



# Value of Energy Resiliency in Military Microgrid for Energy Security

Mohammad Nikkhah Mojdehi

**TECHNICAL DIRECTOR**

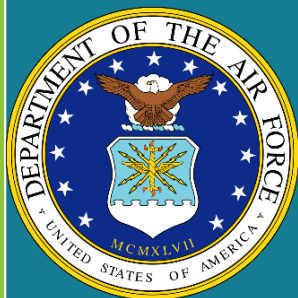
**Mohammad.Mojdehi@obg.com**

**OBG | [www.obg.com](http://www.obg.com)**



# Energy in DoD





# DoD Infrastructure

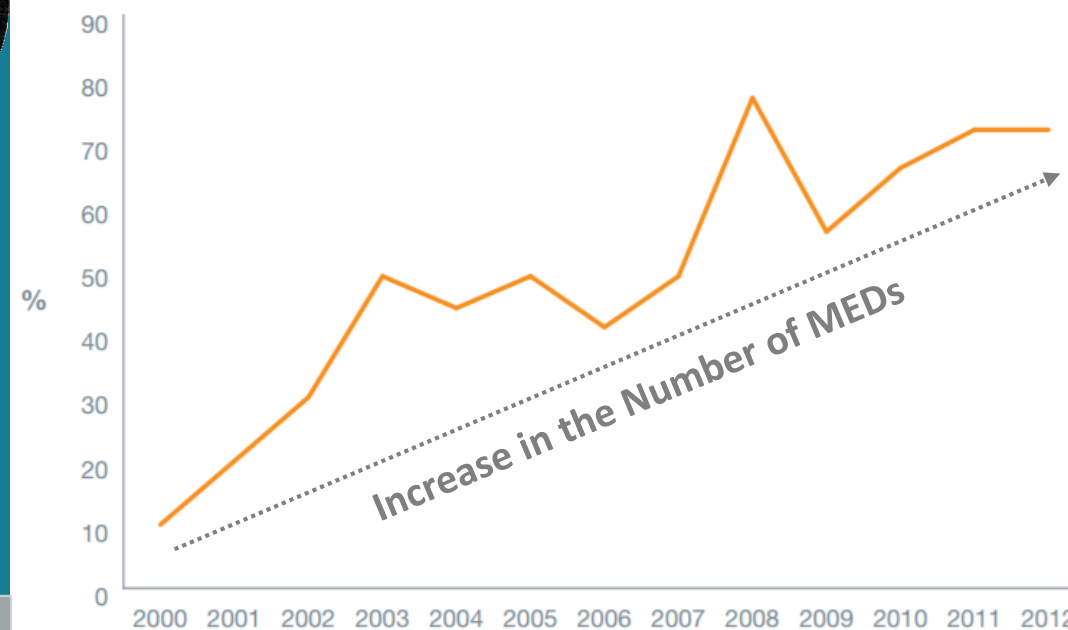
**284k  
Buildings**

**523  
Installations**

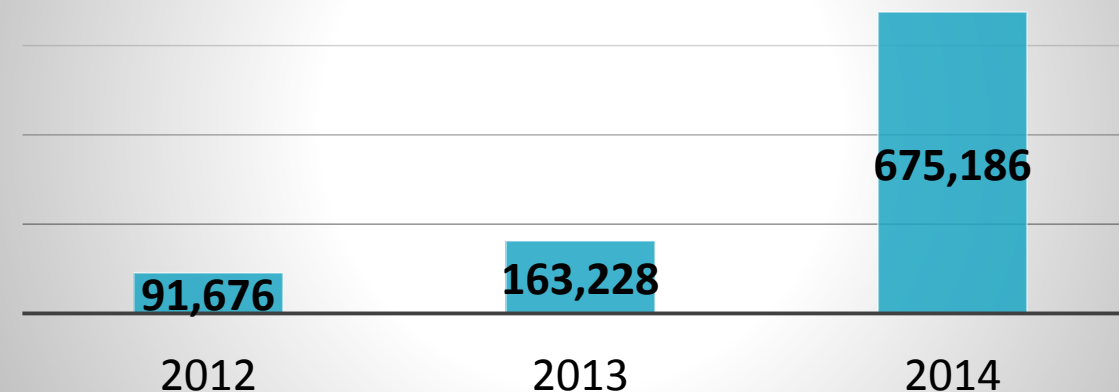
**21% of Total  
Federal  
Energy  
Consumption**

**\$3.7B on  
Installation  
Energy**

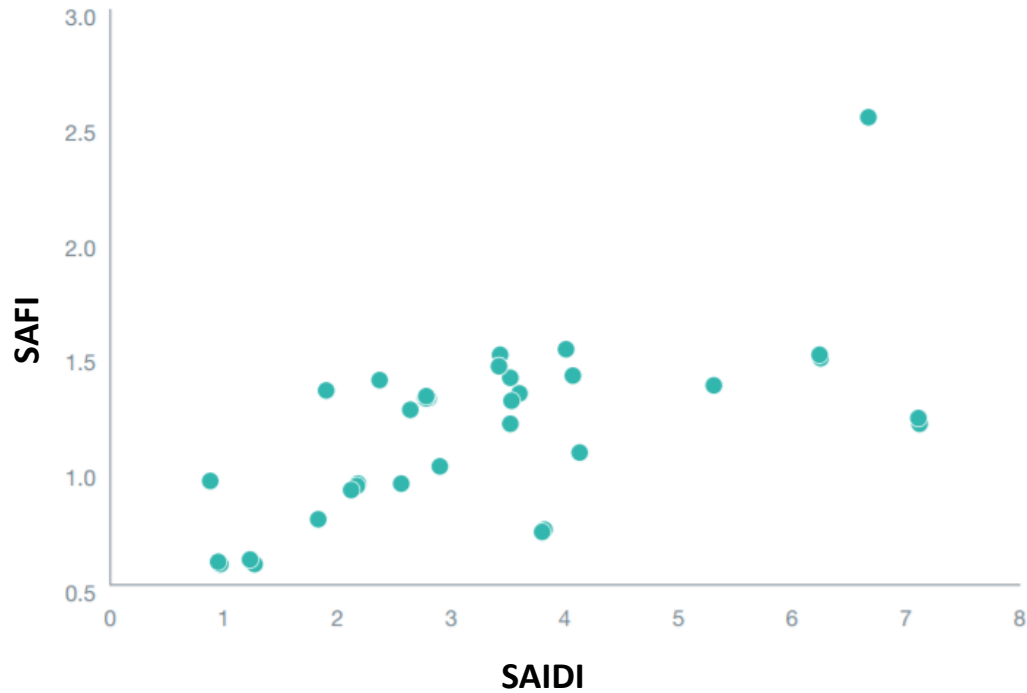
## Percentage of US Utilities that Experience 3+ Outages per Year (Major Event Day)



