office of Energy Efficiency and Renewable Energy (EERE) enters into this non-binding MOU pursuant to the authority of section 646 of the Department of Energy Organization Act (Pub. L. 95-91, as amended; 42 U.S.C. § 7256) and Title III of the Energy Conservation and Production Act (Pub. L. 94-385, as amended; 42 U.S.C. 6831 *et seq.*).

EERE and ASHRAE are committed to working together toward the following goals:

- 1) Encourage the continued development of voluntary consensus-based standards related to energy efficiency.
- 2) For each succeeding version of Standard 90.1 (Energy Standard for Buildings Except Low-Rise Residential Buildings) encourage adoption by states to ensure energy and cost savings, and seek adoption of all technologically feasible and economically justified energy efficiency measures within 90.1.
- 3) Encourage adoption of Standard 90.1 in building codes and in the International Standards Organization (ISO) standards.
- 4) Encourage advanced energy design concepts.
- 5) Collaborate in the development and implementation of the safe use of next-generation refrigerants and concurrently improve equipment energy efficiency.
- 6) Cooperate to provide and encourage the use of clear and consistent information to the building industry about building energy rating and labeling.
- 7) Work within the building community and related professions to encourage the interoperability of building related software and integrated solutions among design disciplines, manufacturers, contractors, and building owners and operators to increase energy efficiency, building and grid resilience, health, and productivity in new and existing buildings.
- 8) Encourage communication of information regarding technology transfers and facilities training to building owners and management about the interrelationships between mechanical systems and building operating costs, concerning energy, indoor environmental quality workplace performance, client satisfaction, resilience, productivity, health impacts, and public safety.

## The role of government in shifting the buildings industry to net zero



## Role of Government



## Electrification



Electrification refers to the process of replacing technologies that use fossil fuels (coal, oil, and natural gas) with technologies that use electricity as a source of energy

## What is being Electrified?

### Transportation

- Public Charging Stations
- Electric Vehicles
- Fleet Electrification



### Residential

- In-Home Charging Stations
- Air-source Heat Pumps
- Lawn maintenance equipment (mower, trimmer, hedger, blower, etc.)



### Aviation

- Pushbacks
- Belt Loaders
- Baggage Tugs



### Commercial and Industrial

- Heat recovery chillers
- Replace pneumatic equipment with electric
- Install induction furnaces for non-ferrous metal melting



### Heavy Duty Off-Road

- Replace propane/gas forklifts with electric
- Eliminate Truck Stop idling
- Convert rail yard cargo handling equipment to electric



### Agriculture

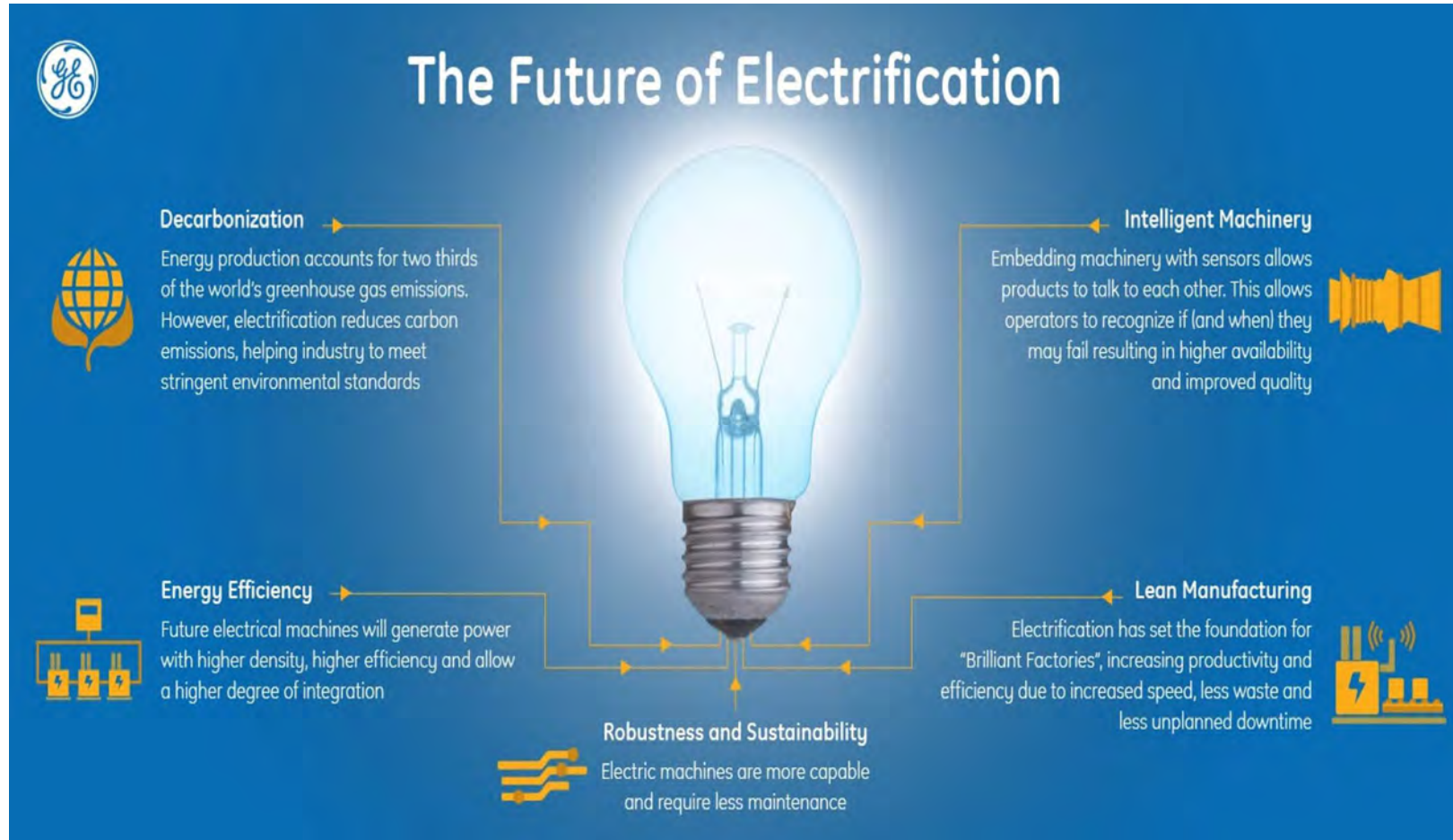
- Retrofit Diesel Irrigation Pumps to Electric
- Indoor agriculture (controlled lighting, and space-conditioning)
- Infrared drying and peeling of vegetables



