

SPIDERS Phase 2

Fort Carson, Colorado

Presented to Asia Pacific Clean Energy Summit

September 10, 2013



SPIDERS Design Considerations

Prioritization of Goals

- Energy Resiliency for Mission Assurance is primary driver
- Increased efficiency, reduced fossil fuel consumption and operational enhancements are secondary benefits

Do No Harm

- Avoid unnecessary complexity and failure points
- Fail safe modes revert to traditional backup power operation



SPIDERS Design Considerations

Minimize Changes to Existing Infrastructure

- Maximize value through use of existing assets
- Utilize existing systems and practices to increase reliability and maintainability of systems

Minimize Disruption to Ongoing Operations

- Critical missions can't afford lengthy construction and testing outages
- Consider cost/disruption versus benefit when integrating facilities



Fort Carson Microgrid Overview

- Serves Tier 1, 2 & 3 building loads (2,000 kW)
- Integrates existing generation assets
 - Building diesel generators
 - PV array
- Develop bi-directional PEV charging
 - Energy storage
 - Grid services
 - Power factor correction



Fort Carson Microgrid Overview



Critical
Facilities

Specker
Avenue

PV Array



Microgrid Power Sources

- 1250kW Diesel Generator
- 1000kW Diesel Generator
- 900kW Diesel Generator
- 2MW PV Array
- Five, 60kW Bi-Directional Electric Vehicles
(600kWh combined capacity)



Microgrid Loads

Tier 1

- 4th ID HQ
- NEC Data Center
- NEC
- Network Control Center

Tier 2

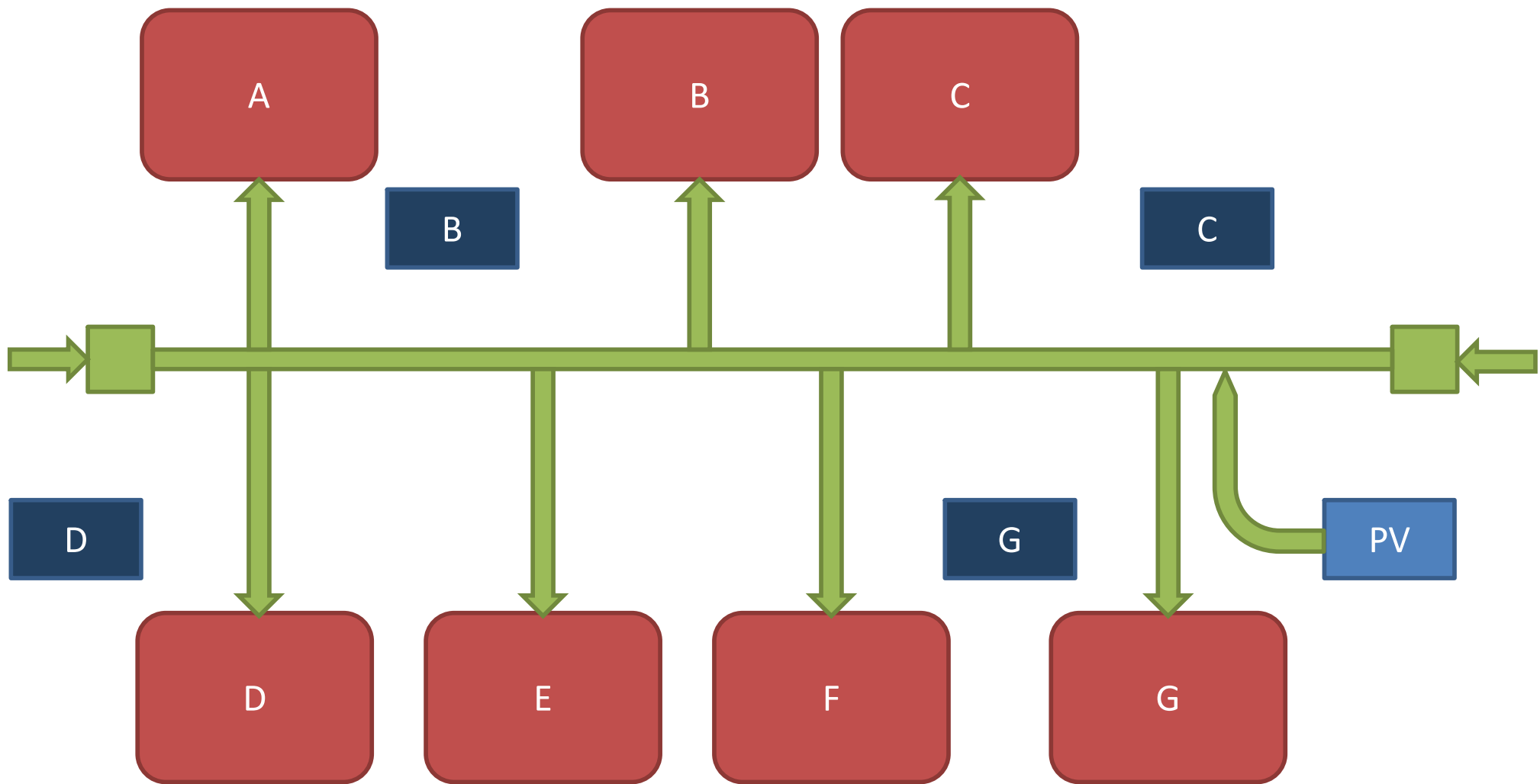
- Battalion Headquarters
- Community Service Center

