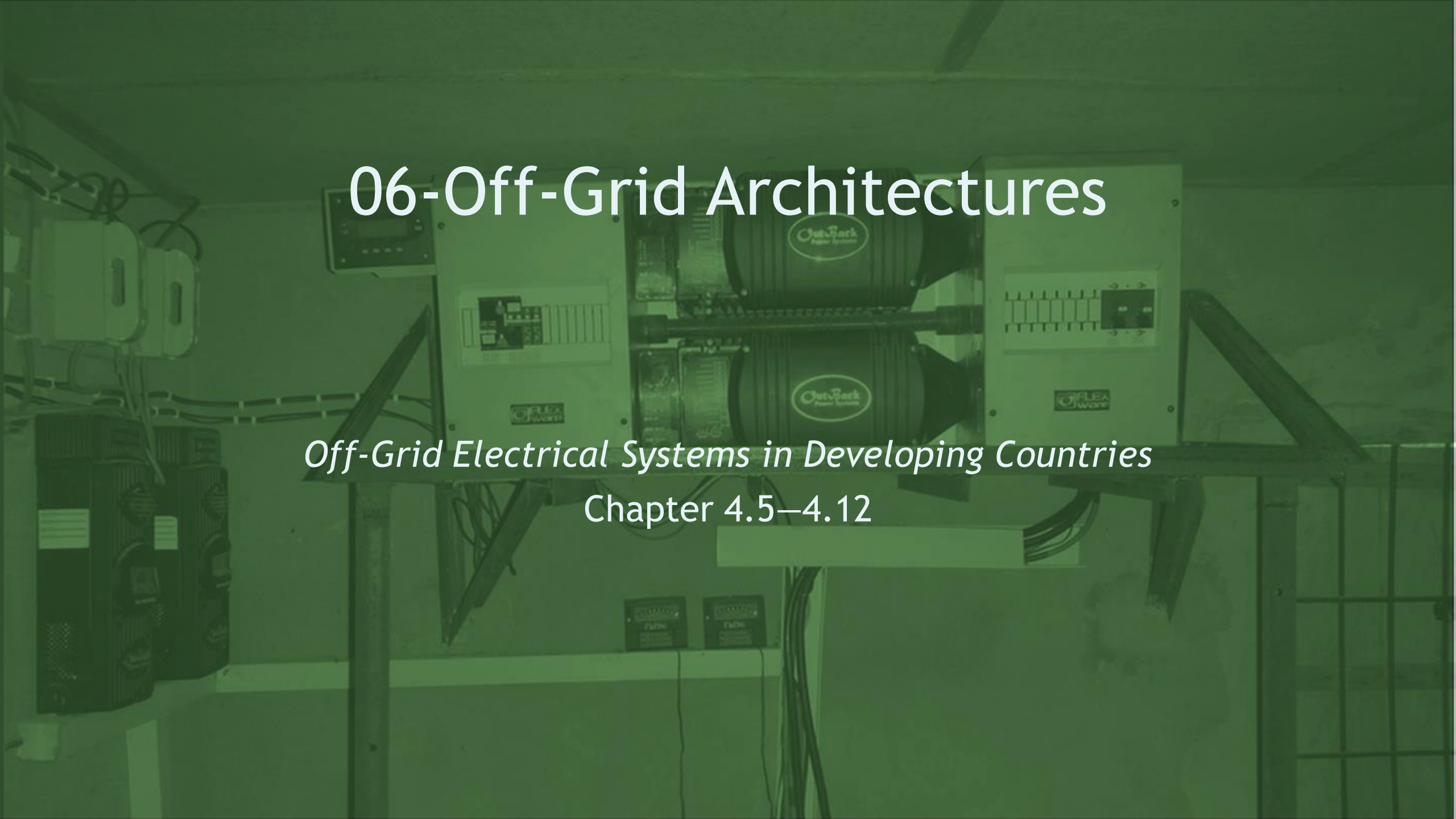


# 06-Off-Grid Architectures

*Off-Grid Electrical Systems in Developing Countries*

Chapter 4.5—4.12



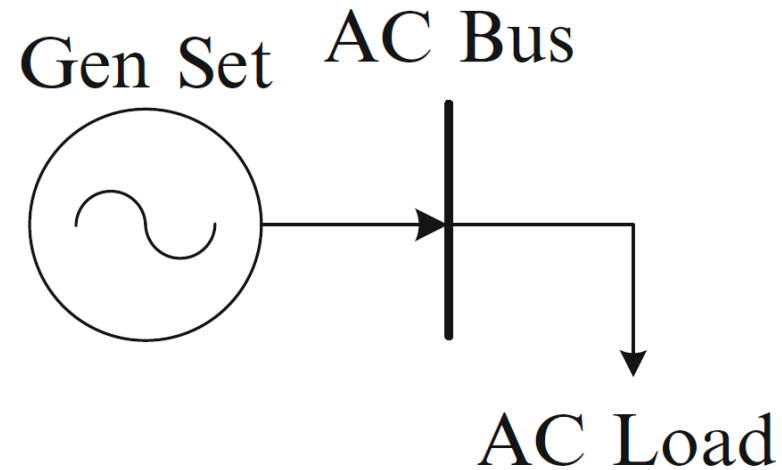


# Learning Outcomes

At the end of this lecture, you will be able to:

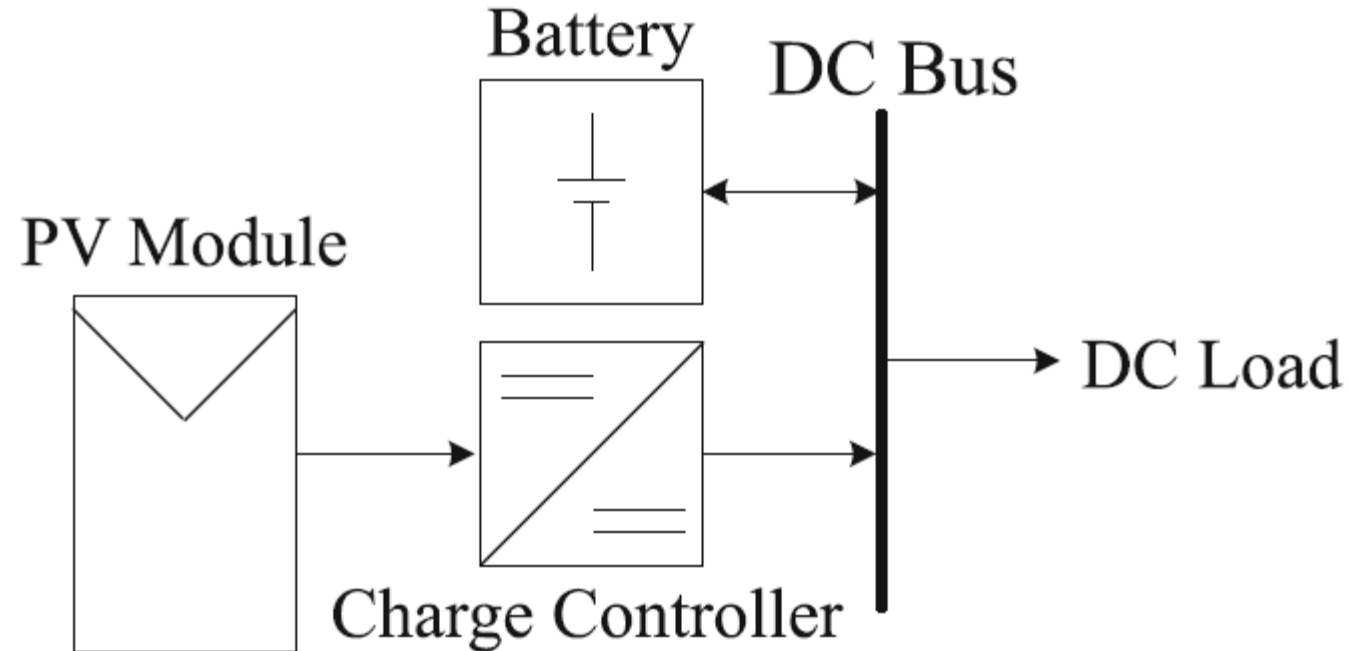
- ✓ Understand the common architectures of off-grid systems
- ✓ Identify the components responsible for voltage and frequency regulation and battery charge management

# Conventional or Biomass Gen Sets



What component is responsible for voltage/freq. regulation?