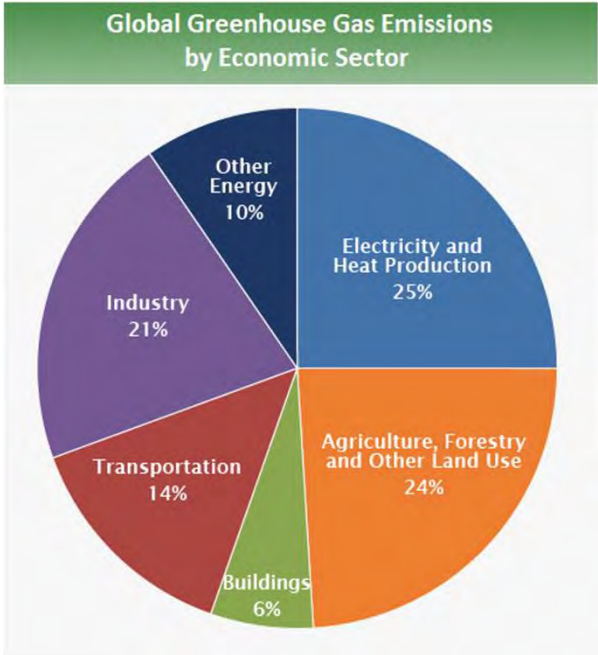
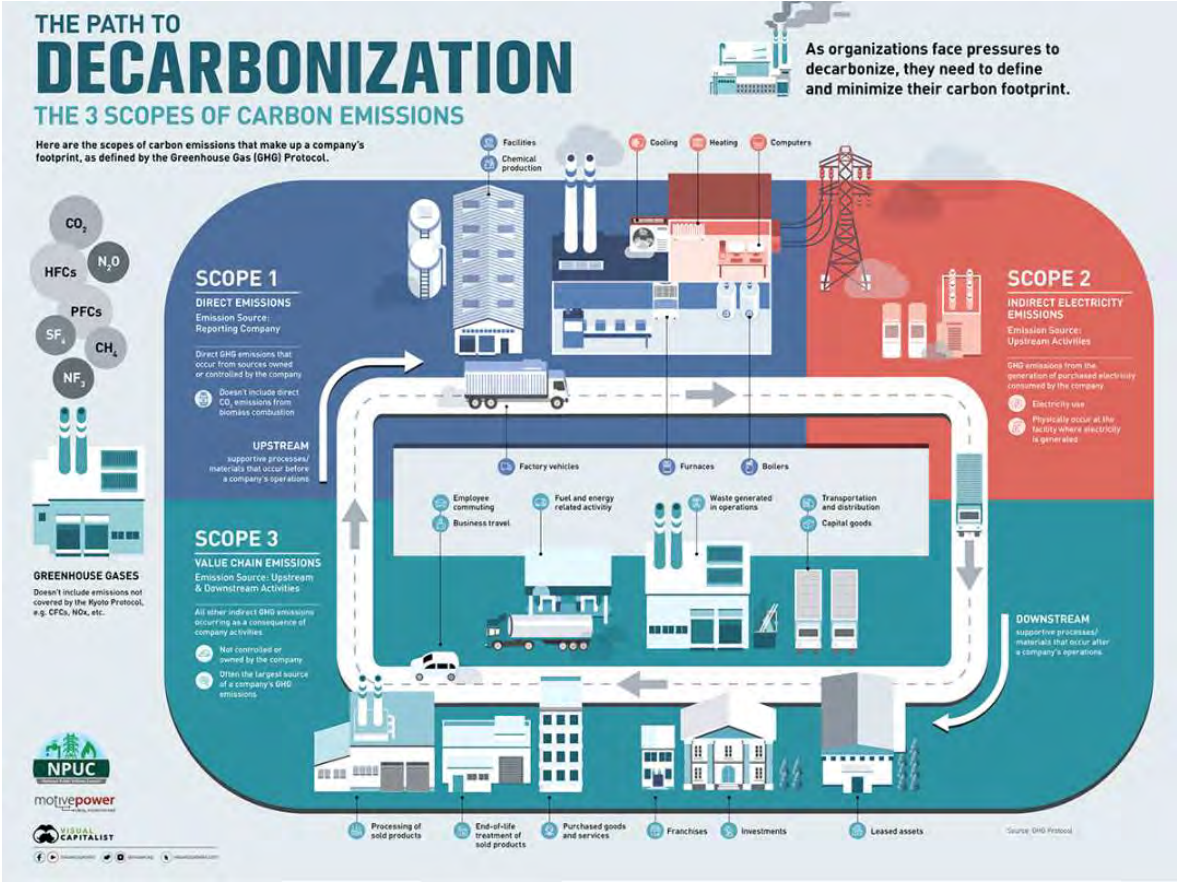
## HISTORY OF ELECTRIFICATION

- Electrification is not new; it was a very big idea in the 1950's and 60's
  - The “Atomic Age” was going to provide cheap unlimited power through the wide scale adoption of nuclear power
  - 1973 US Atomic Energy Commission prediction: 1000 reactors by turn of 21<sup>st</sup> century
  - **Reality In 2020: we have 96 reactors.**
- So why didn't this happen (simple version)?
  - Massive cost overruns in many nuclear plant projects
  - Three Mile Island partial meltdown March 28, 1979
  - Cheap coal and natural gas alternatives





# PATH TO DECARBONIZATION



## NY's Climate Vision

"New York will undertake a sweeping set of measures to reduce the State's carbon footprint, transform electricity generation in the State, and drive innovative solutions through technology advancement."

