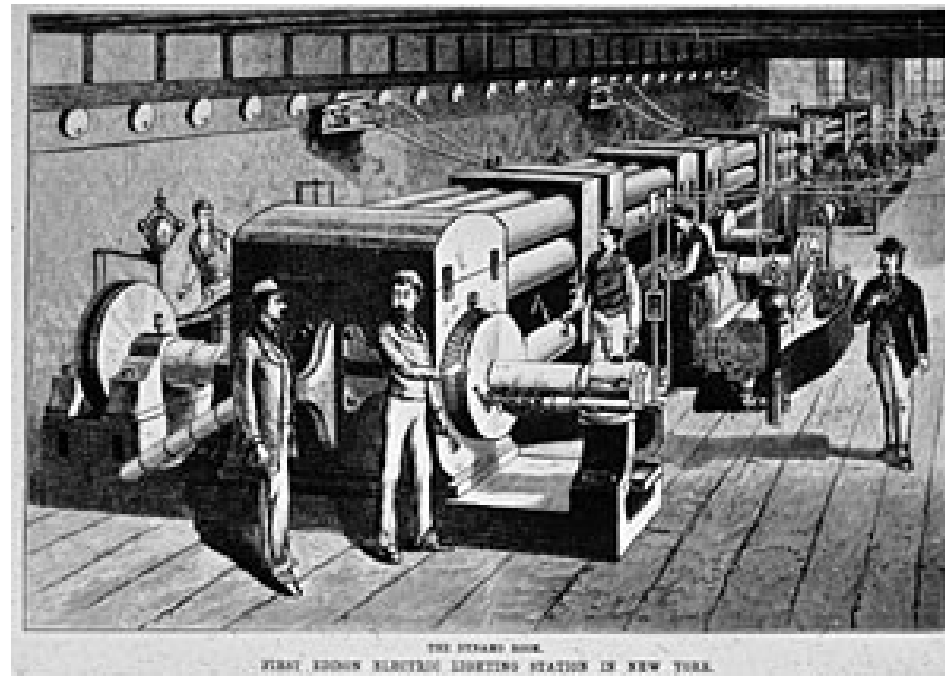
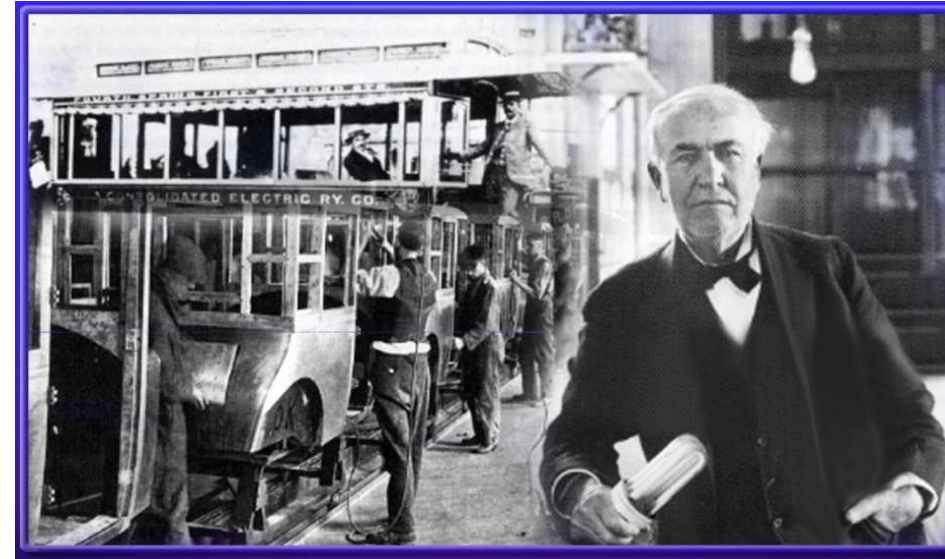