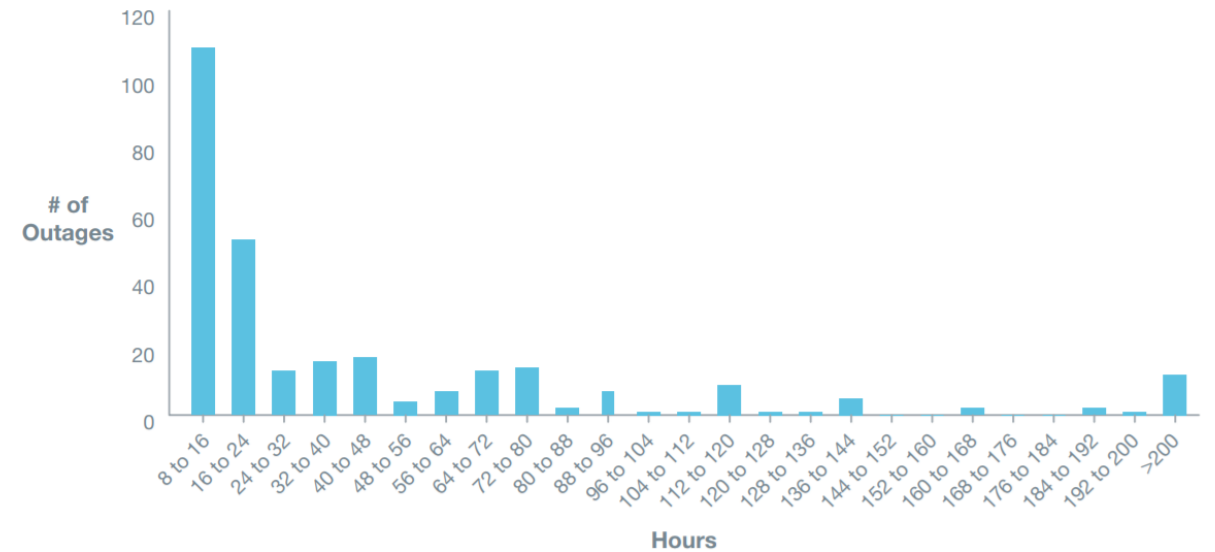
## SCADA Attacks in the US



# Reliability of Utilities that Serve Major Military Bases



Reliability of 30 Large Utilities Serving Major Military Bases in 2013 and 2014 (Source: Noblis)



Number of Outages at US Military Bases as a Function of Duration (Hours) from 2012 - 2014 (Source: Noblis)

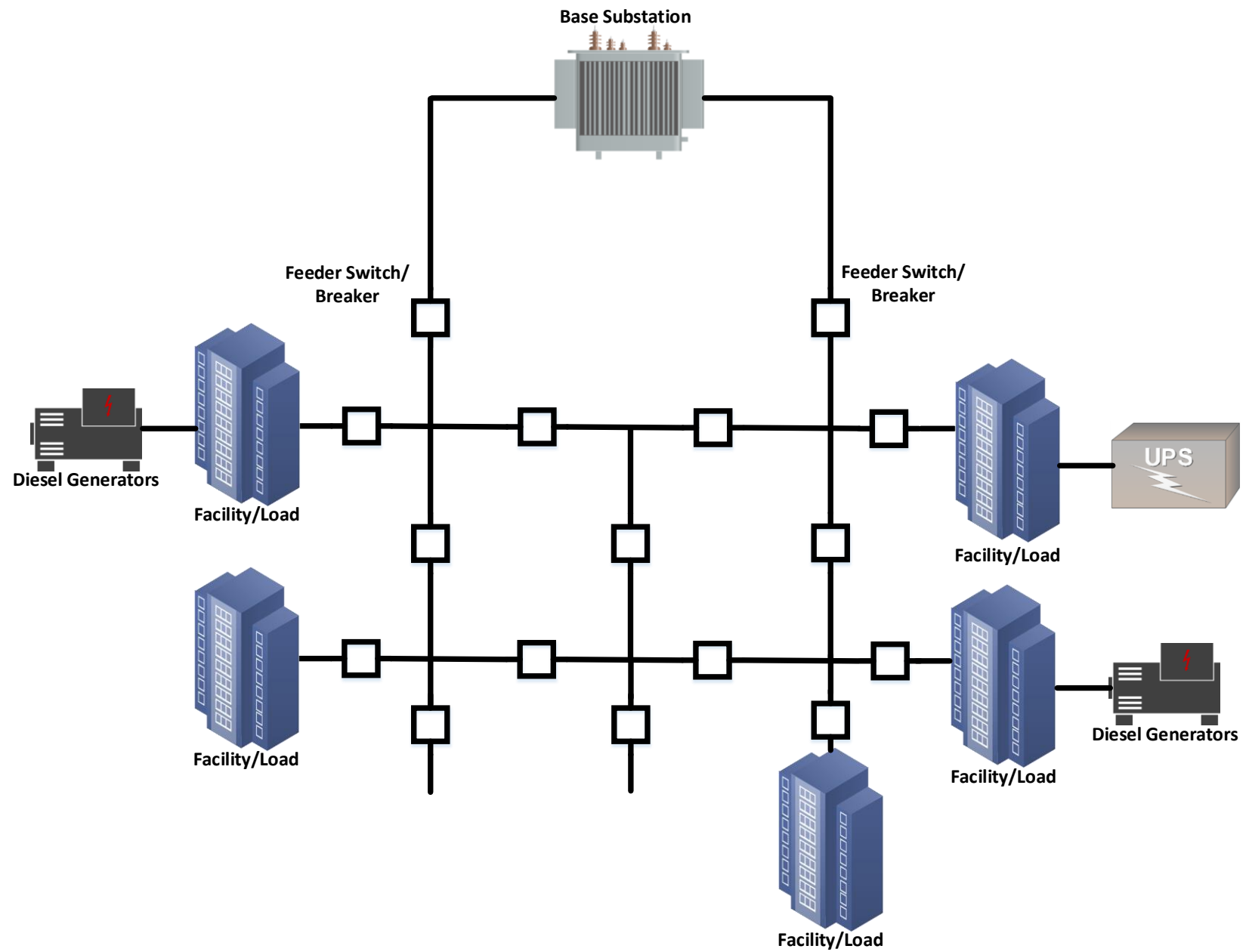




# Current Approach for Energy Resiliency in Military Bases



# STANDALONE BACKUP GENERATORS



# Standalone Generators Strategy

## ADVANTAGES

- Degree of Operator Control
- Independent of Electric Distribution System
- No Coordination with Other Operators