Tier 3

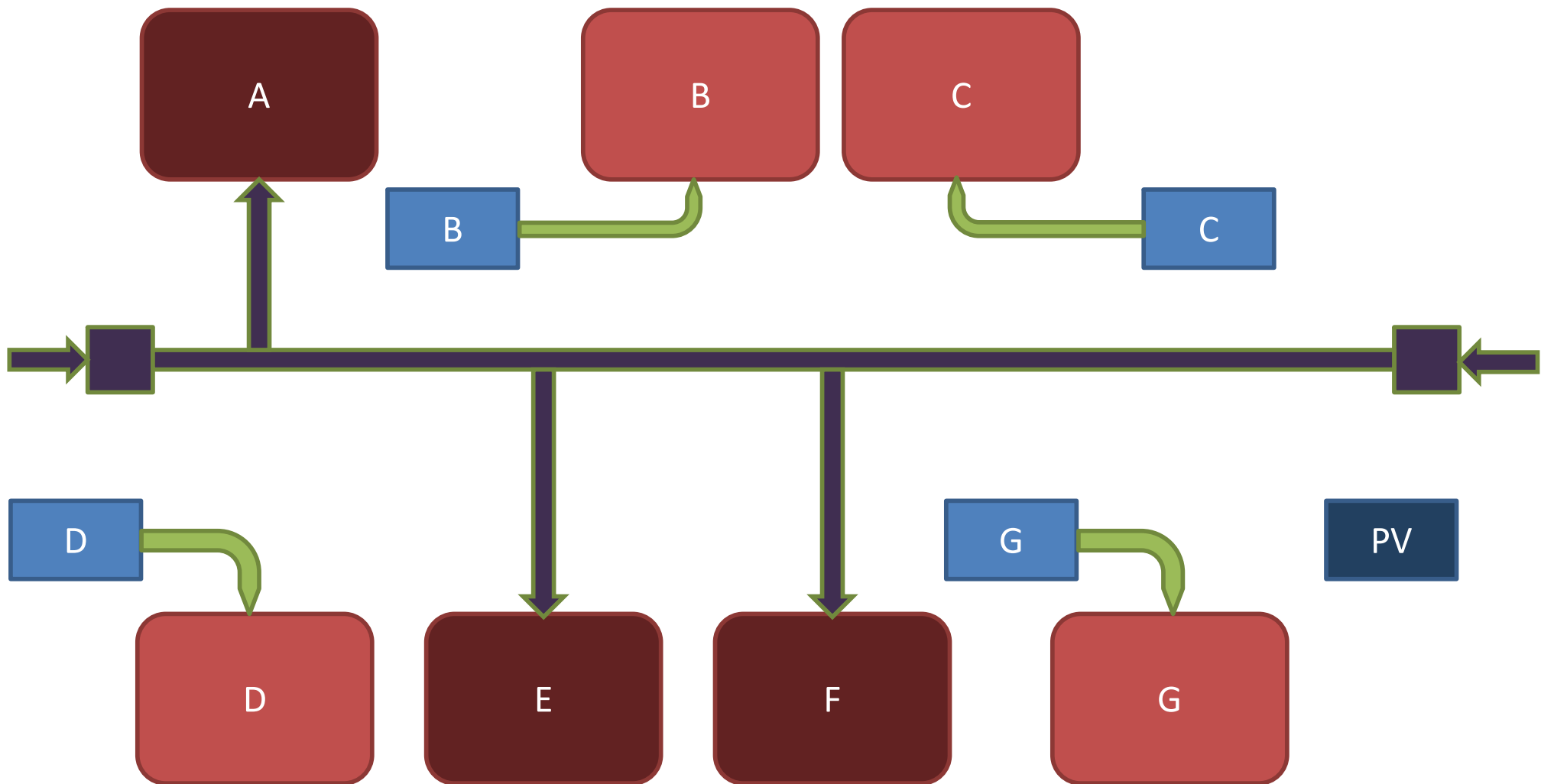
- Grant Library