# 2030

- 70% renewable energy
- 40% reduction in statewide GHG emissions

# 2040

- 100% zero-emission electricity

# 2050

- 85% reduction in statewide GHG emissions by 2050
- Net zero emissions statewide by 2050.

# 85%

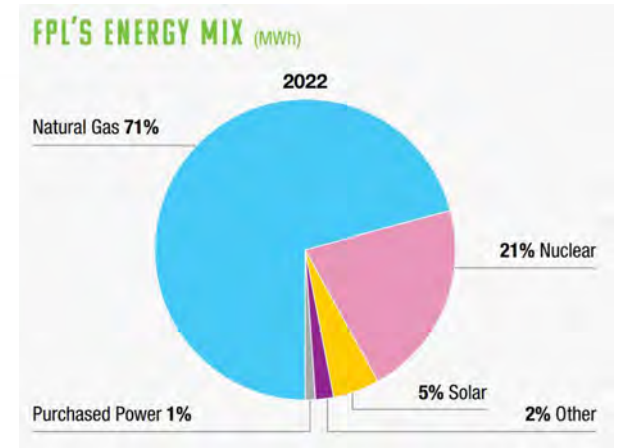


of all buildings will use clean heating and cooling by 2050



# Is Florida a Green State?

We're on our way. According to the [American Energy Information Administration](#), Florida is **No. 3 in the U.S.** for total solar power generating capacity. In addition, Forbes ranks Florida as the **fifth most sustainable state**. The state is home to NextEra Energy, the world's largest generator of renewable energy from the wind and sun, and our team is here to help other sustainability-minded companies make the move to Florida.



## Real Zero

FPL's parent company, NextEra Energy, announced Real Zero, the most ambitious carbon-emissions-reduction initiative ever set by an energy producer. As part of Real Zero, FPL's goal is to significantly accelerate the transformation of its generation mix, starting with 36% decarbonization by 2025 and culminating in 100% decarbonization by no later than 2045.

[Learn More](#)

# Power Sector

## Key Takeaways

Over the last decade, natural gas has emerged as the primary source of power generation in Florida; however growing cost competitiveness is leading to significant growth in solar generation.

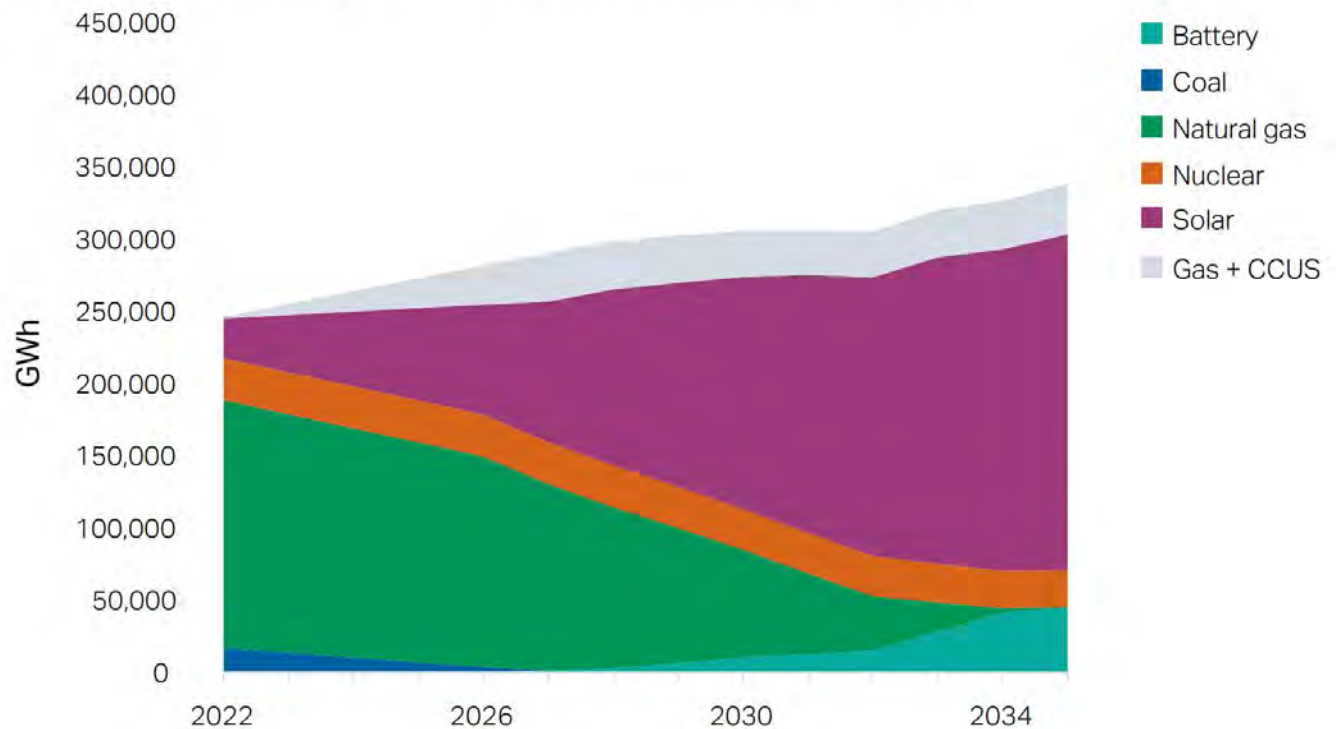
Solar photovoltaics (PV) costs are anticipated to continue to decline into the future.