## DISADVANTAGES

- Efficient Sizing of the Generators
- Maintenance and Testing of the Generators
- Reliability of the Generators
- Lack of Flexibility
- Limited Coverage



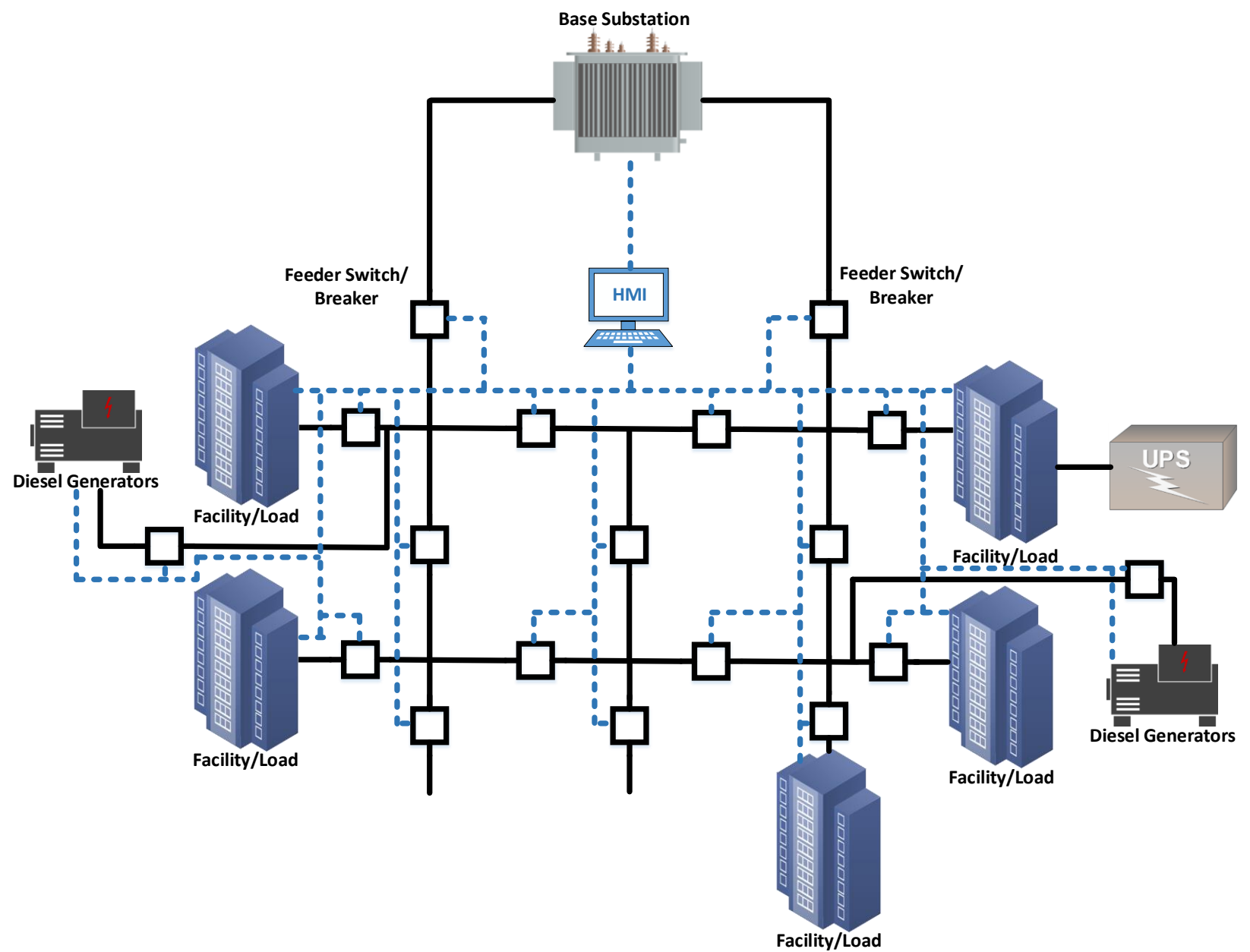


# Alternative Strategy **Microgrid**





# MICROGRID



# Armed Forces Microgrid Resiliency

Environmental Security &  
Technology Certification  
Program (ESTCP)