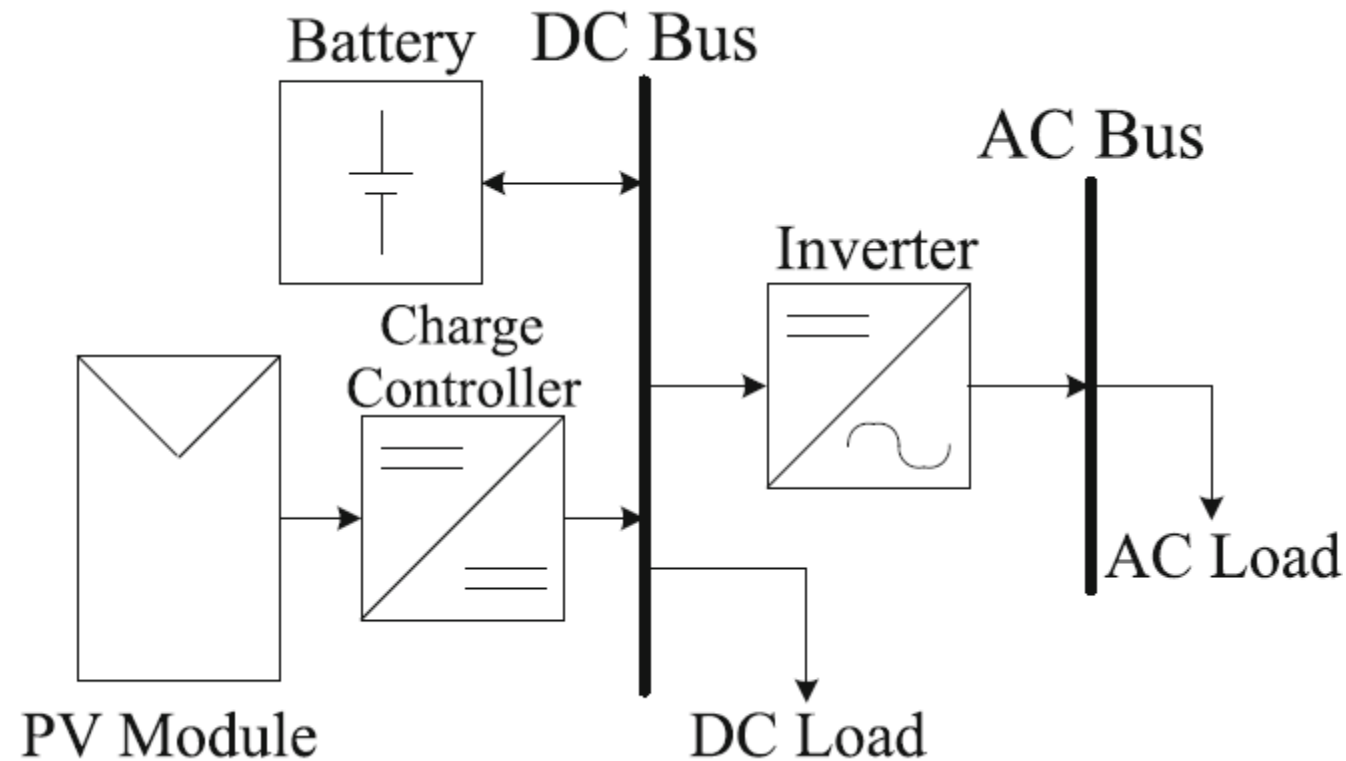
# Photovoltaic System with DC Load



# Photovoltaic System with AC Load

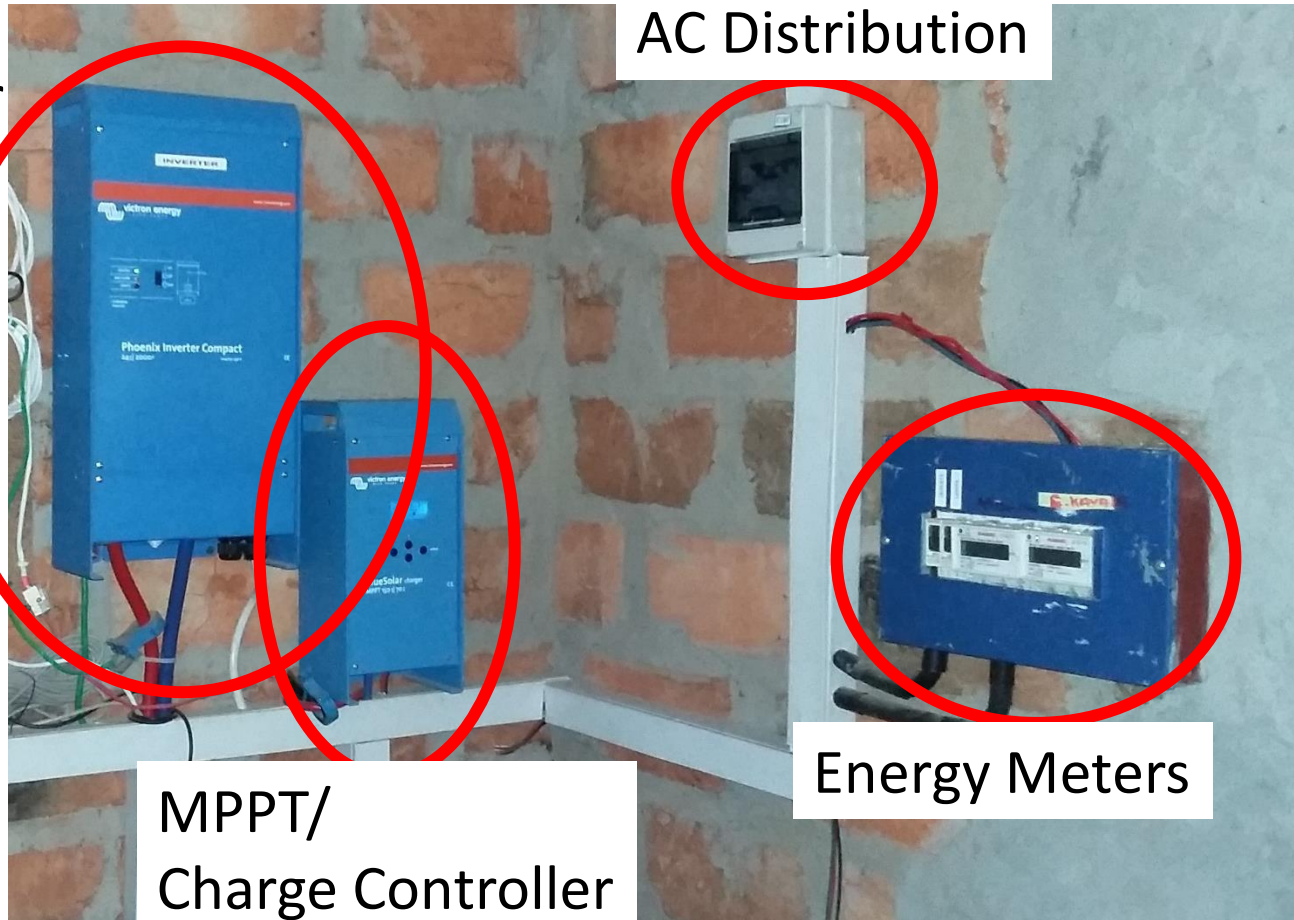
What component is responsible for voltage/freq. regulation?

What component(s) is responsible for battery charge management?