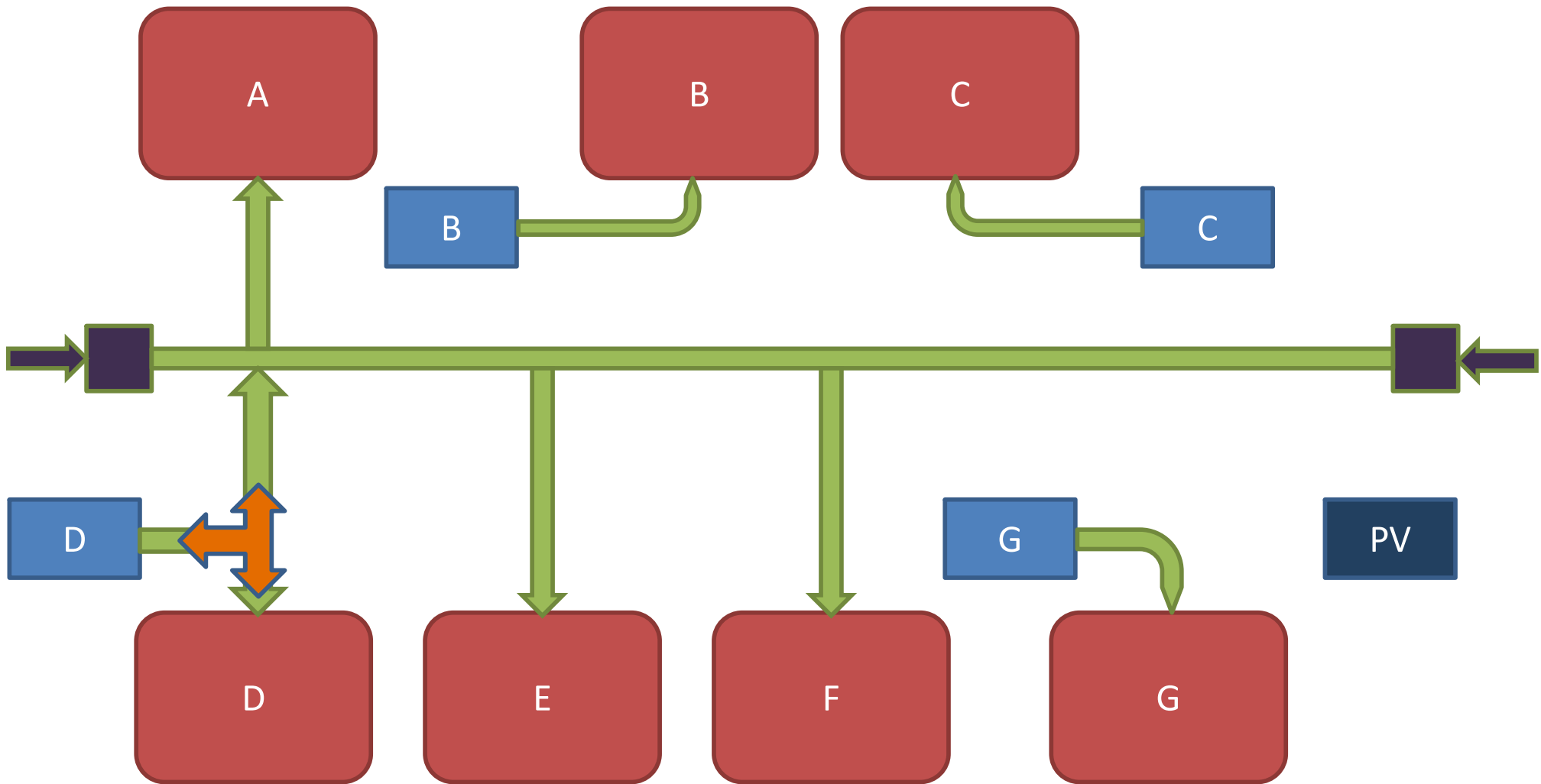
Normal Operation