Net Zero Initiative

SPIDERS JCTD

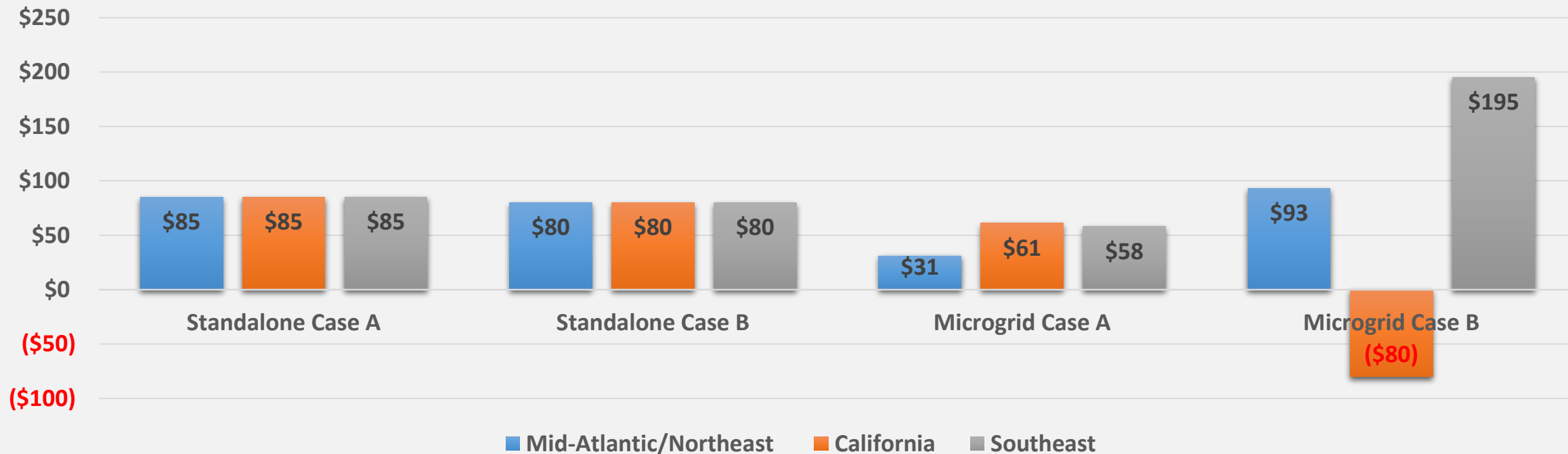


# Cost Comparison

	Standalone Generator	Microgrid
Case A	Generators Purchased in Year 1	Large Diesel Generators
Case B	Generators Purchased in Year 10	NG Baseload Generator and Diesel Generators

- Mid-Atlantic and Northeast
- Southeast
- California

THE ANNUAL NET COST OF PROTECTING EACH KILOWATT OF CRITICAL LOAD (Source: Noblis)



# Microgrid in DoD

Buying  
Microgrid

Microgrid as  
a Service

DoD's Technical  
Guidance on  
Energy Security

Definition of  
Energy Security  
Requirements

Barriers

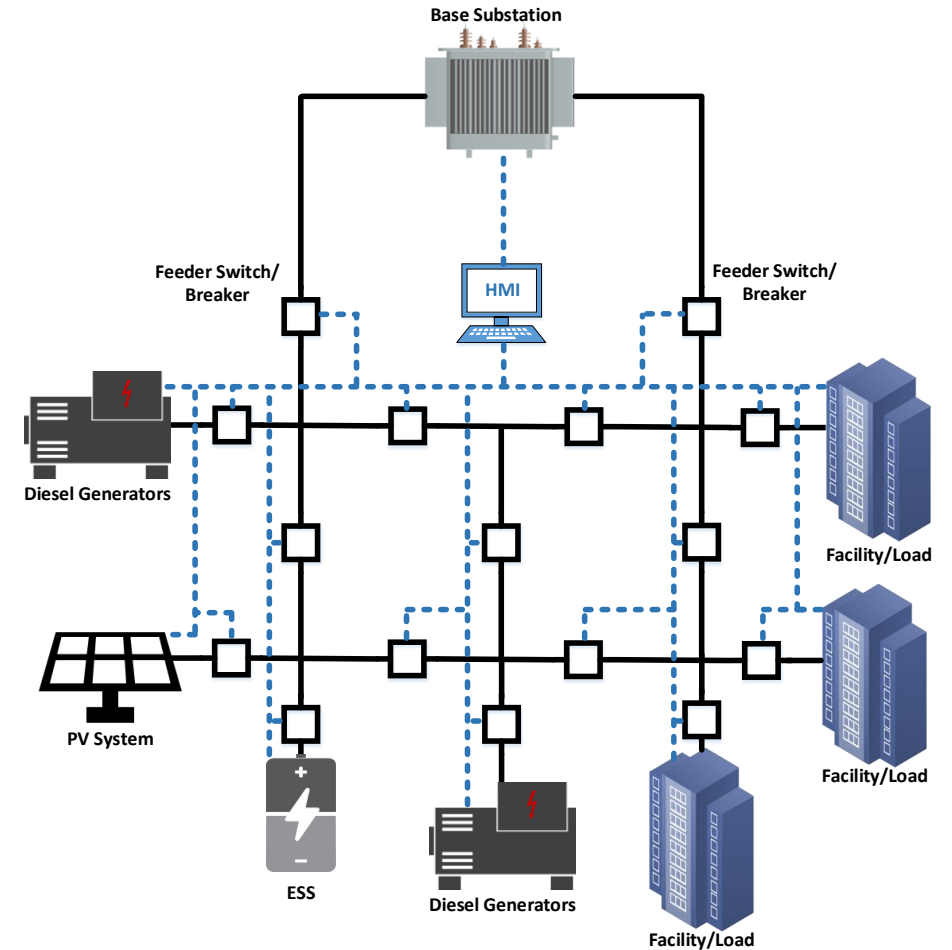
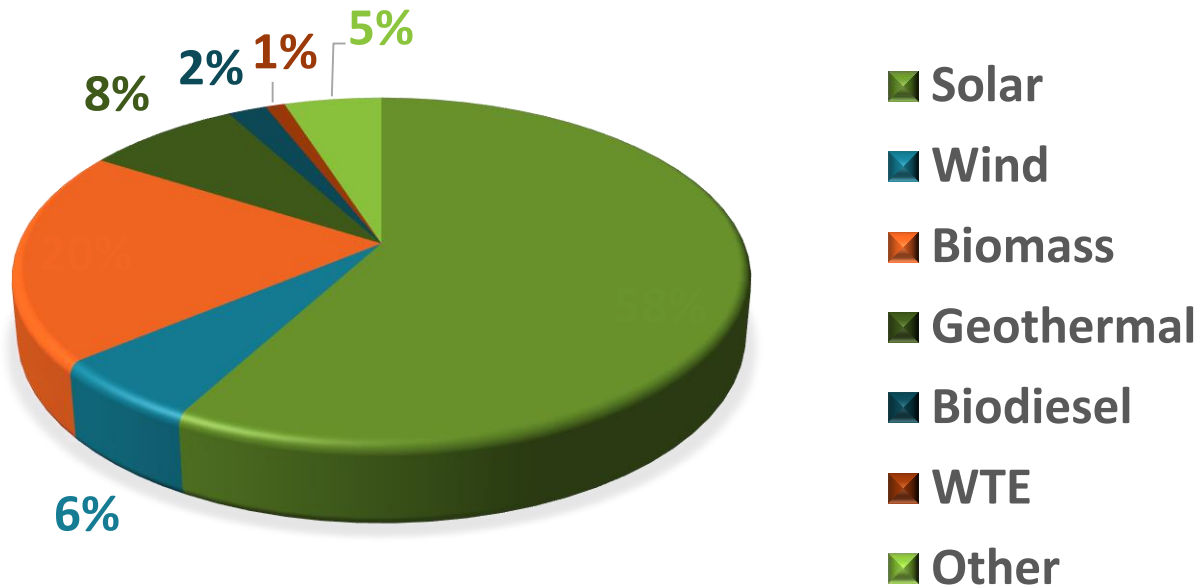
Knowledge and  
Expertise