Inverter

AC Distribution



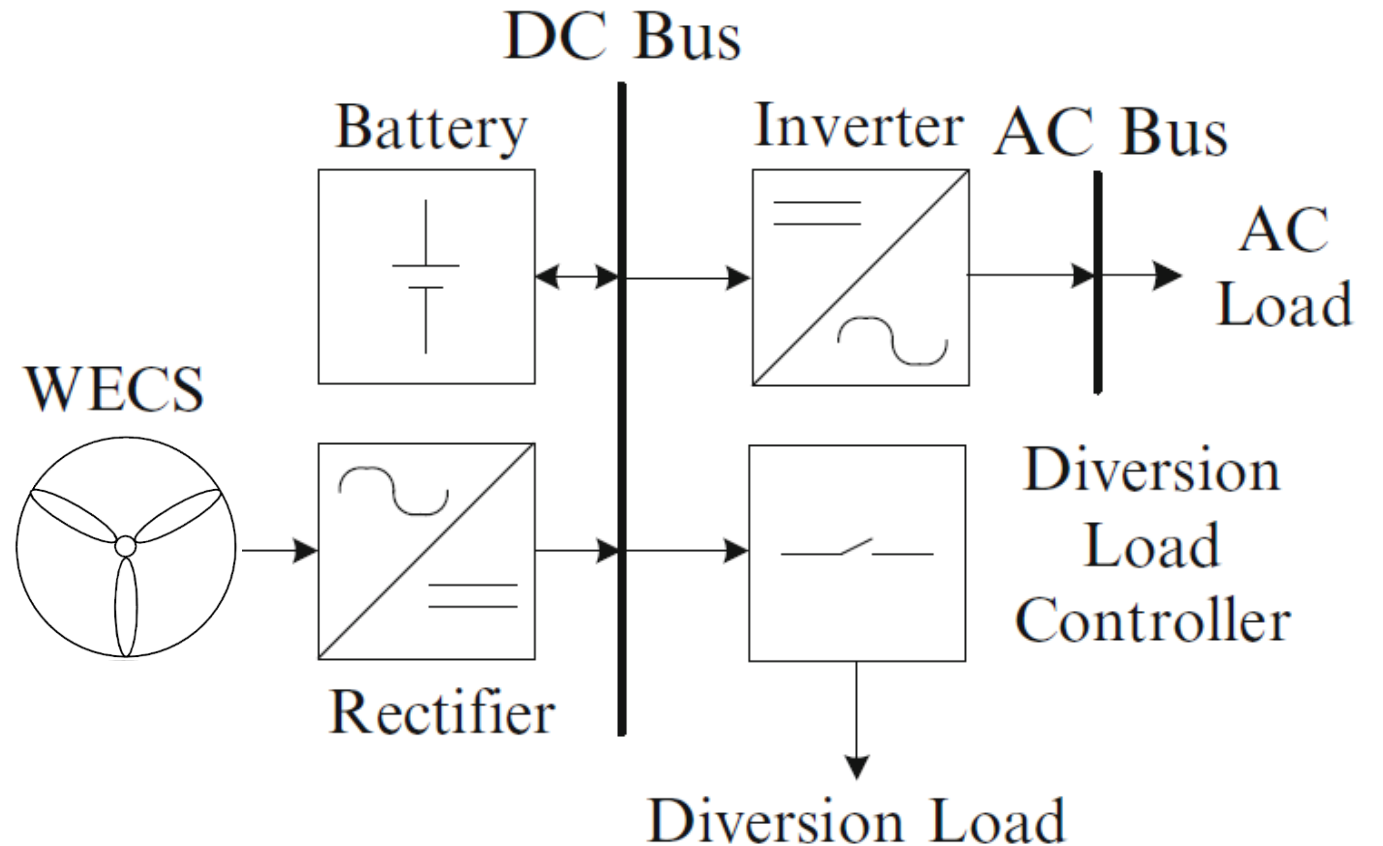
MPPT/  
Charge Controller

Energy Meters

# Wind Energy Conversion Systems

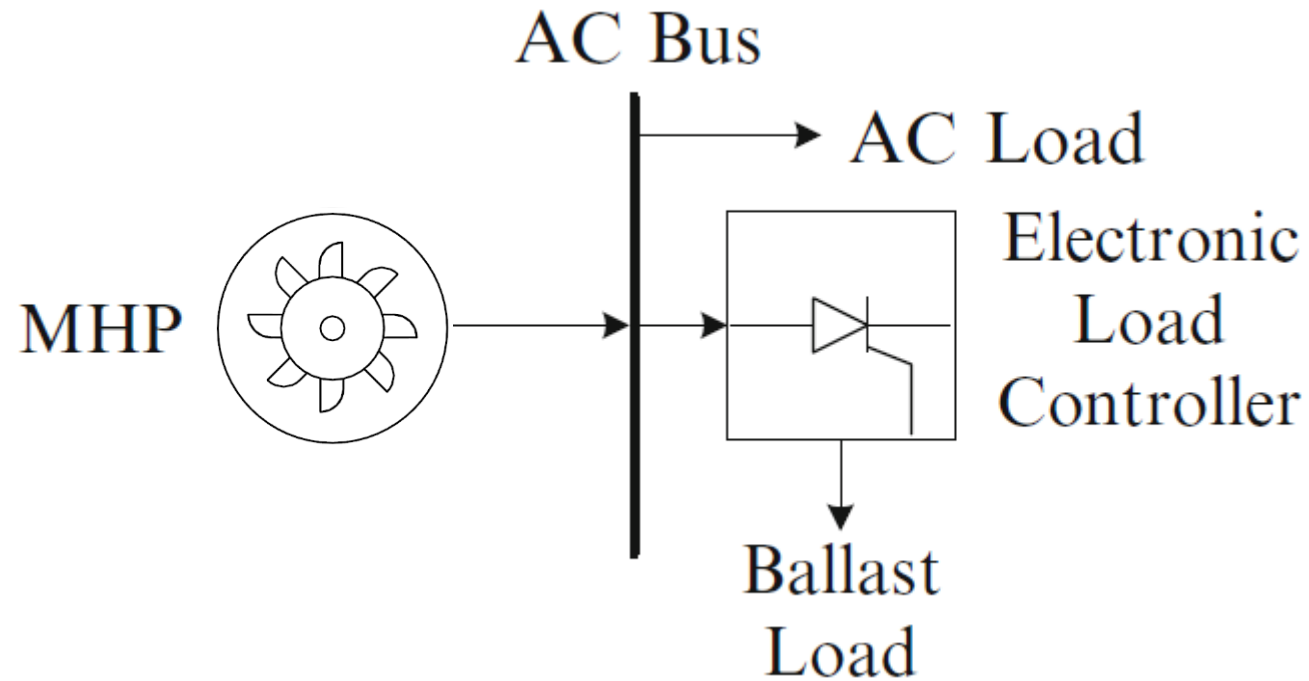
What component is responsible for voltage/freq. regulation?

What component(s) is responsible for battery charge management?