By 2035, solar PV accounts for 33% of power generation in the baseline. Heightened levels of investment are anticipated to increase that generation percentage in the modeled scenarios, which estimate that solar PV accounts for more than two-thirds of generation in the Net Zero Power System and Net Zero Economy scenarios by that time.

This increase in renewable generation is paired with an assumed growth in battery storage and natural gas with carbon capture for the Net Zero Power System and Net Zero Economy scenarios.

# PATH TO NET ZERO IN FLORIDA

Figure 3.3. Primary sources of power generation in the Net Zero Power System scenario

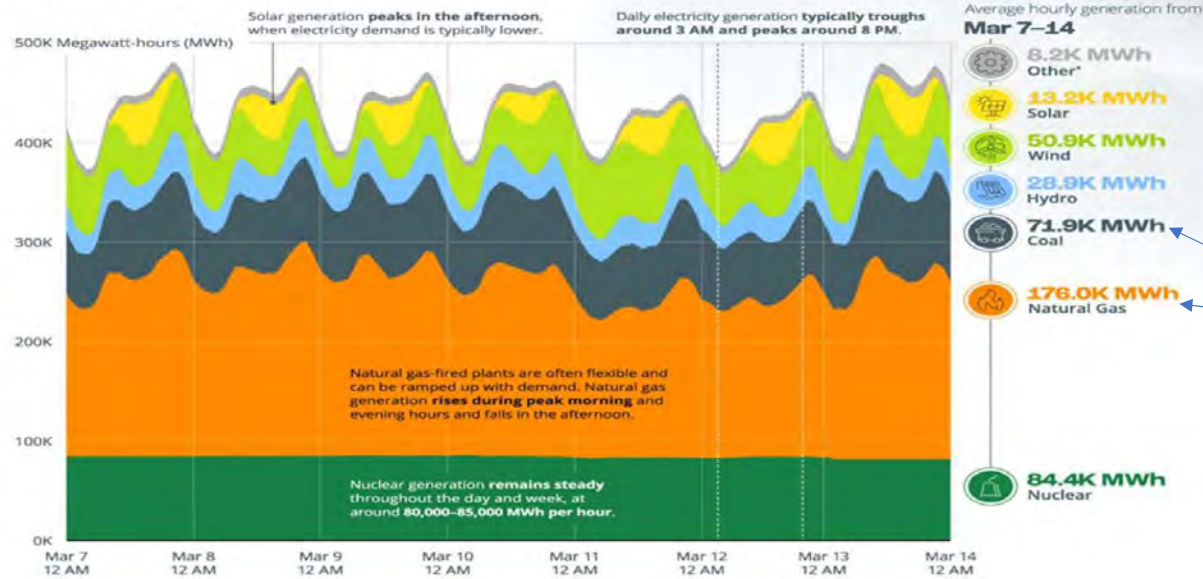


# U.S. Hourly Electricity Generation Over One Week

At all times in a day, the electricity supplied through the grid must perfectly match demand. Undersupply can strain the power grid and cause blackouts, whereas oversupply leads to wastage.

Here's how U.S. electricity supply changes by hour and day, over one week.

## Hourly Electricity Generation by Source (March 7, 2023–March 14, 2023 EST), MWh



U.S. Electricity Generation

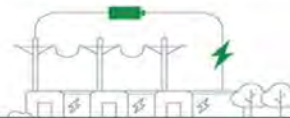
## The Renewable Intermittency Challenge

Unlike conventional sources of electricity, wind and solar are variable and location-specific. This is a concern for grid operators, especially as more renewable capacity is deployed.

Here are some ways to mitigate these challenges:

### Energy storage

can be combined with renewables to mitigate variability. Batteries can store electricity during times of high generation and supply it when demand is high.



### Demand-side management

can be used to shift flexible demand to times of high renewable generation. For example, utilities can ask industrial customers to operate certain factory lines in the afternoon, when solar generation peaks.



### Expanding transmission lines

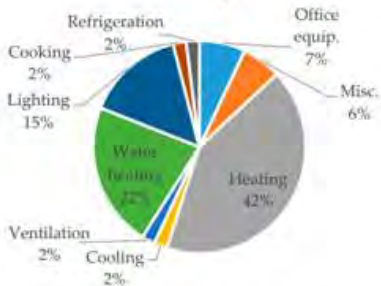
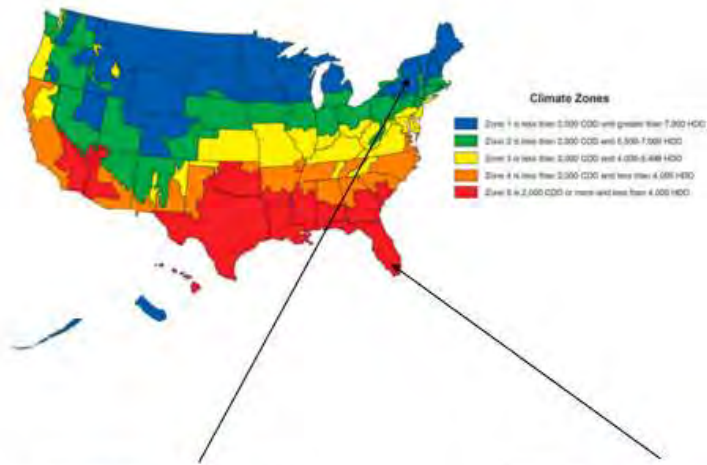
can help connect projects in remote areas to centers of demand. Across the country, over 900 gigawatts of solar and wind capacity are queued for grid interconnection."