DoD's  
Accounting  
System



# Renewable Energies in the Microgrid Solution

## PLANNED DOD RENEWABLE ENERGY CAPACITY





# Energy Security Value for DoD

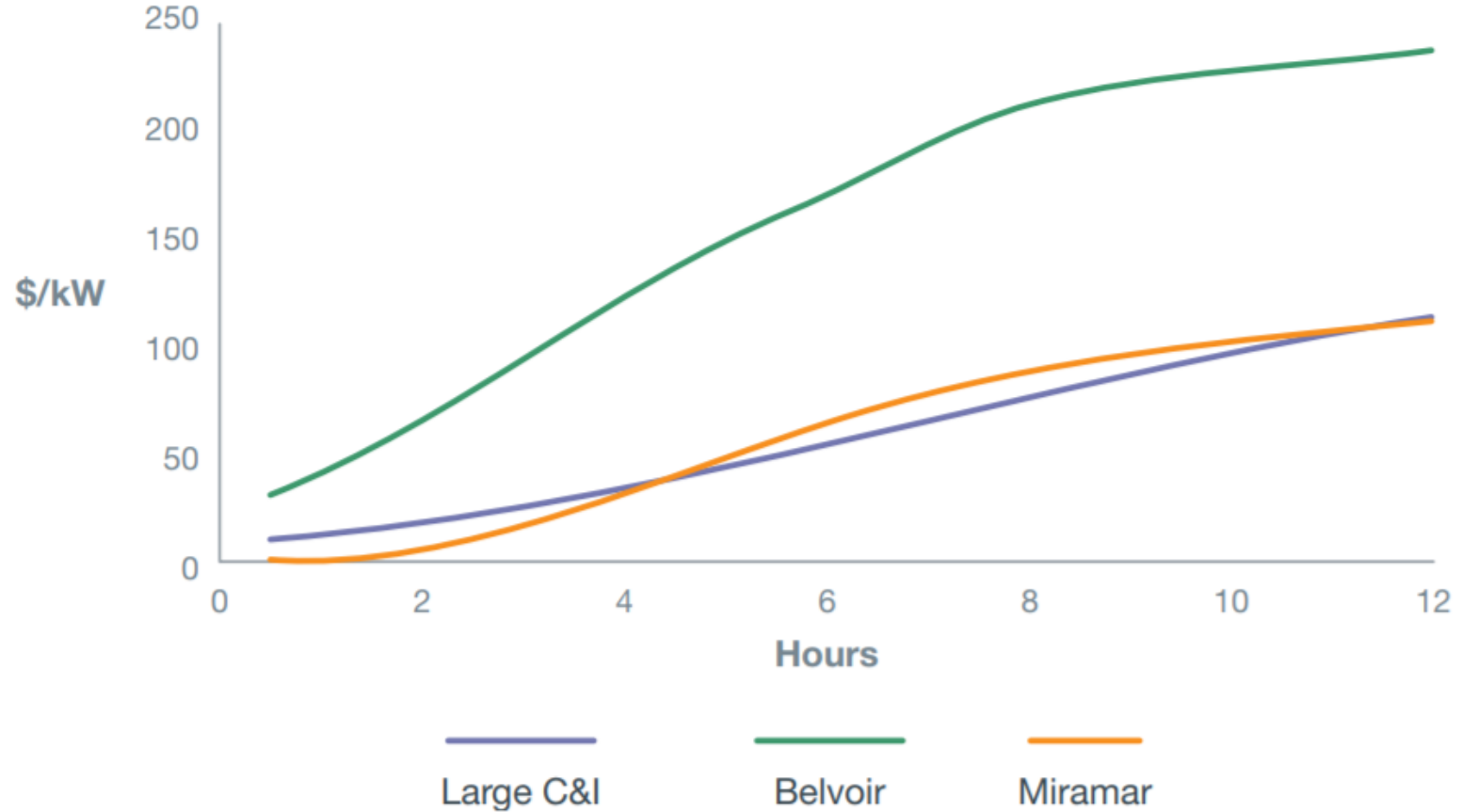


# Value as Potential Damage?

Existing DoD Strategy  
for Budgetary Costs

Least-Cost Method  
of Providing Energy  
Security

Value of Non-Critical  
(Intermediate Load)



Value of Lost Load (Source: NREL)