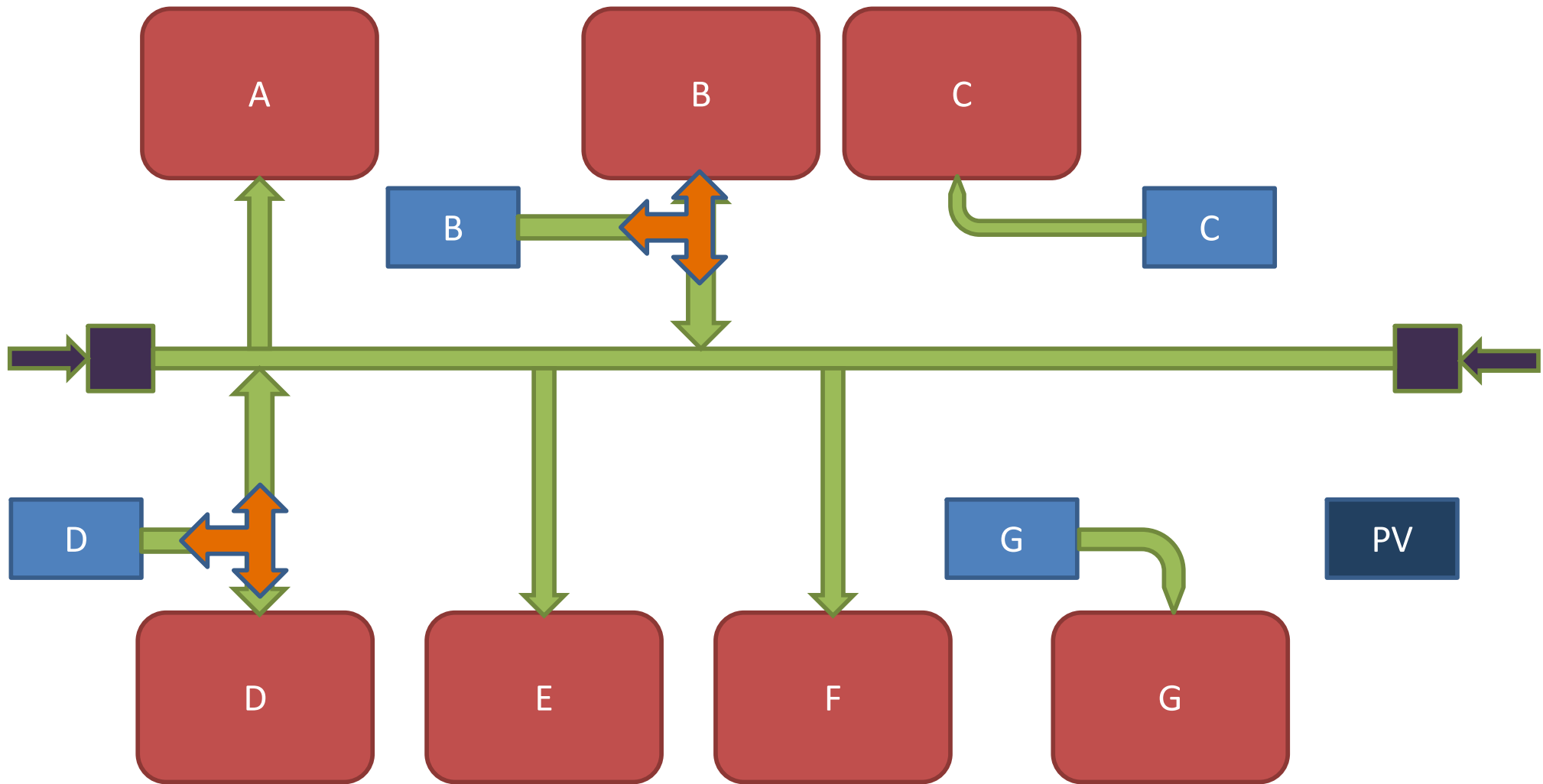
Utility Failure