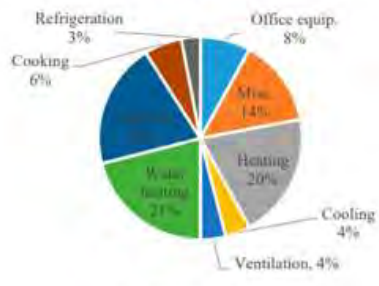


## Sustainable Building Design

# Indoor Air Quality and Energy Efficiency

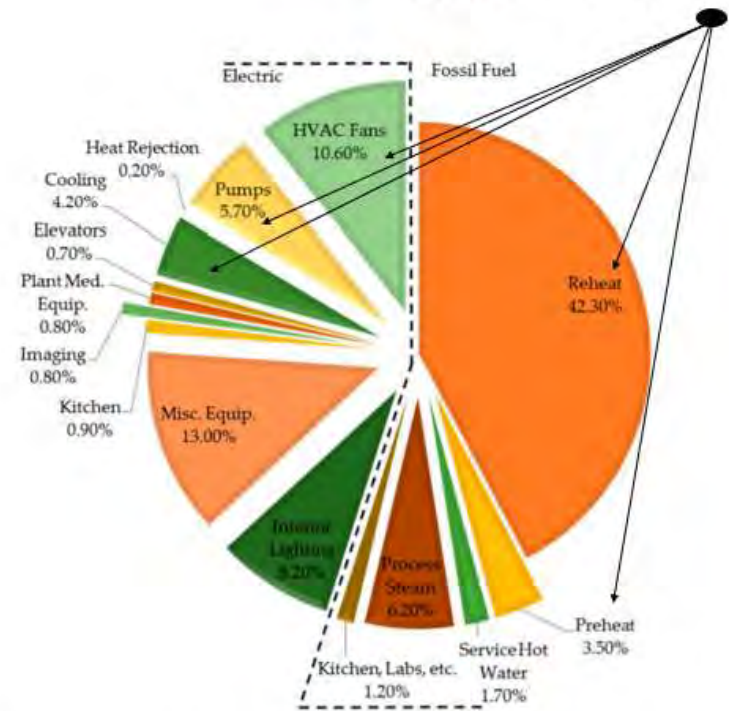


(a) Climate Zone 1



(e) Climate Zone 5

Over 60% of Energy Spend



National Average Energy Consumption For Hospitals



## ELECTRIFICATION/DECARBONIZATION & HVAC



Ventilation / Make Up Air



Temperature & Humidity Control



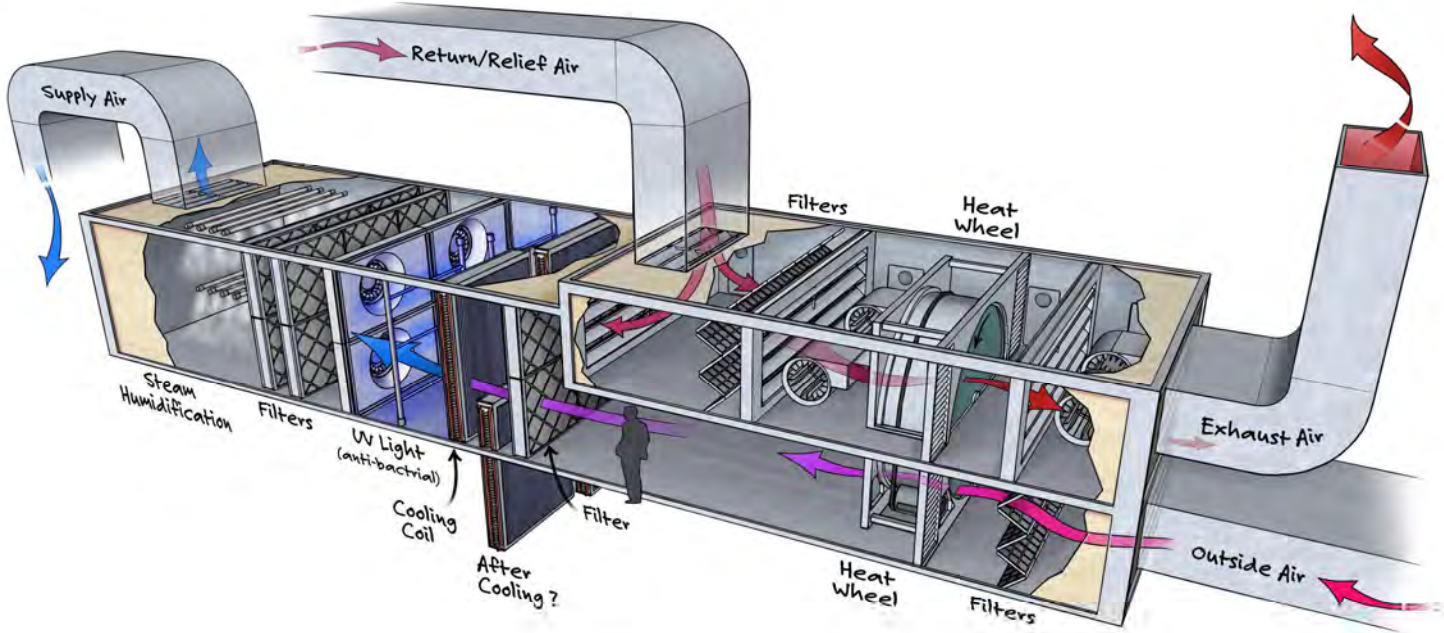
Filtration



Air Changes an Hour



# HVAC DECARBONIZATION



Energy Recovery on Exhaust Air & Practicality (Plate, Heatpipe, Wheel)



Centralized or Decentralized Approach



Detailed Analysis of Each Critical Component. Fans, Coils - Incremental APD & BHP Savings



**Decarbonize with Resiliency**  
**A Guide for Hospitals**

## 8 Step Planning Process

### ▼ PLANNING PROCESS

- Step 1: Designate an Initiative Leader
- ▶ Step 2: Understand the Regulatory Landscape
- ▼ Step 3: Establish Your Baselines
  - The DWR Baselining Survey
  - ▶ HVAC
- Step 4: Gather your Team
- Step 5: Set Vision & Map Strategy
- ▶ Step 6: Secure Funding
- Step 7: Implement
- Step 8: Measurement & Verification