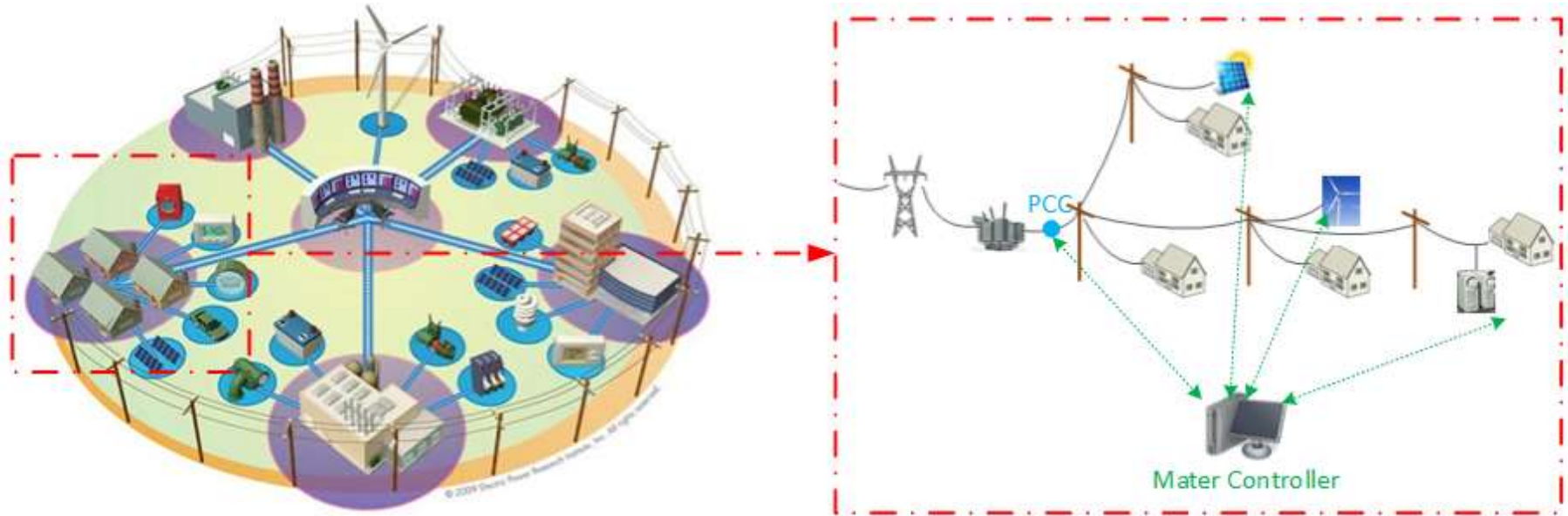
# **What is a Microgrid?**

**Professor Mohammad Shahidehpour  
Galvin Center for Electricity Innovation  
Illinois Institute of Technology**

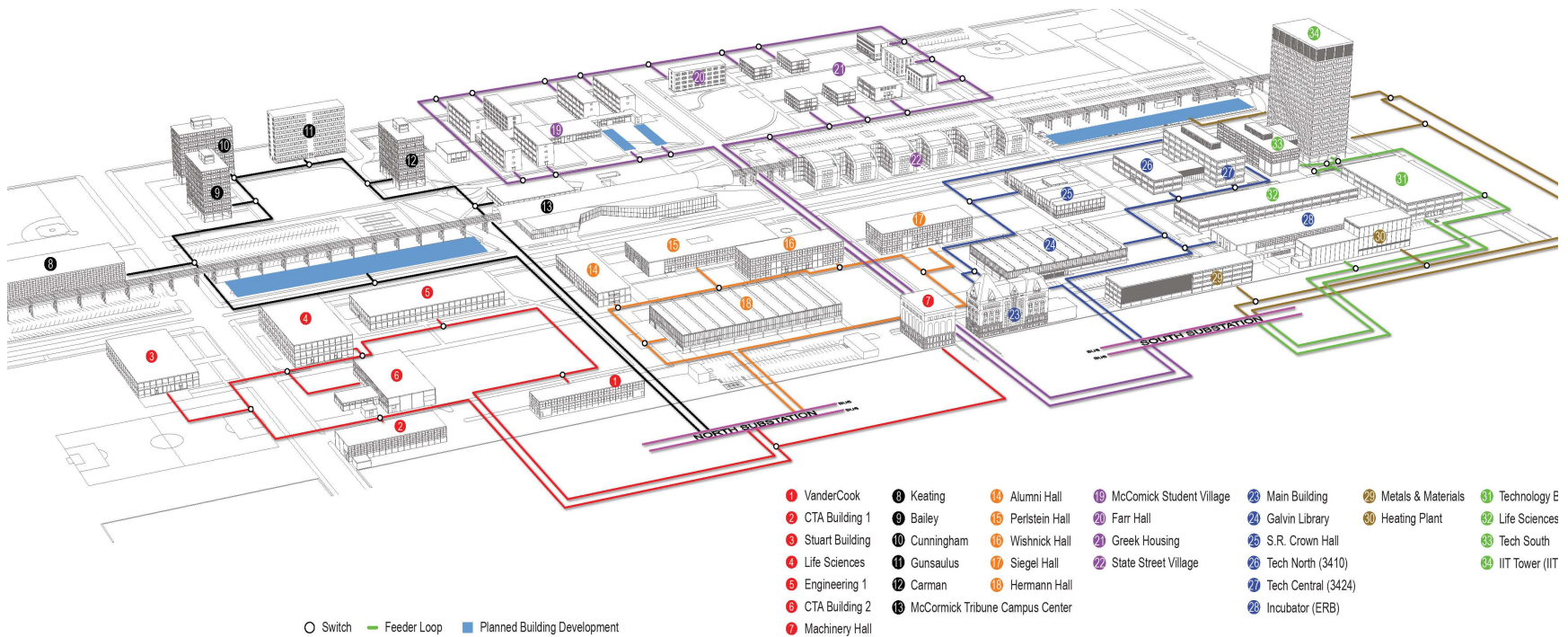
# Edison Transformation

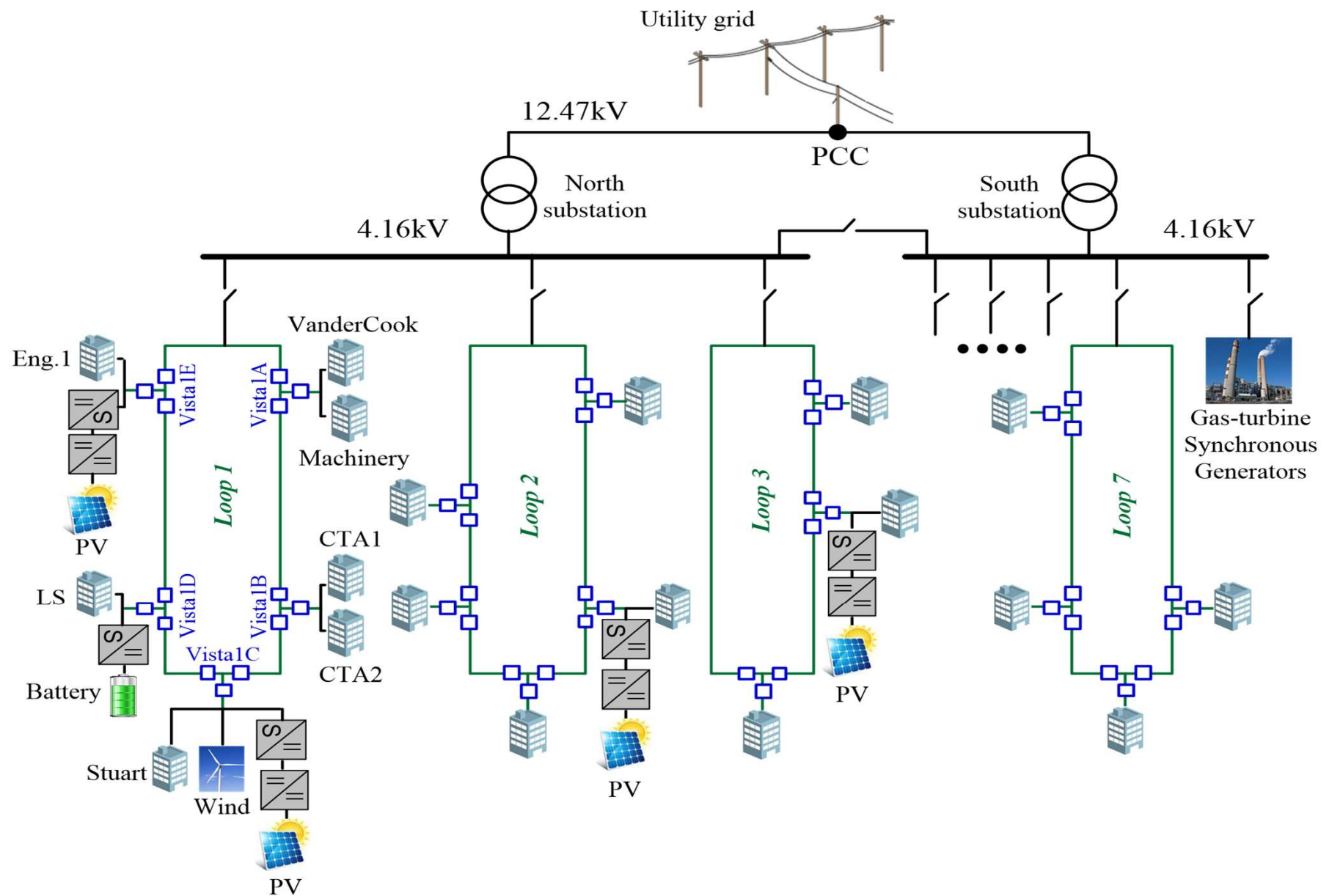


# Building Block of Smart Grid: Microgrids



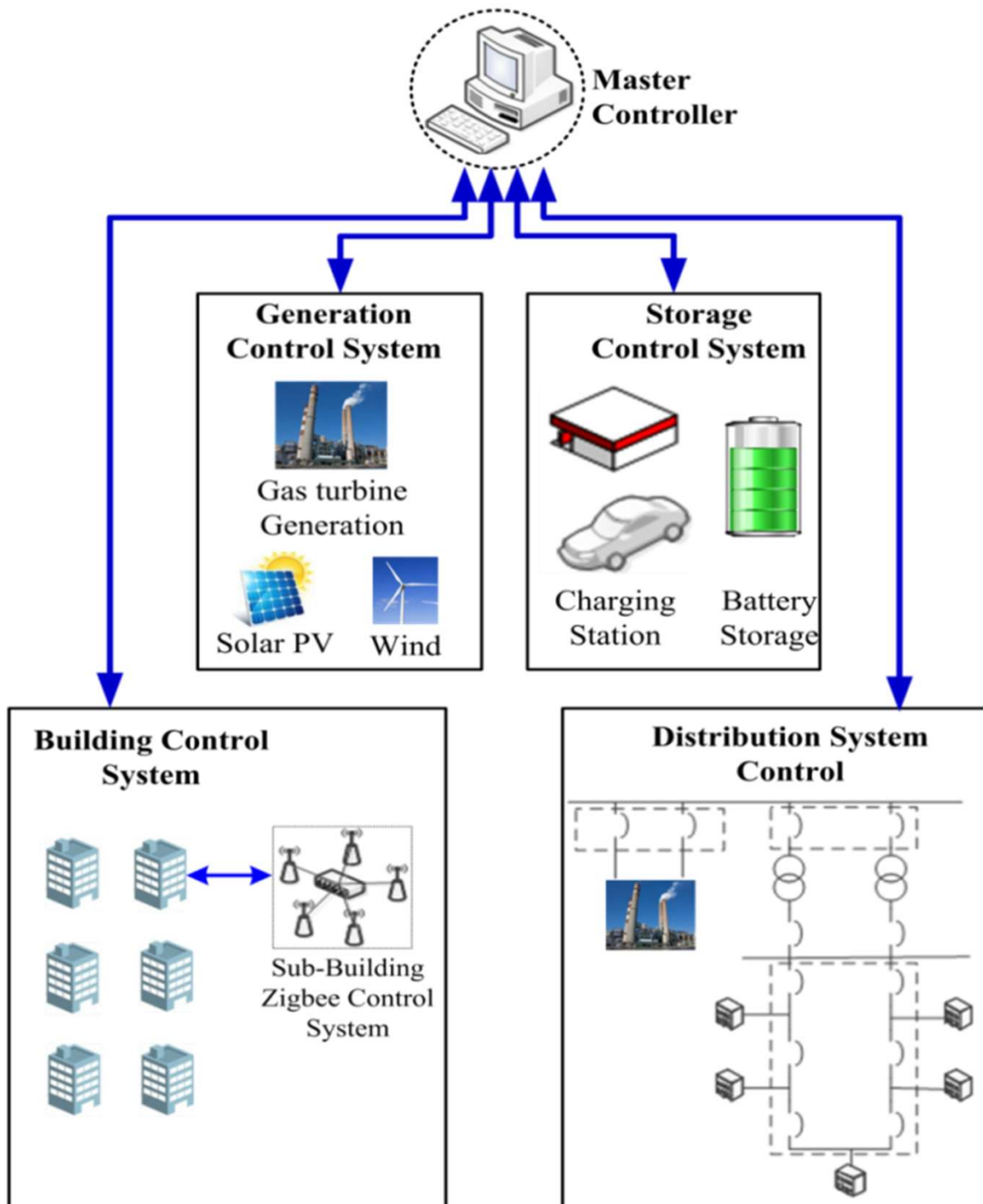
- Locally integrate renewables and other distributed generation sources and provide reliable power to customers.
- Protect critical infrastructure from power outages in the event of physical or cyber disruptions in the bulk electric grid.
- Ensure that critical operations can be sustained during prolonged utility power outages.
- Electric power grid will be the “grid of grids” in the future.