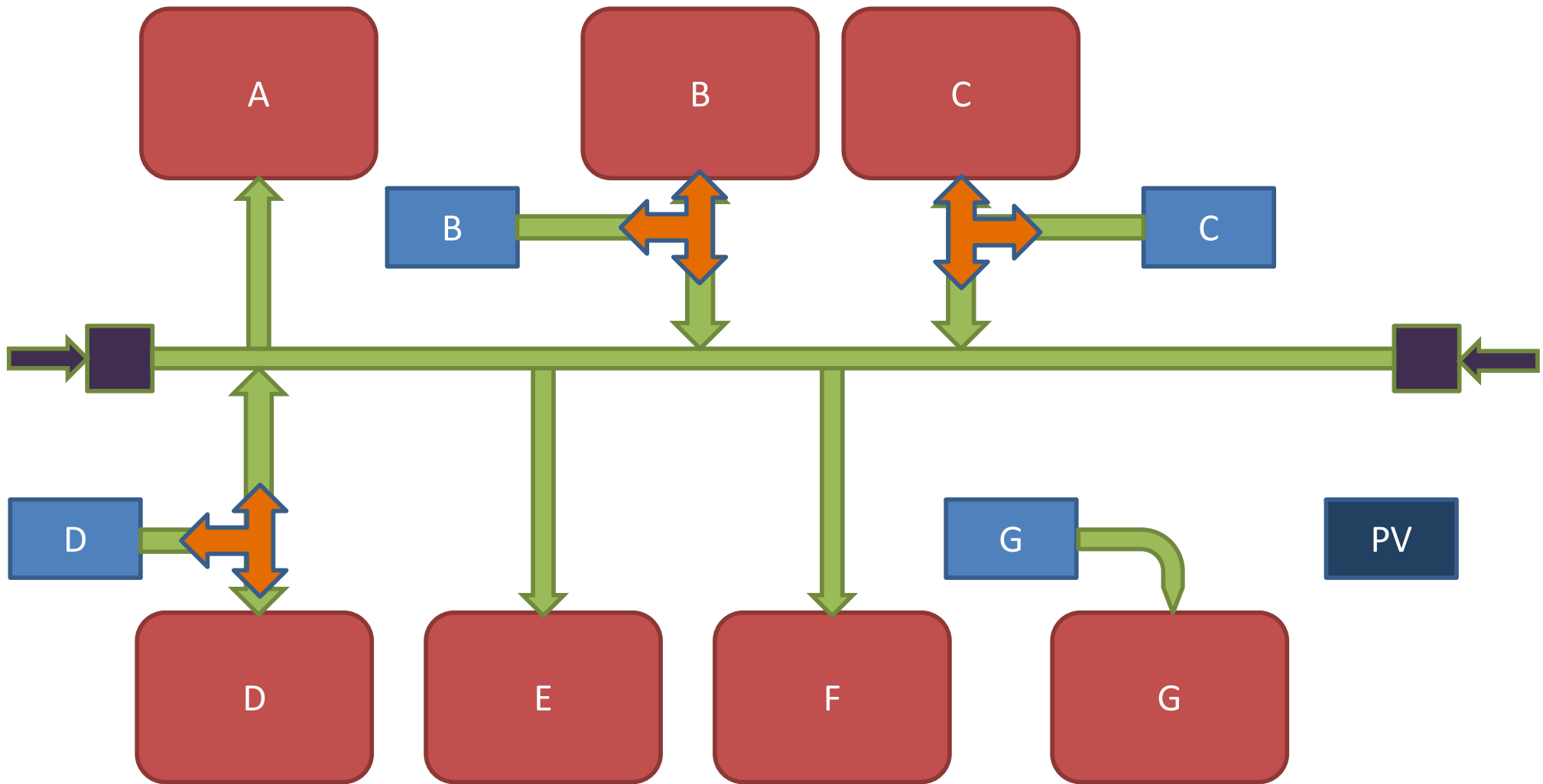
Microgrid Forms