# Micro Hydro Power System

What component is responsible for voltage/freq. regulation?



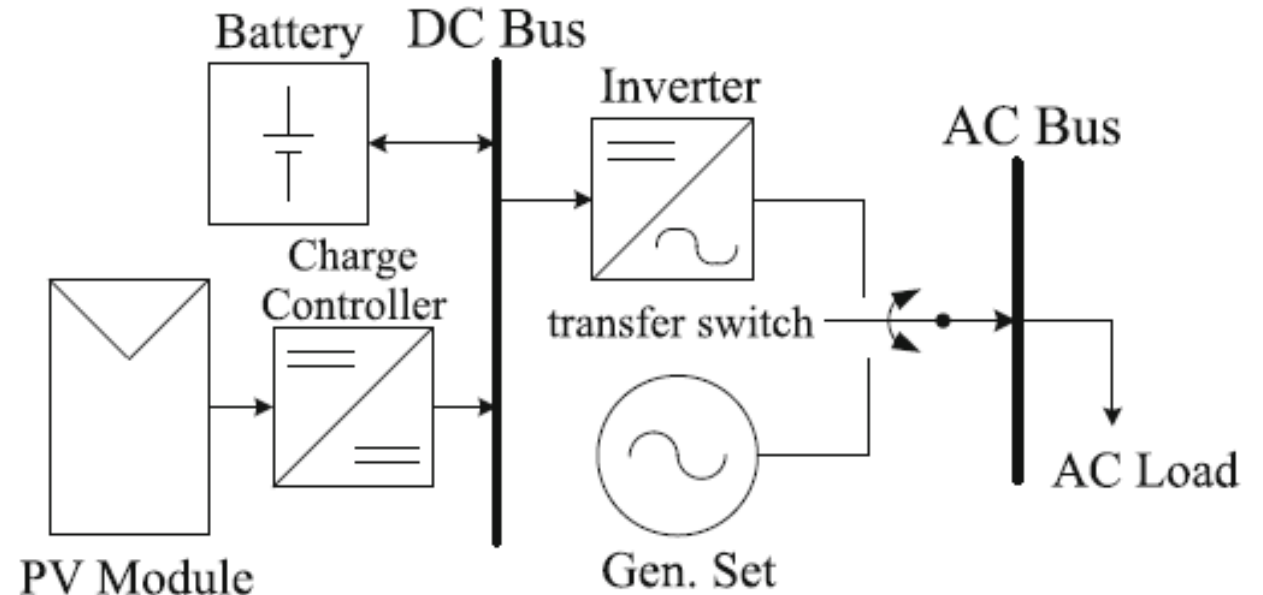


# Hybrid Systems

- Recall that hybrid systems incorporate two or more different energy sources
- One source is often, but not always, a gen set