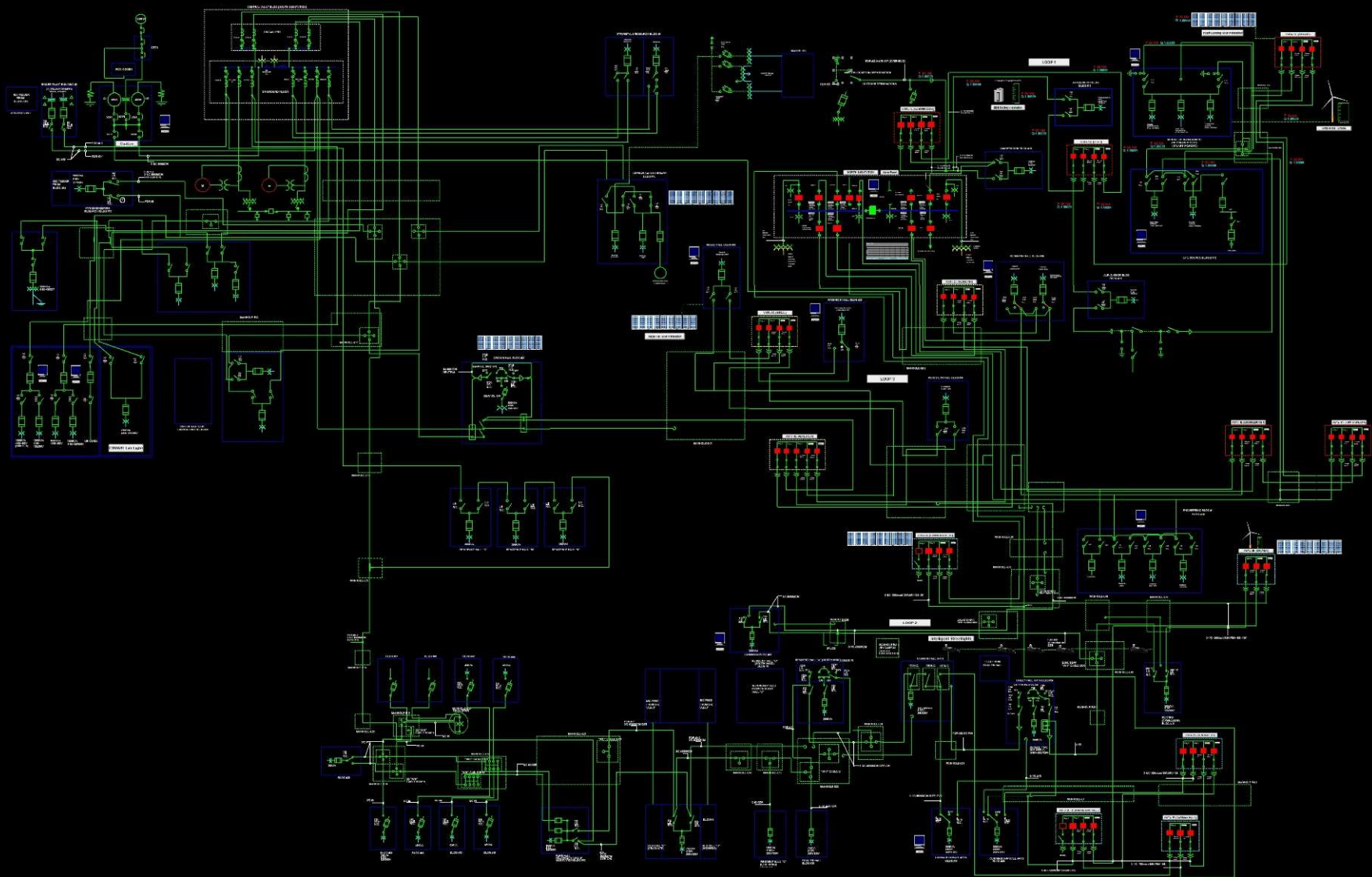


# Solar Canopy, Flow Battery

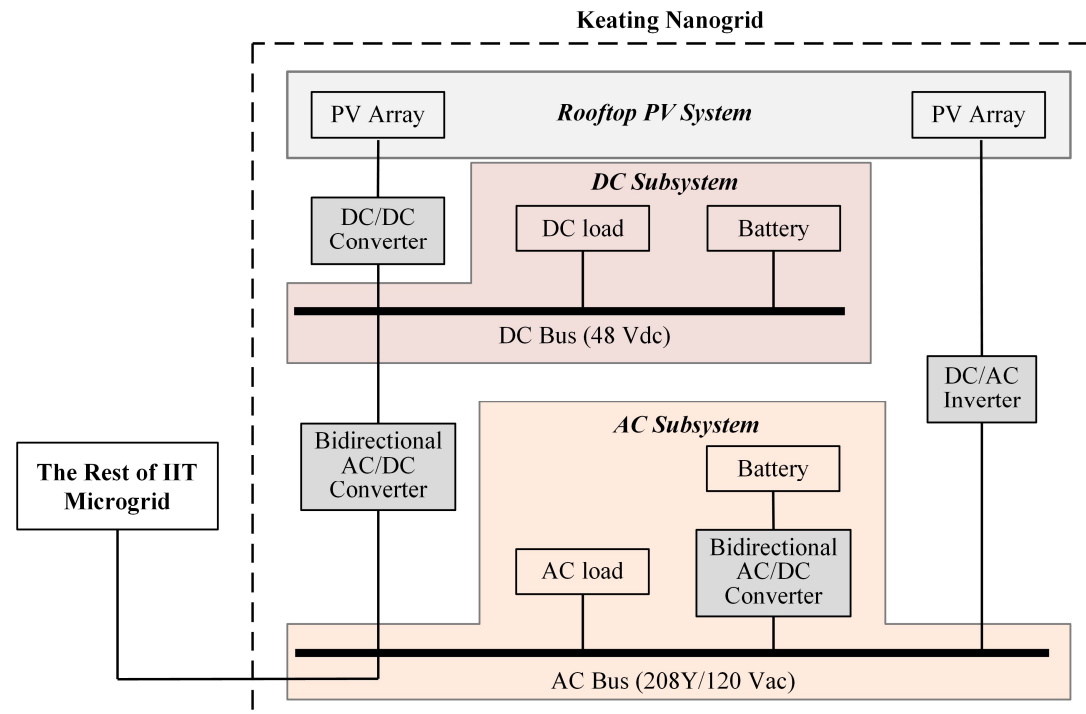
