

# Microgrid Concepts and Definitions – What is a Microgrid?



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# Learning Objectives

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In this lesson, you will learn to:

- Define a microgrid
- Compare microgrids to traditional power system infrastructure
- Describe the history of microgrid development
- Identify and describe microgrid components

# What is a Microgrid?

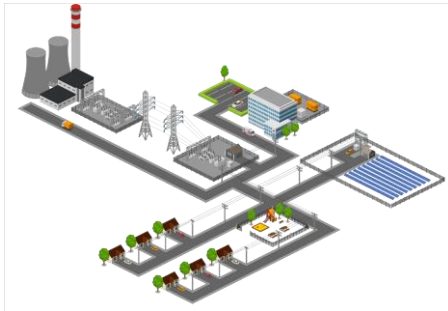
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# Microgrids and Mini-grids

## On-grid “Microgrid” Systems

Group of interconnected loads and distributed energy resources (DER) with clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid [and can] connect and disconnect from the grid to enable it to operate in both grid-connected or island mode

*Source: US Department of Energy*



## Off-grid “Mini-grid” Systems

An isolated power system with no grid connection. Includes generation and loads in a small “micro” or “mini” grid. Generation may include a combination of traditional and renewable, with energy storage as an optional yet increasingly common asset. Generation could be centrally located or distributed across the distribution network