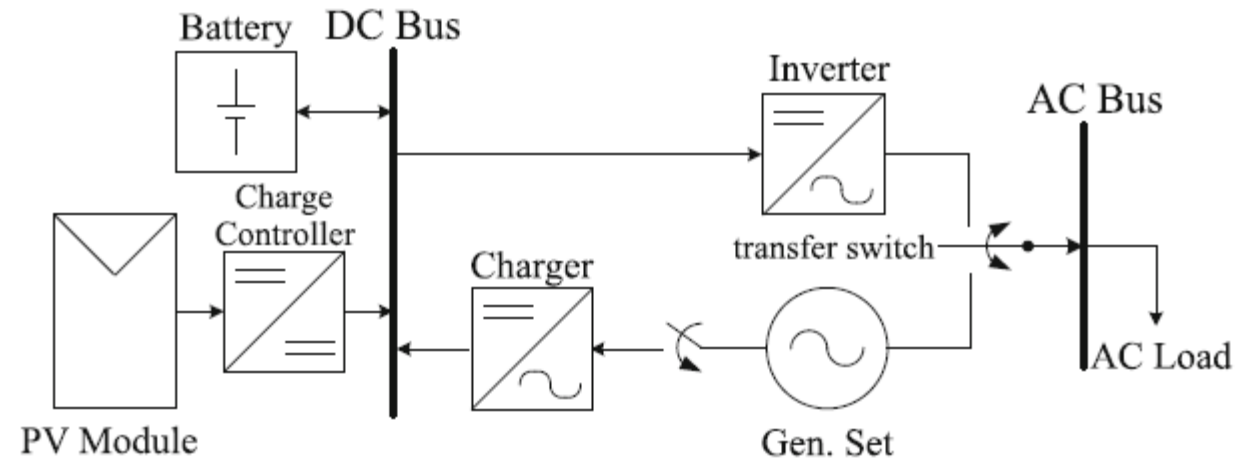
# Hybrid Systems: Switched Architecture

- Gen set is used as a back-up supply in case battery state-of-charge is too low
- Load is supplied by EITHER inverter or Gen Set (not both)
  - no need to synchronize
- Inverter is not bi-directional



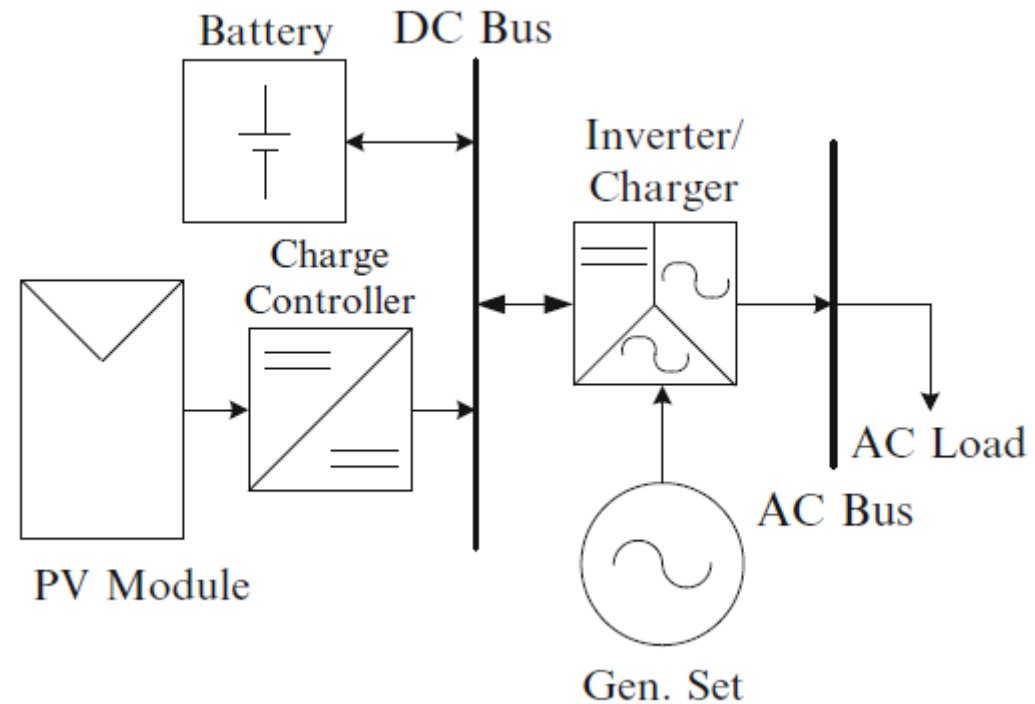
# Hybrid Systems: Switched Architecture with Battery Charging