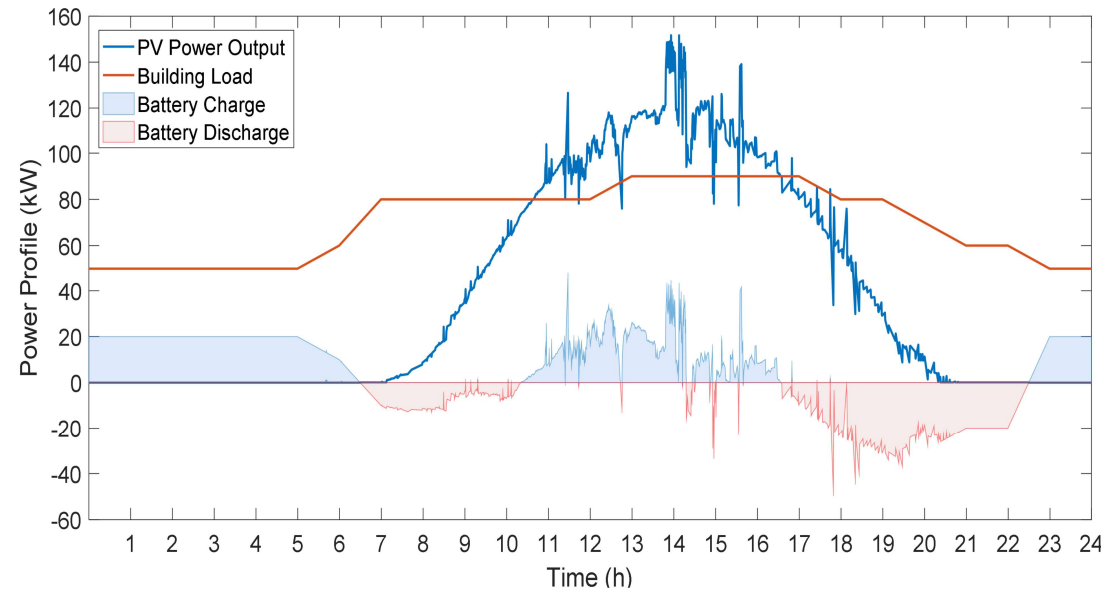
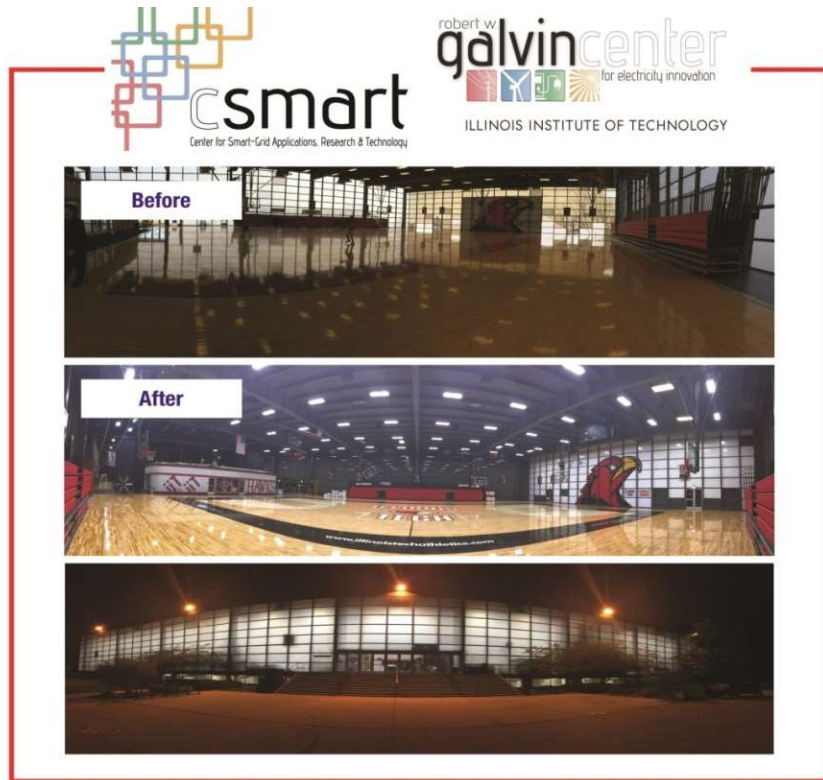