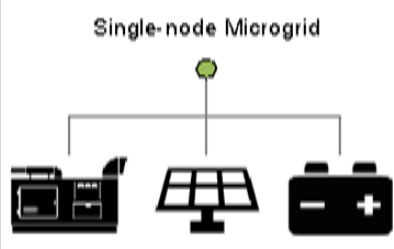


# Categorizing Microgrids by System Size and Network Design

Off-grid villages  
Cell towers  
Building



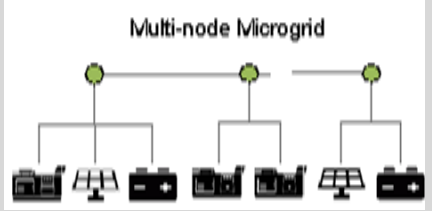
**1 kW - 1 MW**



Refugee camps  
Islands  
Command post



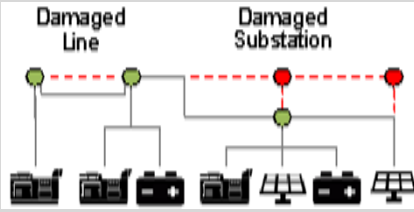
**100 kW - 10 MW**



Disaster response  
Disaster relief  
Weak grid



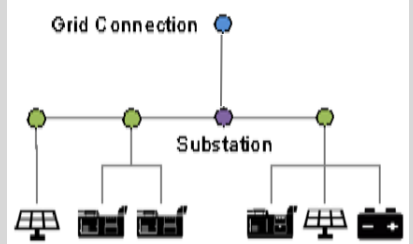
**10 kW - 10 MW**



Remote on-grid locations  
Grid-tied islands  
Campuses



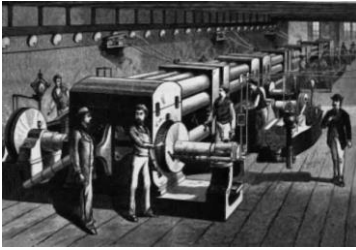
**1 MW - 100 MW**



# A Brief History of Microgrid Evolution

1880

Pearl Street Station



1920-2000

Consolidated grid

Generation mix



Off-grid systems



1880-1920

Industry, farming, cities, islands



2000s

Modern electric grid



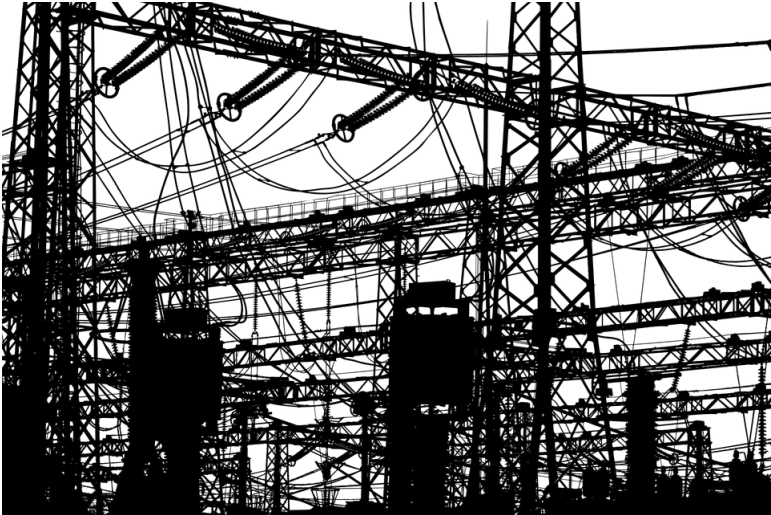
Toda



On-grid systems

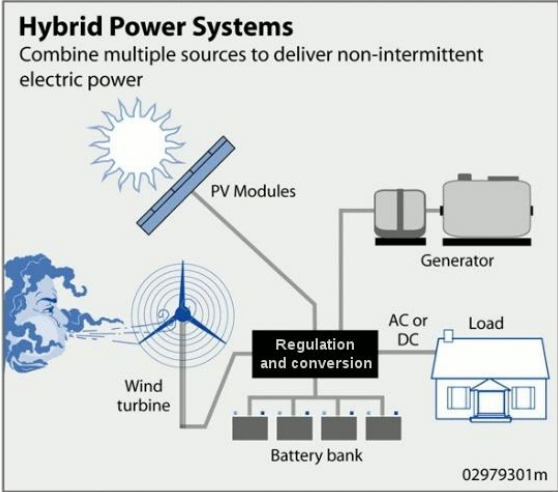
# Adding Renewables and Storage to Offset Generators

## Conventional (Traditional) Power



Generator

## Hybrid Power Systems

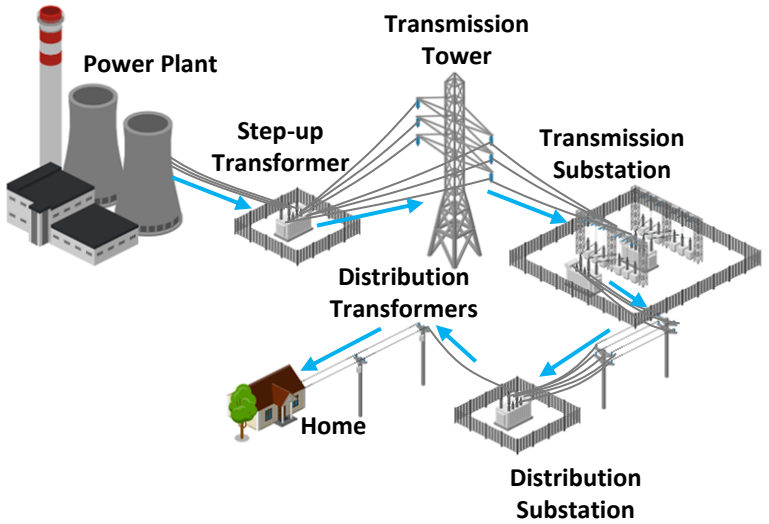


Generator + Storage  
+ Renewables (solar, wind,  
etc.)