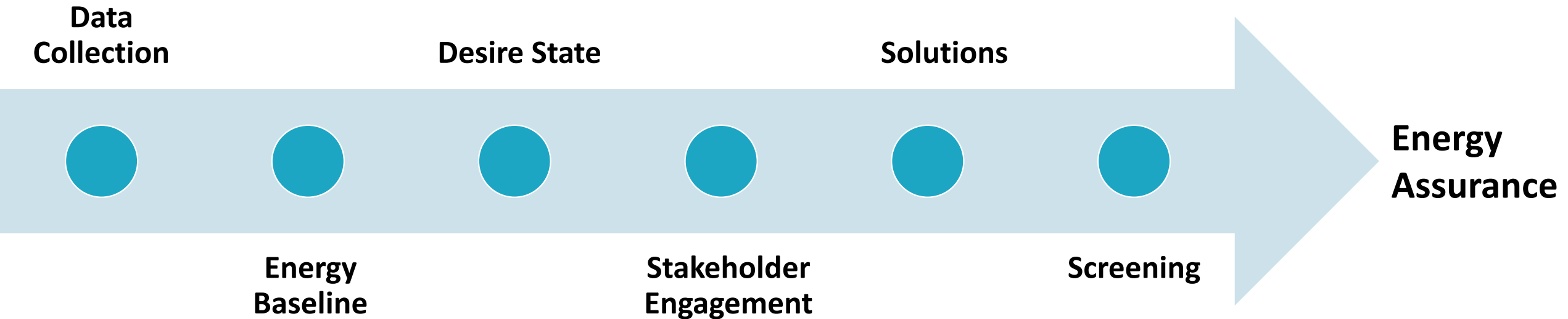


# Analytical Approaches

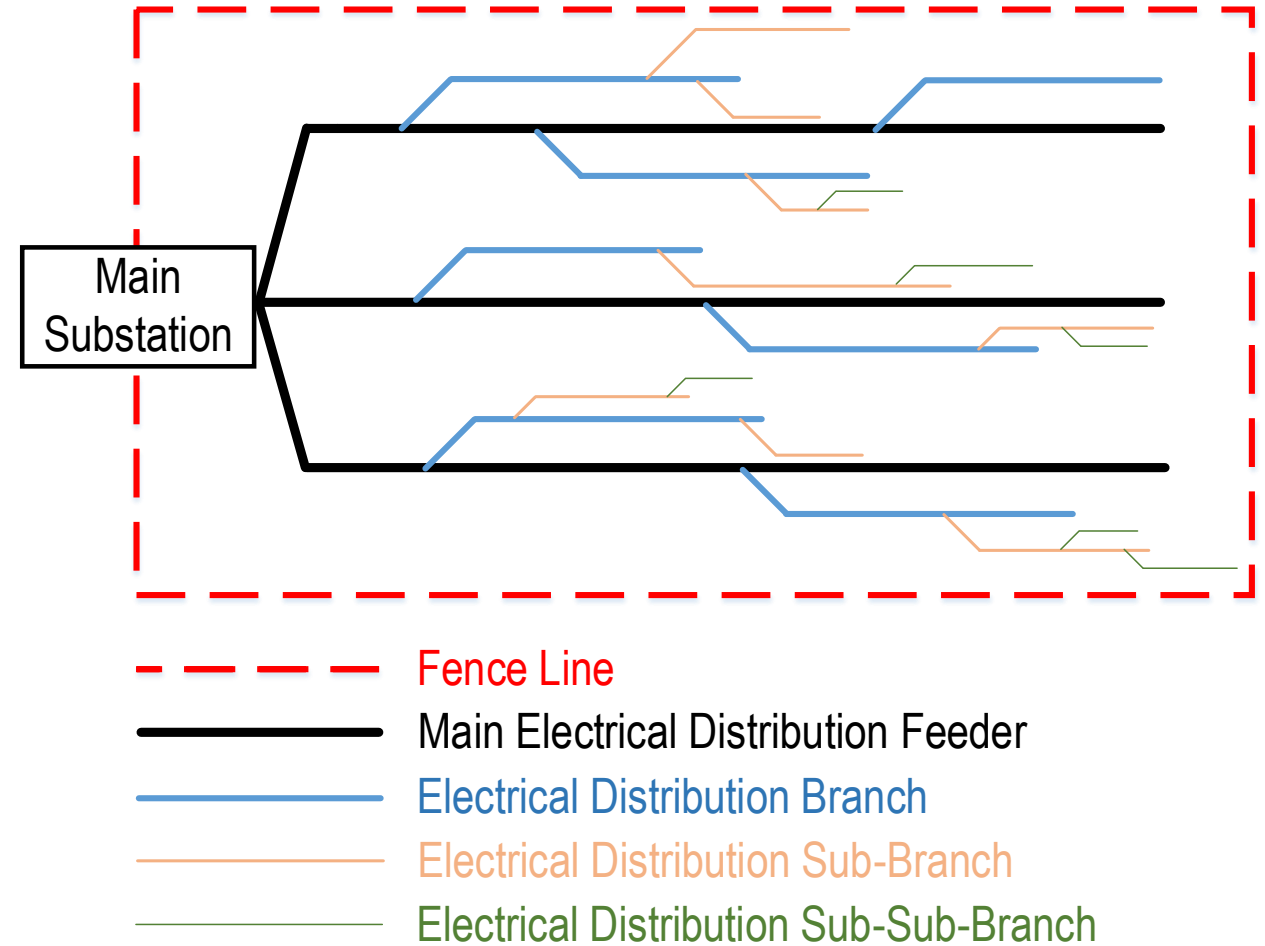
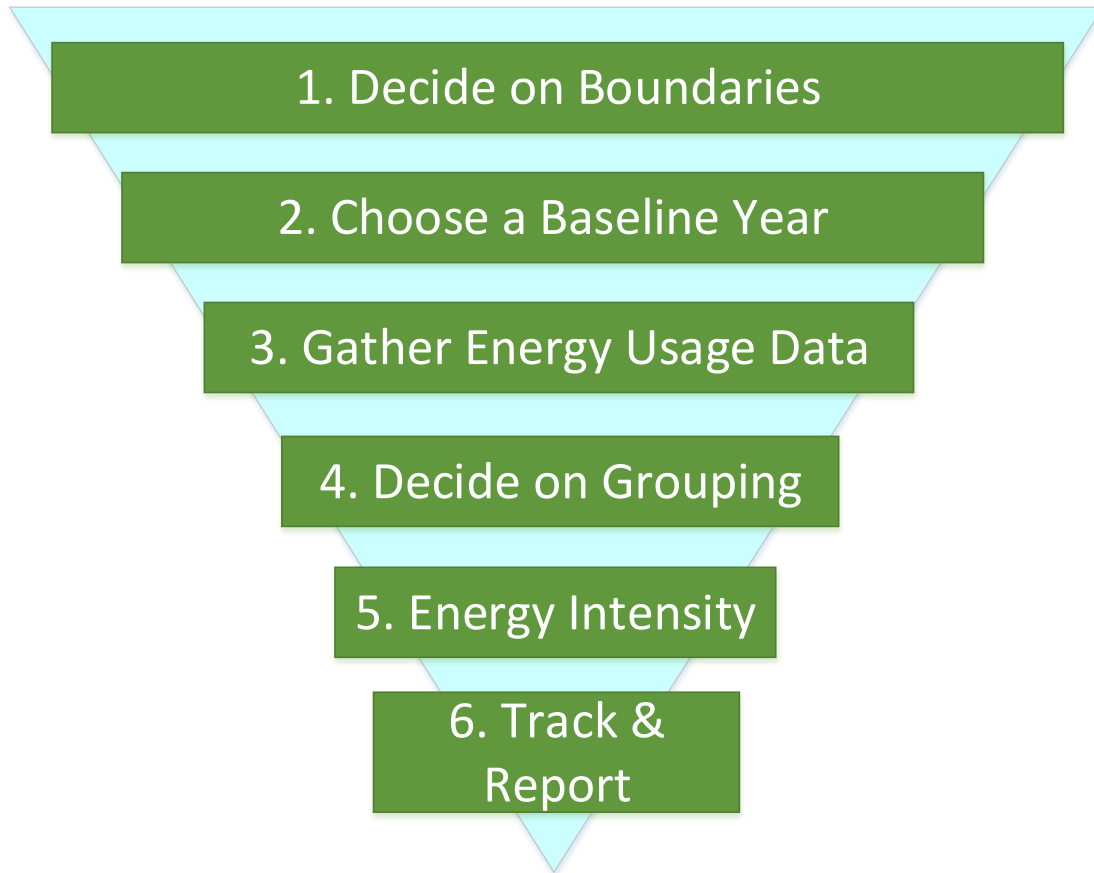