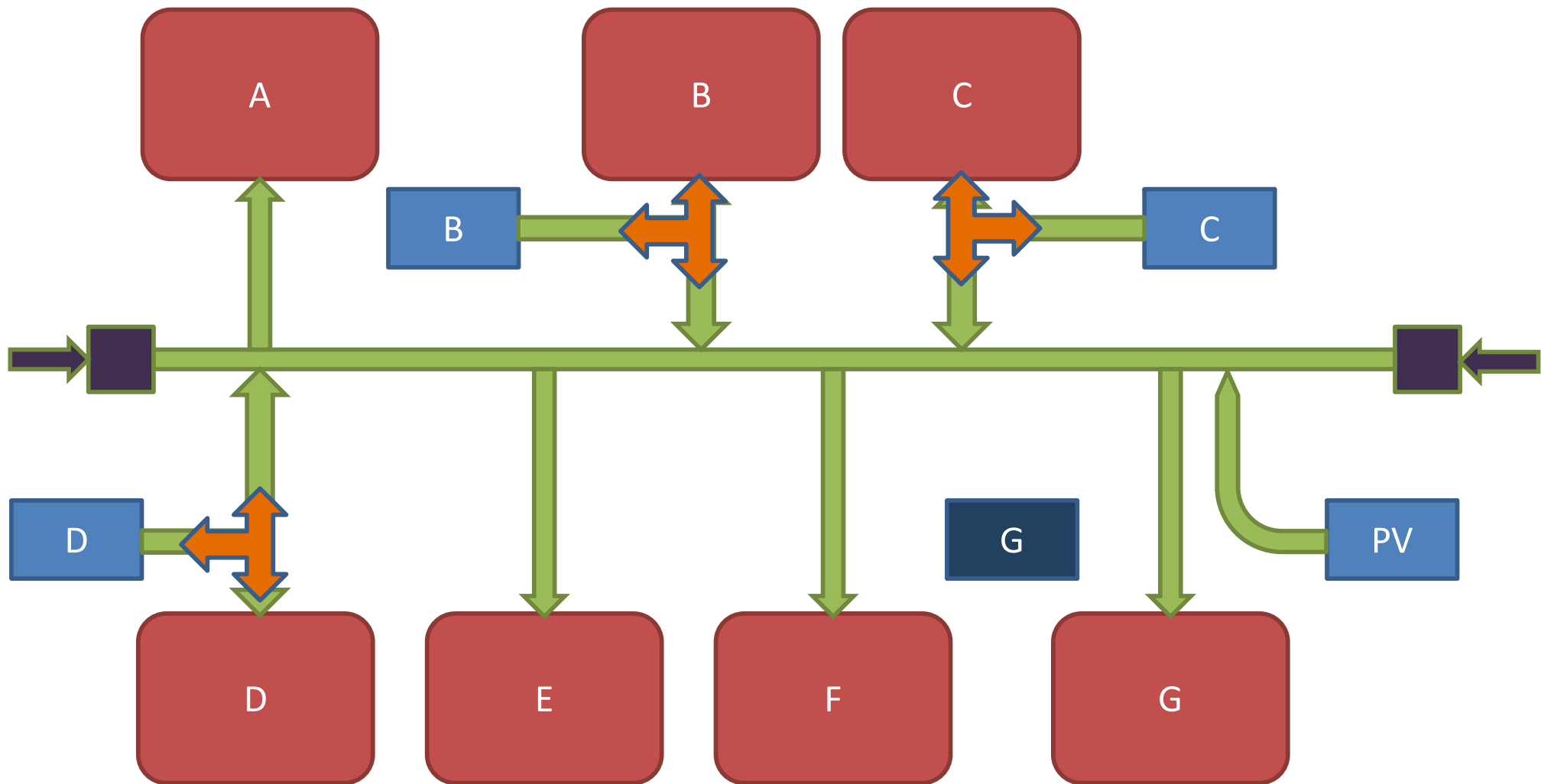
Microgrid Forms (Step 2)