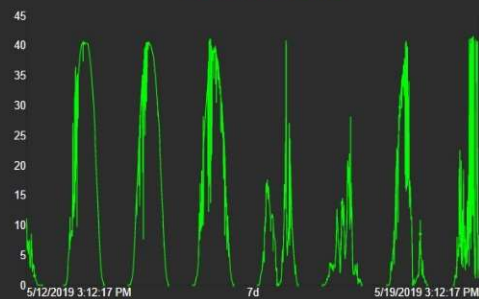
Loop-based microgrid topology introduces additional benefits in enhancing the reliability and resilience of energy supplies.



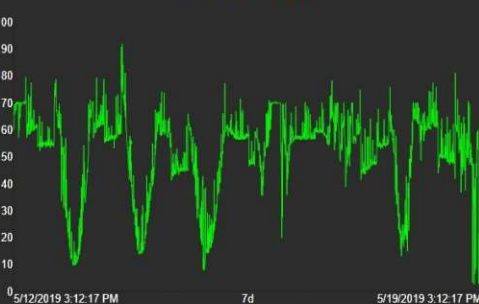
# AC/DC Nanogrid at IIT



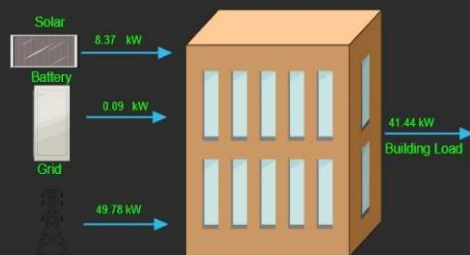
Solar Power (kW)



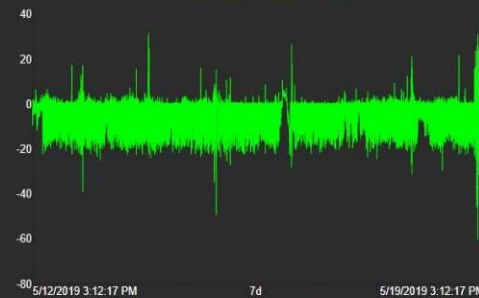
Grid Power (kW)



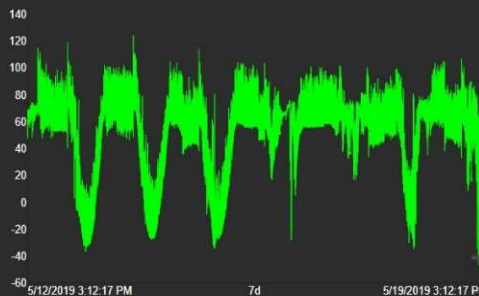
Crown Hall



Battery Power (kW)



Building Load (kW)

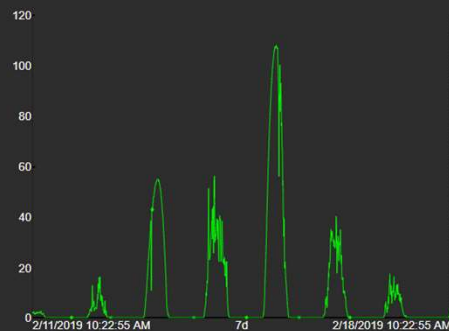


7d

Now

5/19/2019 3:12:17 PM

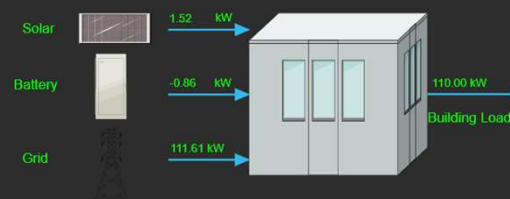
Solar Power (kW)



Grid Power (kW)



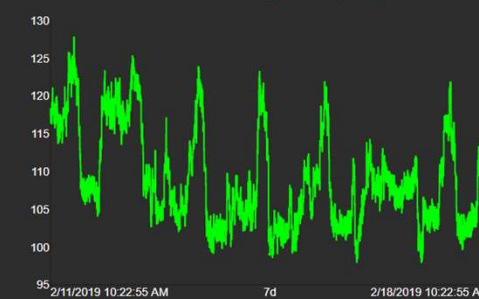
Keating Hall



Battery Power (kW)



Building Load (kW)