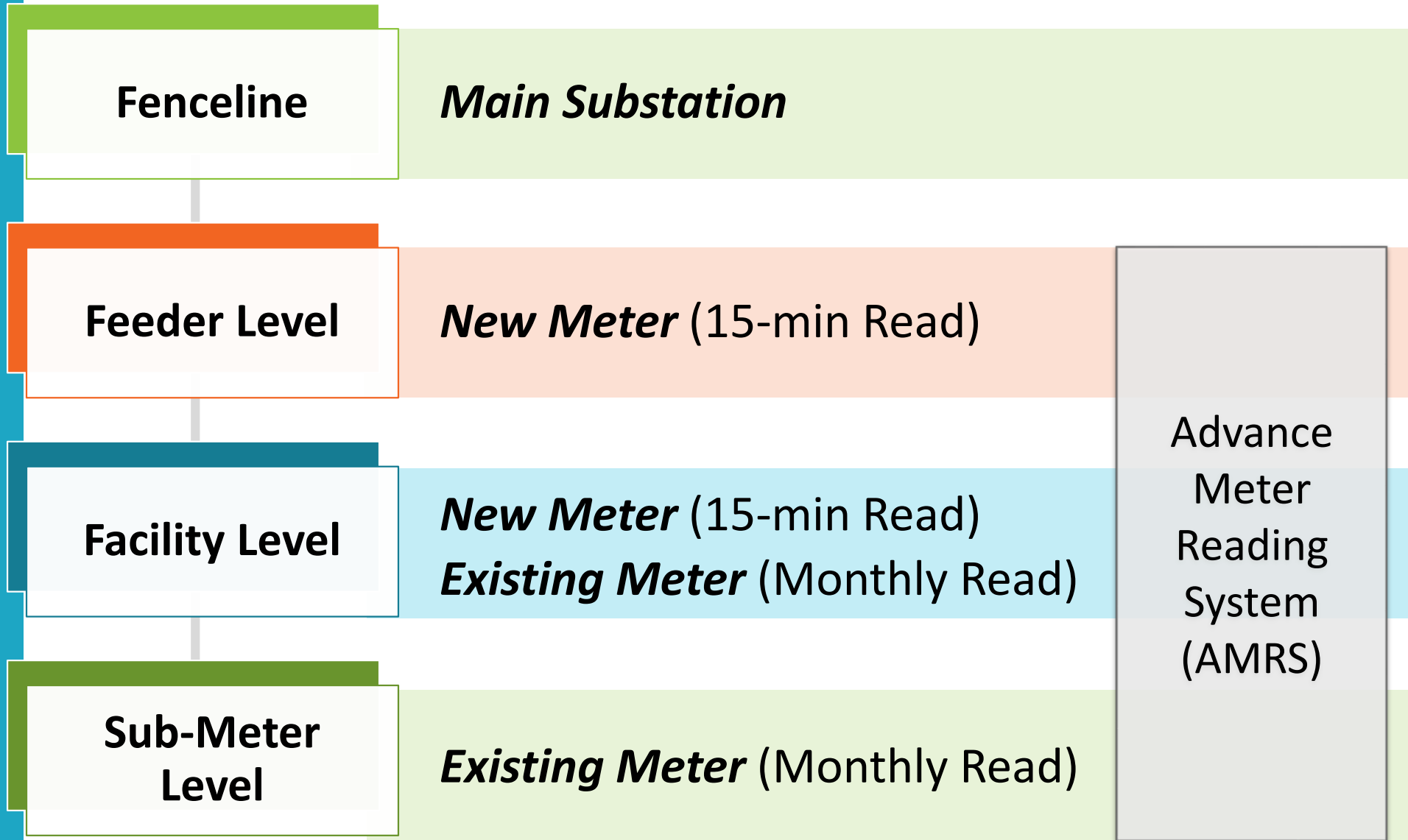
# Energy Assurance Master Plan



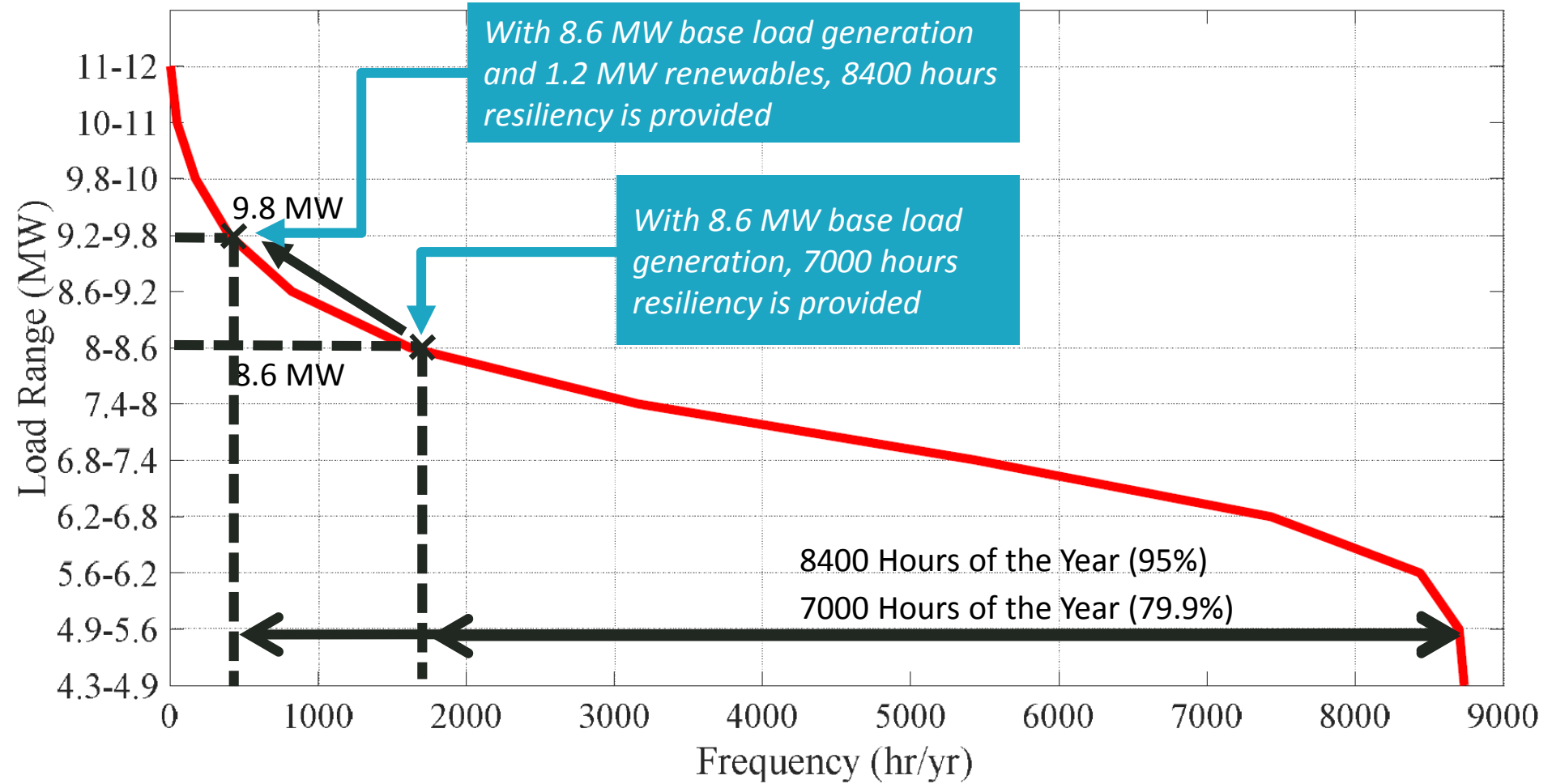