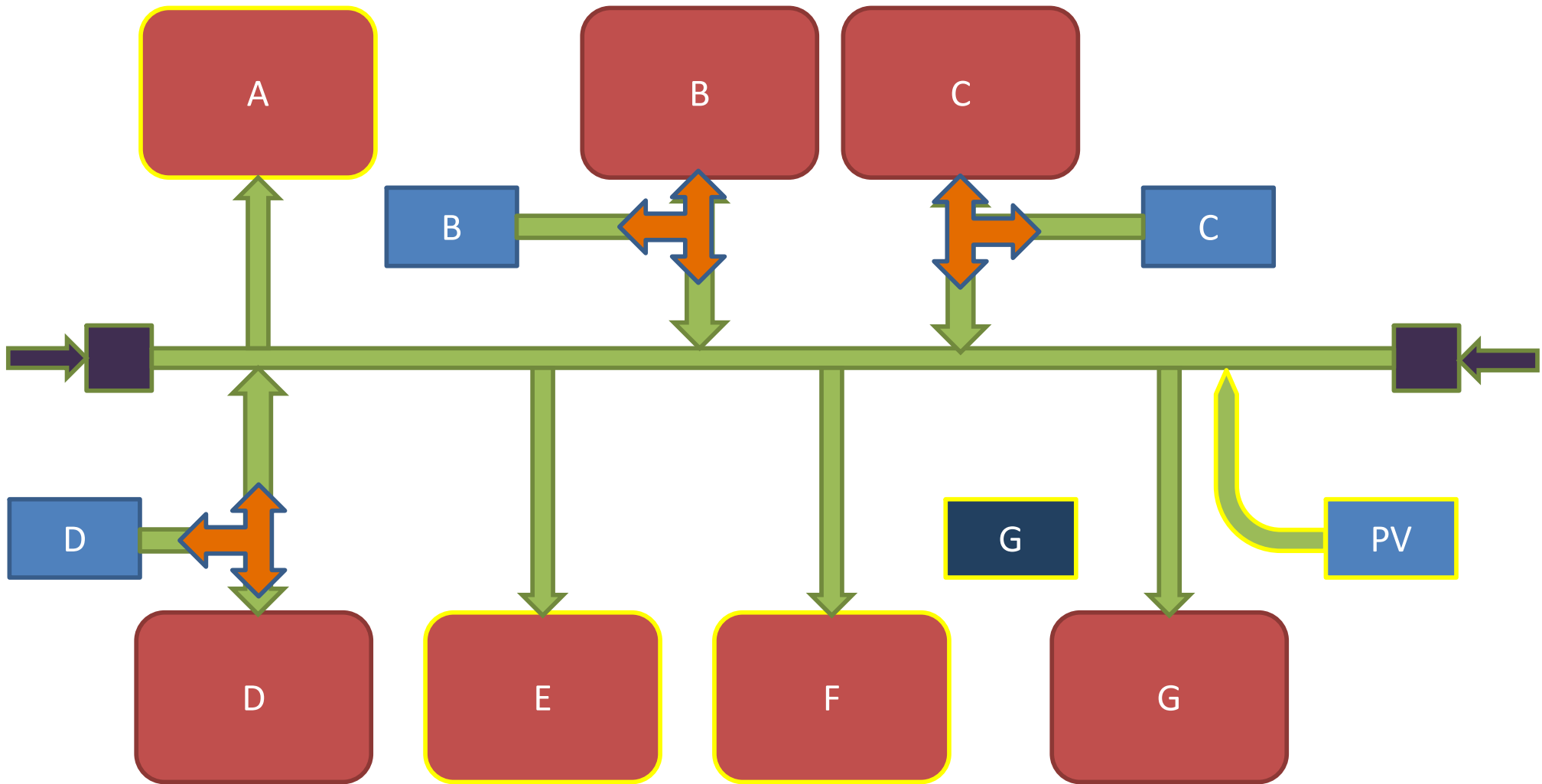
Microgrid Forms (Step 3)



Microgrid Fully Formed



Microgrid Differences



Fort Carson EVSE

- Develop bi-directional PEV charging
 - Energy storage
 - Vehicle-to-grid (V2G) services
 - Power factor correction



EVSE Development Challenges

- SAE J1772 standard in development and not complete
- Integration of EVSE/PEV required customized collaboration among vendors
- Infrastructure design to support EVSE
 - Proper power infrastructure sizing to meet code requirements
 - Account for parasitic loads associated with EVSE support



SPIDERS EVSE Status

- Five operational EVSEs installed
- Integrated with both Boulder Electric and Smith vehicles
- Demonstrated full charge/discharge of 50kW at each EVSE
- Demonstrated power factor correction (exported and absorbed 394kVAR)
- Demonstrated communication between EVSE, aggregators and microgrid control system
- Validated aggregator software



