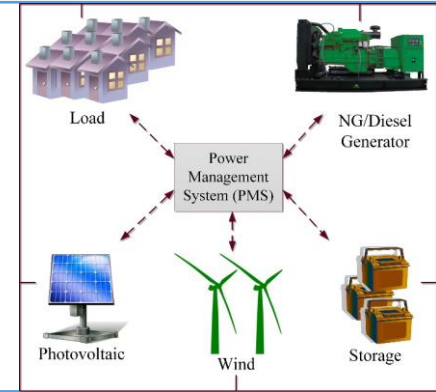


Motivations for Microgrids



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Learning Objectives

In this lesson, you will learn to:

- Identify the motivations for microgrids
- Describe example use cases for on-grid and off-grid microgrids
- Identify challenges to meeting the demand for microgrids

Energy-related Goals of Different Users

Civilian



Safety

Reliability

Affordability

Sustainability

Defense



Mission assurance

Mission capability

Mission reach

Mission autonomy

Humanitarian



Access

Speed

Flexibility

Endurance

Primary Motivations for Microgrids

Accessibility – provide power to people without electricity (~1 billion)

Safety – no physical harm to customers, workers, and others

Reliability – reduce outages and improve power quality

Affordability – reduce cost to users, facilitate economic development

Sustainability – make the power green, reduce carbon emissions

Autonomy – operational assurance to meet loads in case of grid outage

Resilience – flexibility and adaptability for known and unknown events

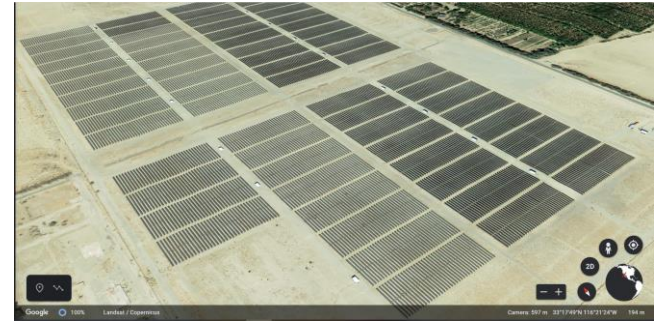
Microgrid Example for Accessibility and Safety

- **Location:** Northern Uganda (2019)
- **Motivations/Benefits:**
 - Meets multiple needs in refugee settlement
 - 12,000 refugees and local citizens
 - Primary care clinic for outpatient care; vaccines
 - 700 people served per week
 - Water treatment of 350 gal/hr
 - Power for clinic, surrounding buildings, and street lighting for safety
- **Load:** 7 kW (peak), 5 kW (average) for medical equipment, water treatment, lighting
- **Assets:** 10 kW solar PV, 40 kWh battery storage, 10 kW diesel generator (optional)



Microgrid Example for Reliability and Affordability

- **Location:** Borrego Springs, CA, USA (2013)
- **Motivations/Benefits:**
 - End of long feeder; microgrid deferred cost of conductor upgrade; reduced outages
 - Reduce peak load in feeder
 - Integrate advanced metering infrastructure with microgrid
 - Demonstrate demand response
 - Reactive power management
- **Load:** 4 MW for 2800 residential customers
- **Assets:** Two 1.8 MW diesel generators, one 1500 kWh battery, three 50 kWh batteries, six 8 kWh home energy storage, 700 kW rooftop solar PV, and 125 integrated home area systems