2/11/2019 10:22:59 AM

7d

Now

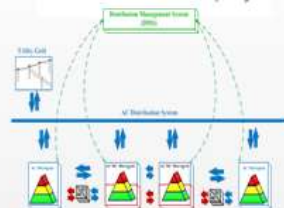
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# Multi-Microgrid In Chicago

## Technology Product and Testing Providers



## Project Lead & Electric Utility Key Technology: Microgrid Controller

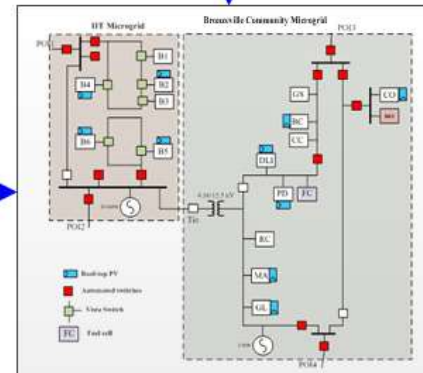


McCom  
(Master Controller for Microgrid)

## Technology Developers



Database and Solution Platform  
Providers



Bronzeville Community Microgrid  
(BCM Design Model)

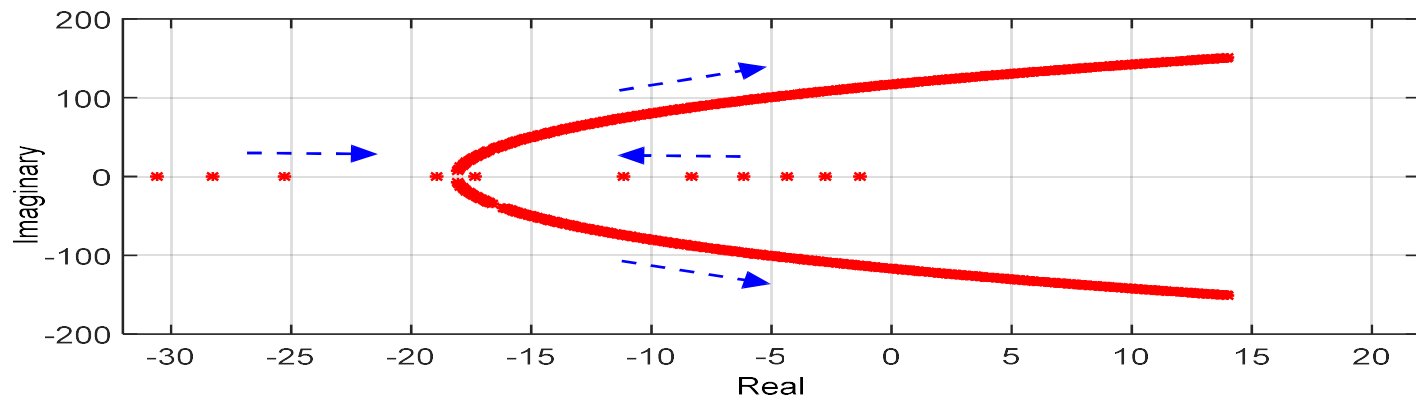


Bronzeville Community Microgrid  
(BCM Physical System)