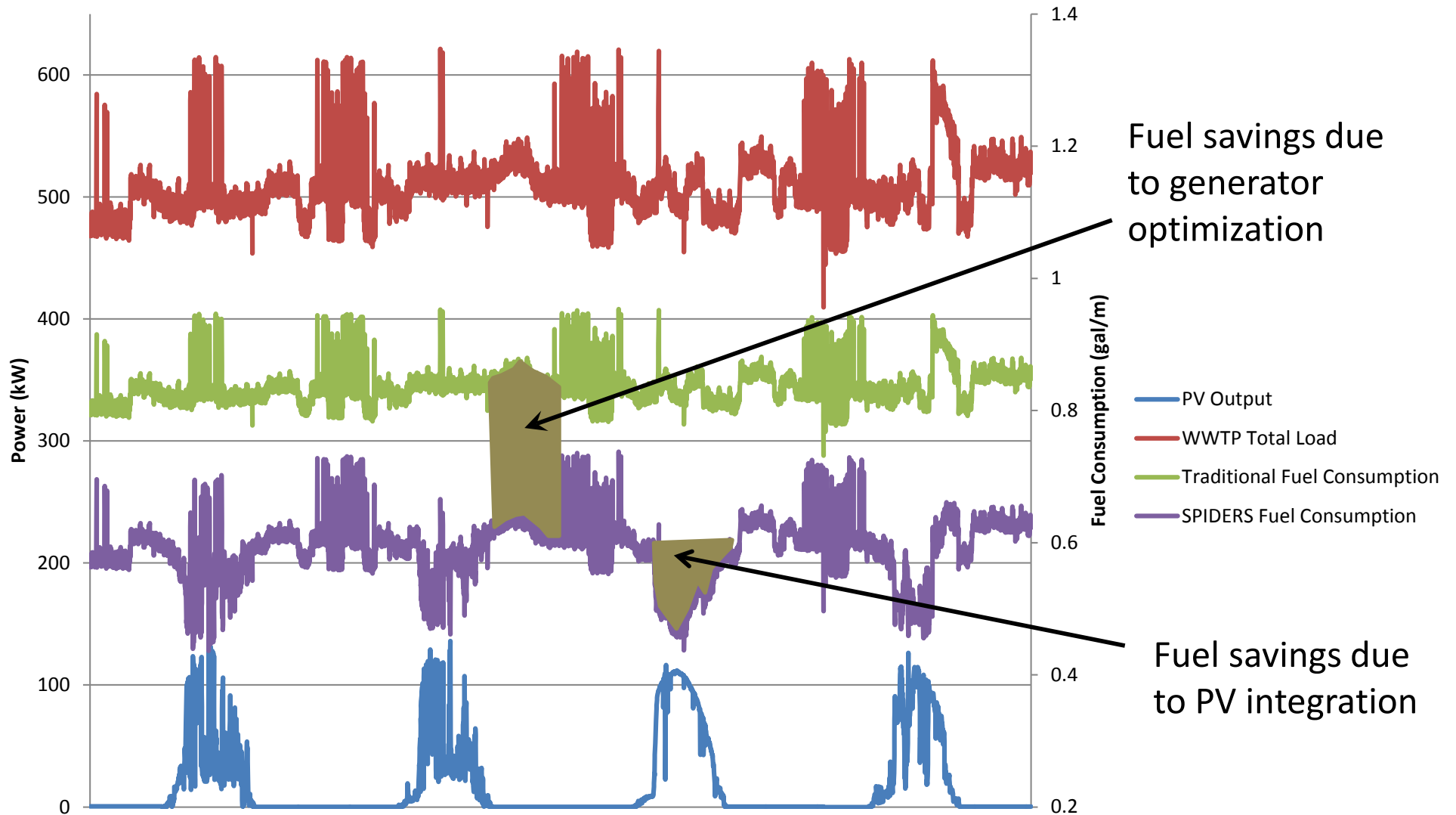
Renewables Interface

- Firm power sources provide spinning reserve for variable power sources
- PV owned and operated by third party under PPA contract requiring access agreement for microgrid control interface
- Integrate PV output in small segments (500kW inverters)



Anticipated Performance Data

Typical Microgrid Power and Fuel Consumption



Thank You