### Energy and Carbon Reduction Plan

Exhibit 15. Historical Falconer Total Electricity Usage

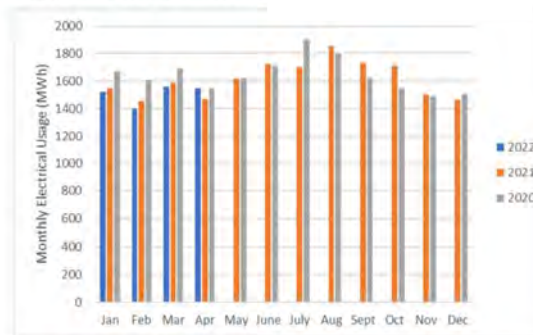


Exhibit 16. Percentage of Total Main Plant Consumption by Numbered Sub-meter



# Establish your Baselines

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### Energy and Carbon Reduction Plan

## Energy Use

The SKF facility in Falconer has 8 independent buildings with electricity delivered and metered by the utility, Jamestown Board of Public Utilities (JBPU). Electrical energy for the facility is submetered by JBPU and is shown in Exhibit 13 below. Six of the electrical submeters are connected to the main plant, which includes Buildings 1, 5, 6, 8 and 9 and accounts for 98% of the energy demand for the Falconer, NY facility. As stated earlier, electricity at the Falconer, NY facility is used for multiple purposes including HVAC, compressed air, heat treatment, lighting, and process machinery (including CNCs and heat treat equipment).

Exhibit 13. SKF Falconer facility map of facility with energy meters marked with their corresponding meter number

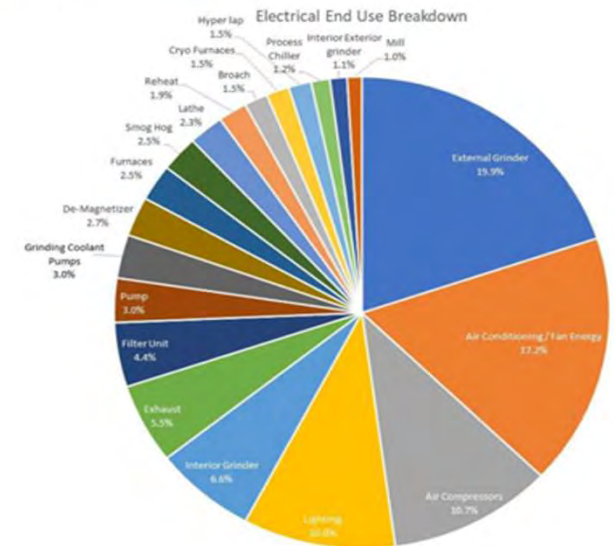


## Electricity

SKF provided monthly electricity use data for their facility in Falconer, NY from January 2016 through April 2022 along with access to the monthly metered data through the Schneider Resource Advisor software. Interval data for the facility was provided by JBPU from August 2021 through May 2022 for the six submeters serving Buildings 1, 5, 6, 8 & 9. Data for the past 28 months was included in this report (January 2020 to April 2022). Historical electrical characteristics analyzed include:

- Monthly cost of electrical energy (\$)

Exhibit 45. Electrical End Use Breakdown



# Establish your Baselines

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## Energy and Carbon Reduction Plan

Exhibit 3: ECM Summary Table:

ECM #	Description	Recommended R	Energy Savings			GHG Savings MT CO2	Project Cost, \$	Incremental Cost, \$	Energy Payback yrs	Incremental Payback yrs
			Electricity kWh	Natural Gas MMBtu	Cost Savings \$					
1A	New 90 kW VSD Air Compressor	R	523,041	0	\$ 29,290	55	\$ 149,000	\$ 50,000	5.1	1.7
1B	New 110 kW VSD Air Compressor	NR	521,101	0	\$ 29,182	55	\$ 178,000	\$ 60,000	6.1	2.1
2A	Compressed air leak reduction - Option 1	NR	113,286	0	\$ 6,344	12	\$ 7,400	\$ 7,400	1.2	1.2
2B	Compressed air leak reduction - Option 2	R	51,271	0	\$ 2,871	5	\$ 1,200	\$ 1,200	0.4	0.4
3	Small RTUs Replacement (ASHP - 14 units)	R	-13,778	385	\$ 1,840	19	\$ 1,020,000	\$ 200,000	554.3	108.7
4	Large RTUs Replacement (ASHP - 9 OA units) w/ controls	NR	324,200	28,938	\$ 214,352	1570	\$ 3,350,000	\$ 1,730,000	15.6	8.1
5A	Central Boiler / Chiller Plant & Hydronic RTU w/ controls	NR	430,607	28,153	\$ 214,991	1539	\$ 8,750,000	\$ 5,860,000	40.7	27.3
5B	Central Boiler / Heat Pump Chiller & Hydronic RTUs w/ controls	NR	-968,700	35,925	\$ 189,323	1804	\$ 9,013,000	\$ 6,120,000	47.6	32.3
5C	Central Boiler / Heat Pump Chiller & Hydronic RTUs w/ Heat Recovery & controls	NR	-916,827	35,925	\$ 192,232	1809	\$ 13,535,000	\$ 10,640,000	70.4	55.3
6	Central Boiler / Heat Pump Chiller & Hydronic RTUs w/ Geothermal Heat Exchangers	R	-336,639	36,484	\$ 228,512	1900	\$ 18,155,000	\$ 15,370,000	79.4	67.3
7	Grinding Coolant Pump VFDs	R	256,479	0	\$ 14,363	27	\$ 66,000	\$ 66,000	4.6	4.6
8	New Process Chiller	NR	96,840	0	\$ 5,423	10	\$ 93,000	\$ 93,000	17.1	17.1
9A	LED Lighting Upgrade - Buildings 1, 5, 6, 8, & 9	NR	993,610	0	\$ 55,642	105	\$ 647,612	\$ 647,612	11.6	11.6
9B	LED Lighting Upgrade - Buildings 1, 5, 6, and 9	R	990,741	0	\$ 55,482	105	\$ 451,554	\$ 451,554	8.1	8.1
10	Energy Management Metering and Software	R	0	0	\$ -	0	\$ 107,000	\$ 107,000	N/A	
Recommended Measures			1,471,116	36,870	\$ 332,358	2,111	\$ 19,949,754	\$ 16,245,754	60.0	48.9
Baseline Use - 2021			19,371,000	31,940	\$ 1,301,329	3,746				
Baseline Use - 12 months Weather Normalized (2022)			19,261,000	37,298	\$ 1,331,496	4,019				
Recommended Future			17,789,884	428	\$ 999,138	1,908				
% Reductions from past 12 months (weather normalized)			8%	99%	25%	53%				