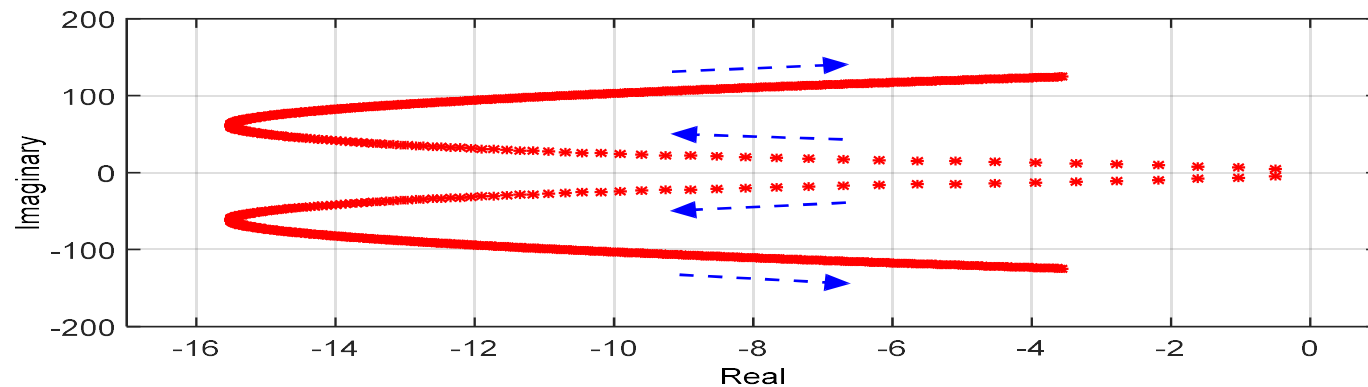


# Frequency Domain Analysis

Independent  
Operation of  
Microgrids

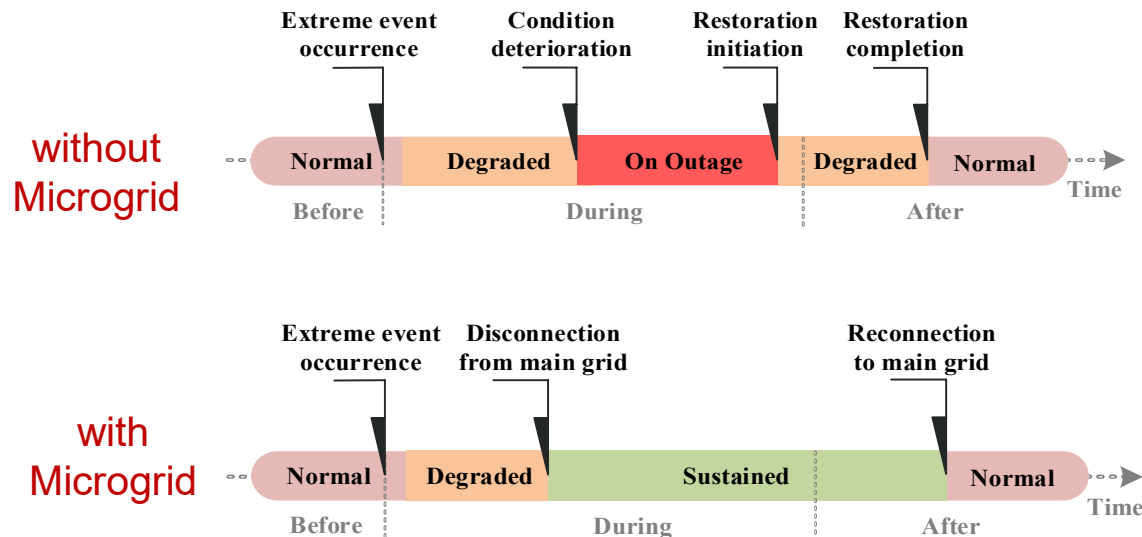
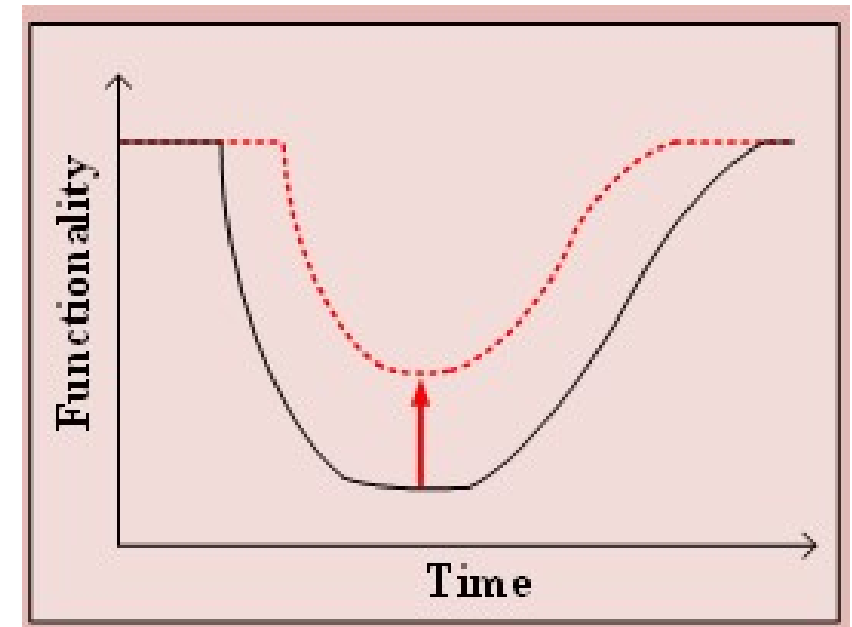
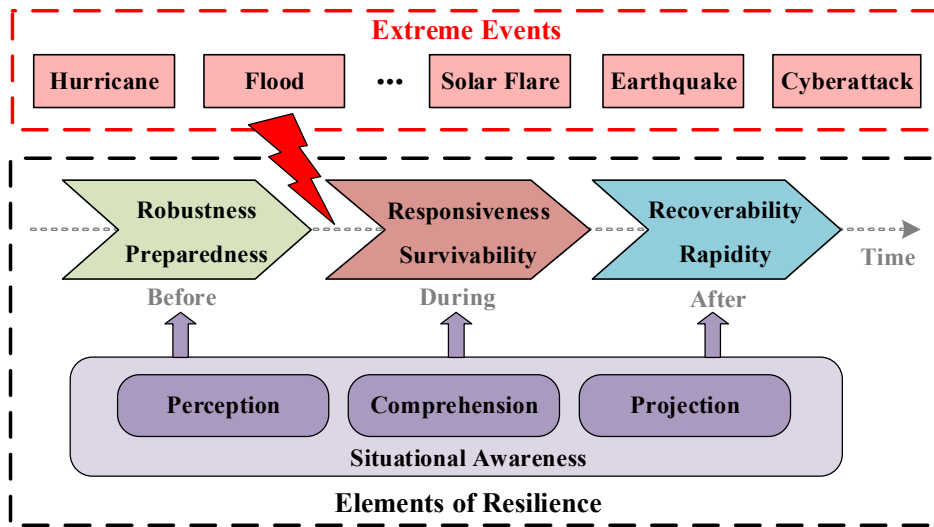


Coordinated  
Operation



Loci of dominant eigenvalues when  $\omega$ - $P$  droop gains increase

# Emergency Microgrid Operations



# Conclusion

- The myriad of extreme events such as severe weather conditions and potential cyber-attacks have posed great challenges to the power system resilience.
- The proliferation of microgrids, which could play a key role in resilience enhancement, has changed the paradigm in power system operations.
- Flexible control strategy could enhance the microgrid system resilience against extreme events which is essential for the operation of power distribution systems.
- The networking of geographically close microgrids is a promising and all-encompassing solution to accommodate more DERs and further enhance the power system resilience.