- Separate AC charger enables gen set to recharge battery



# Hybrid Systems: Switched Architecture with Battery Charging

- Inverter is bi-directional and can synchronize with gen set
- Gen set power to recharge battery and/or supply load
- Gen set and inverter can simultaneously supply load



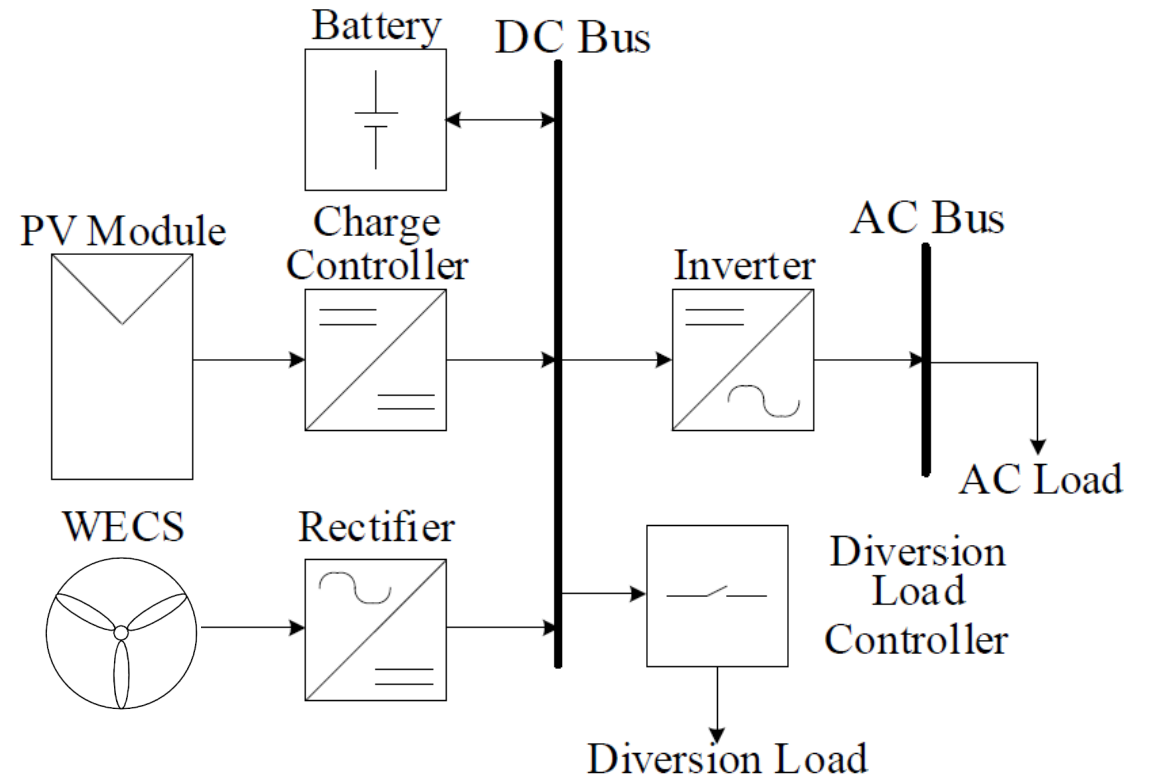
# Hybrid Renewable System

- Two or more different renewable power sources
- Used when sources have complementary characteristics
- Example: sunny during the daytime and windy in the evening



# Hybrid Renewable System

- PV module and WECS are DC-coupled
- Battery managed by charge controller and diversion load controller



# Contact Information

Henry Louie, PhD

Professor

Seattle University



@henrylouie

[hlouie@ieee.org](mailto:hlouie@ieee.org)

Office: +1-206-398-4619