Recommendations  
R - Recommended  
NR - Not Recommended

# Vision & Map Strategy

▼ PLANNING PROCESS

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Project Scoring

Select Project Type: **NewConstruction** | Enter Project Name: **Addition Option #2**

Project Type	Project Name	CRITERIA	FACTORS	Scoring Cue (Select)	Weighted Score
NewConstruction	Addition Option #2	Education & Training	Education & Training	0 = NA	0.00%
		Project Financial Data	Budget Cost	2 = \$1MM - \$2.5MM	0.75%
			Incentive Dollars Included	3 = \$1MM - \$2.5MM	11.25%
			Payback (Years)	3 = 1-2 years	4.50%
			IRR (Percentage)	4 = Greater than 10%	4.50%
			Implementation Duration	3 = 6-12 mo.	2.25%
		Institutional Financial Impact	Cash On Hand (Days)	3 = Medium	3.75%
			Net Operating Margin	3 = Medium	3.45%
			Cashflow Impact	2 = Low	1.70%
			Utility Cost Change (Electricity)	3 = Medium	2.25%
			Fuel Cost Change (Steam, Oil, etc.)	3 = Medium	1.50%
			Water Consumption Change	3 = Medium	1.50%
		Organizational Business Objectives	Patient Safety Impact	4 = High	3.00%
			Patient Experience	4 = High	3.00%
			Community Service/Outcomes Impact	2 = Low	1.50%
			Strategic Initiatives Alignment	2 = Low	1.50%
			Staffing Efficiency (Nurse/Clinician/Support Ratio)	4 = High	2.25%
			Revenue Generation Impact	4 = High	0.75%
		Facility Operation & Resiliency Objectives	Energy Demand Change	3 = Medium	1.88%
			Energy Consumption Change	3 = Medium	1.88%
			Total Cost Avoidance	3 = Medium	1.50%
			Fossil Fuel Consumption Change	4 = High	2.00%
			Utility / Power Interruption Prevention + Extreme Weather Protection	3 = Medium	0.75%
		Facility Carbon Emissions Impact	Facility Carbon Emissions Impact	4 = High	10.00%
		Regulatory Compliance	Federal	4 = High	4.00%
			State	3 = Medium	2.63%
			City/Local	3 = Medium	1.88%

Addition Option #2 Score: **75.90%**

Scoring Criteria, Factors, Weights

Criteria	Weightage
Education & Training	5%
Project Financial Data	30%
Institutional Financial Impact	20%
Organizational Business Objectives	15%
Facility Operation & Resiliency Objectives	10%
Facility Carbon Emissions Impact	10%
Regulatory Compliance Score	10%
	max
	100%



# Measurement & Verification

▼ PLANNING PROCESS

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## Energy Benchmarking

"I want to compare the efficiency of energy use across buildings / plants / process lines."

Save Money by reducing Energy Spend

- Benchmark energy usage with respect to other buildings / plants / process lines
- Multi-site PME enables benchmarking across multiple sites from a centralized location.
- Compare energy usage by normalizing consumption with respect to area / production volume or other drivers
- Gain understanding what makes an energy efficient facility use less energy than an inefficient facility.



[Industry case study](#)



- Energy Data Collection
- Energy Monitoring
- Energy Alarms
- Pareto Charts
- Sankey Charts
- Energy Heat Maps
- Energy Modeling
- Energy KPI Gadget
- Energy Calendar Report



## Battery Energy Storage Solutions

# What is a microgrid?

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A microgrid is a small, localized power system.

- It generates electricity for specific areas of the distribution grid
- It can use various types of generation, including renewable sources like solar and wind power.
- Unique feature: it can operate independently from the larger electrical grid.
- Advantage: In case of broader power outages, a microgrid can continue providing electricity to the area it serves.

## **Traditional Microgrid:**

- A custom-designed and site-specific system. It's usually built from scratch to meet the unique energy needs of a particular location or facility.
- The benefits of a traditional microgrid include a high degree of customization and the ability to optimize the system for local conditions. However, these systems can be complex to design and install, often resulting in longer deployment times and higher costs.