San Diego Gas &
Electric



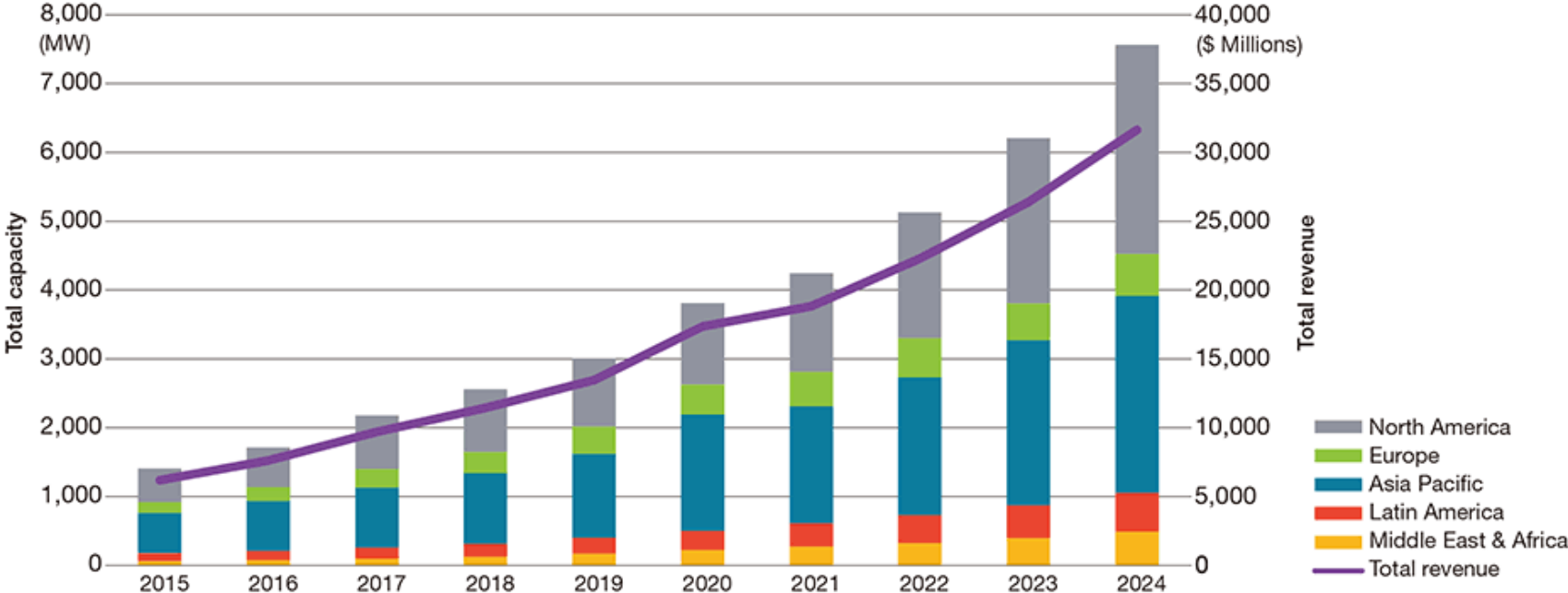
Microgrid Example for Autonomy and Resilience

- **Location:** MCAS Miramar, San Diego, CA, USA (2019)
- **Motivations/Benefits:**
 - Ability to island and operate for up to 7 days
 - Power critical facilities
 - Integrate existing technologies with new technologies
 - Participate in utility demand response programs
 - Additional revenue stream through grid support
- **Load:** 14 MW total, 7 MW average, 3-6 MW critical
- **Assets:** Two 1.8 MW diesel generators, two 1.4 MW natural gas generators, incorporates existing 3.2 MW landfill gas and 1.7 MW solar PV, thermal energy storage, electric vehicle charging station, demand response in 80+ buildings, future provisions for energy storage and more landfill power



Global Growth of Microgrids

Global capacity of microgrids expected to grow 21% per year through 2028 [Navigant]



Source: Guidehouse Insights

Growing Markets for On-grid and Off-grid Systems

On-grid Applications

- Campuses
- Hospitals
- Data centers
- Industrial parks
- Communities
- Military



Off-grid Applications

- Remote villages
- Islands
- Telecom
- Mining
- Oil and gas
- Military



Microgrid Locations and Applications in the USA



Remote
25%



Commercial/
Industrial
7%

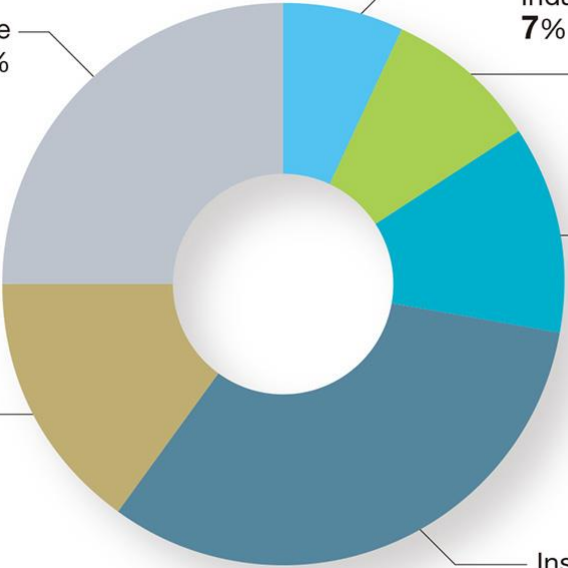


Community
9%

Utility
distribution
12%



Military
15%



Institutional/
Campus
32%



Source: Guidehouse Insights

Microgrid Locations and Applications in the USA



Figure 1: Select Microgrid Assessment and Demonstration Projects in the U.S.

Challenges of Meeting Demand for Microgrids

- Each site is unique, no one microgrid is the same
- Lengthy engineering design process
- Limited or no provision for scalability or expandability
- Limited interoperability of components, communications, and grids
- Integration with existing older (legacy) assets
- Cost and complexity of microgrid controls and controller
- Insufficient workforce size and training to respond to microgrid demand
- Partially defined regulation and permitting process
- Financial risk in new technologies and markets



Lesson Summary

Lesson Summary

- What are the motivations for microgrids?
- Name and describe example microgrids.
- What are the challenges to meeting microgrid demand? How do you think those challenges will slow down market growth?
- What do you think is the fastest growing application for microgrids?