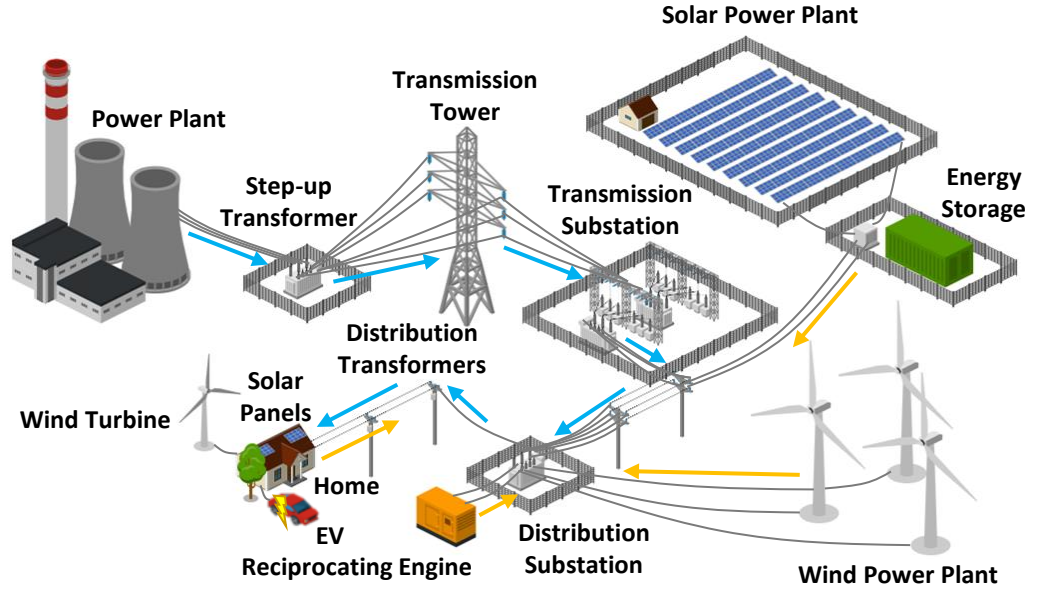


# The Changing Direction of Electron Flow in the Grid

## Conventional (Unidirectional) Flow



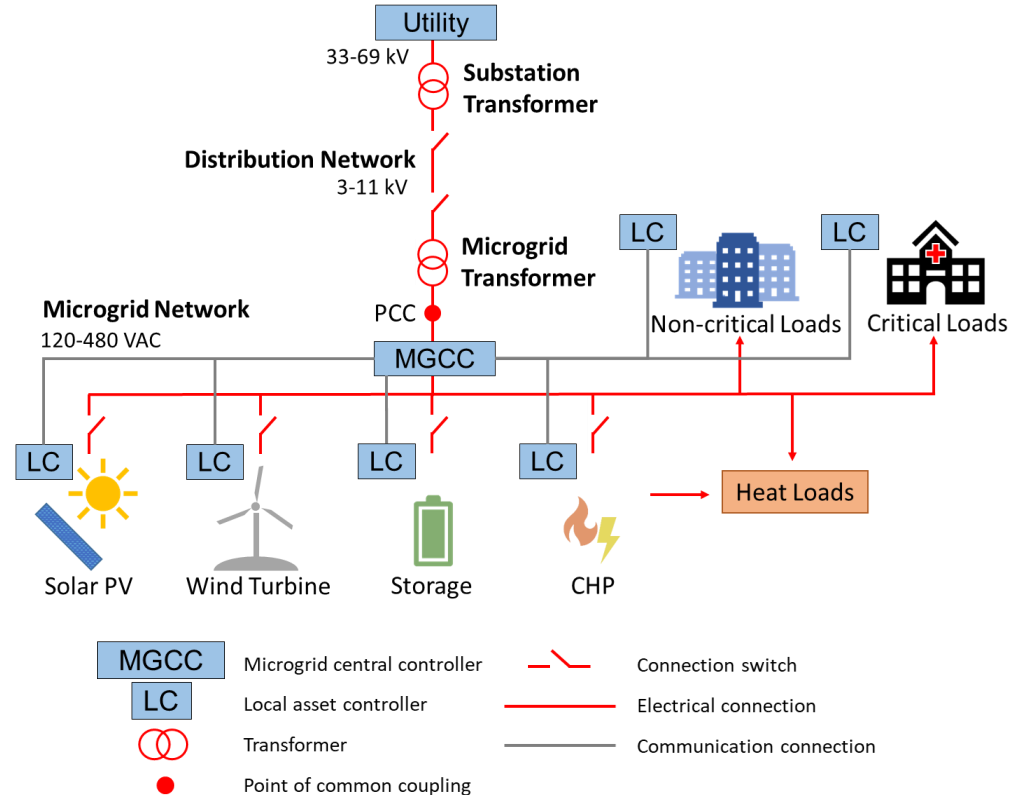
## Distributed (Bi-directional) flow





# Summary of Microgrid Components

- Assets (generation, storage)
- Loads (critical and non-critical)
- AC and DC power
- Distribution network
- Point of Common Coupling (PCC)
- Controllers / controls
- Communications / SCADA
- Balance of plant



# Lesson Summary

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- Define the essential characteristics of a microgrid.
- How is a microgrid different than a mini-grid?
- Describe the history of electric power and microgrid development.
- Contrast microgrids and distributed generation to traditional power systems.
- Identify and describe microgrid components.