## **Productized Microgrid:**

- A standardized, modular, and scalable microgrid solution that can be rapidly deployed and easily replicated across various sites.
  - Pre-engineered and packaged as products with defined specifications and functionalities.
  - reduces the complexity, cost, and deployment time of microgrids. It also allows for easier integration with existing infrastructure, greater operational efficiency, and more predictable performance.
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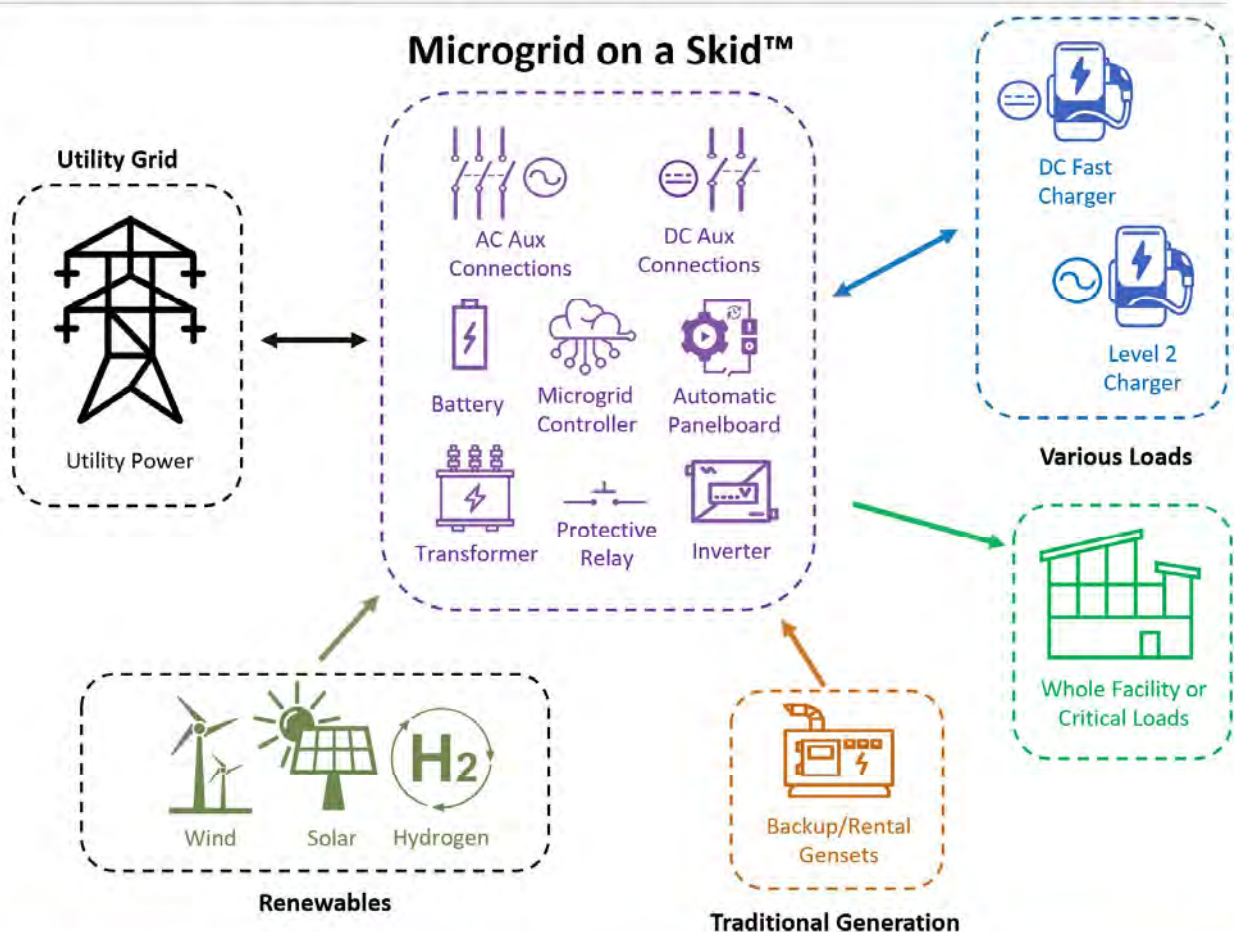


# MGS: The Multi-tool of Utility and C&I Power Systems

The Microgrid on a Skid (MGS) is a productized, pre-engineered microgrid that's designed to seamlessly fit any application.

With up to 1.5 MWh of energy storage, systems are ready to provide power for multiple use cases.

- Factory Integrated and Tested
- Designed and Manufactured in the USA
- Virtual Power Plant Enabled
- Economic Dispatch Software and Modeling Standard
- Configurations for any application
- Fully functioning microgrid
- Fits in a standard parking spot
- Cuts installation cost by up to 65%, Install time by 85%
- 24/7 remote monitoring

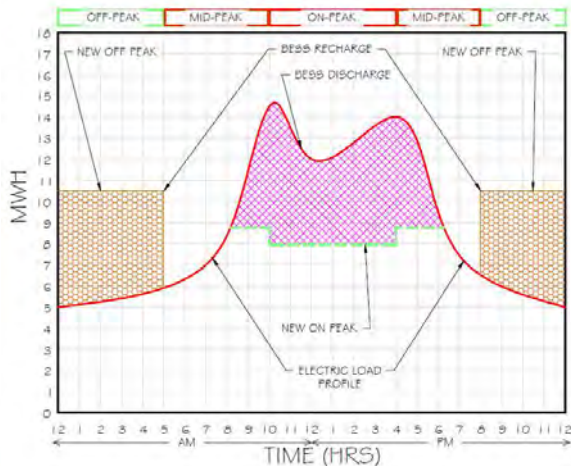


## Use Cases

**Peak Load Shaving:** Discharge at times of peak load to reduce demands on distribution and transmission infrastructure.

**Renewable Energy Smoothing:** Smooth out intermittency of renewables (wind/solar) by releasing stored power during momentary weather changes.

**Demand Response:** Load relief to systems that have high peak demands that overload.



**Defer Transmission & Distribution (T&D) Investment:** Postpone costly grid infrastructure upgrades by supplying power at distributed locations. This allows the deferral of upgrading aging transmission infrastructure as a Non-wire improvement alternative.

**Voltage Support / Power Factor Correction:** Introduce and absorb reactive power from the inverters to maintain local grid voltage levels.

**Frequency Regulation:** Maintain grid stability by rapidly changing charge or discharge power in response to changes in grid frequency.

**Support Increased EV Charging:** Build a localized grid to limit demand spikes that could set high monthly kW demands or/could overload existing electric infrastructure

**Microgrid:** Build a localized grid that can disconnect from the main power grid on a scheduled or emergency basis.



**Create Roadmap & Plan**

## Roadmap

- Meter and Analyze High Consumers
- Enhance Controls & Visibility
- Establish an Energy Baseline Report
- Create a Priority List





Questions