# Data Analysis



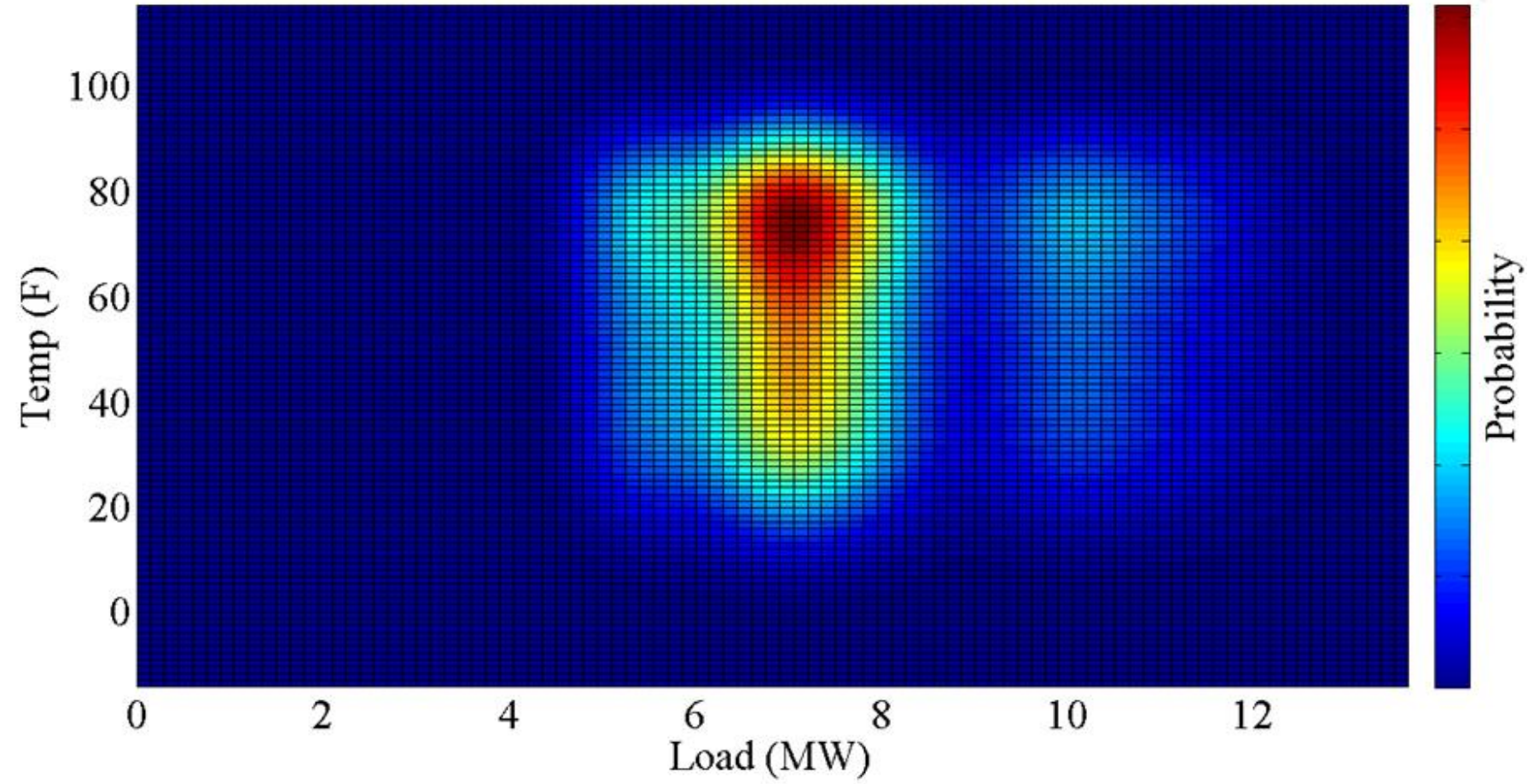
## Establishing Energy Baseline



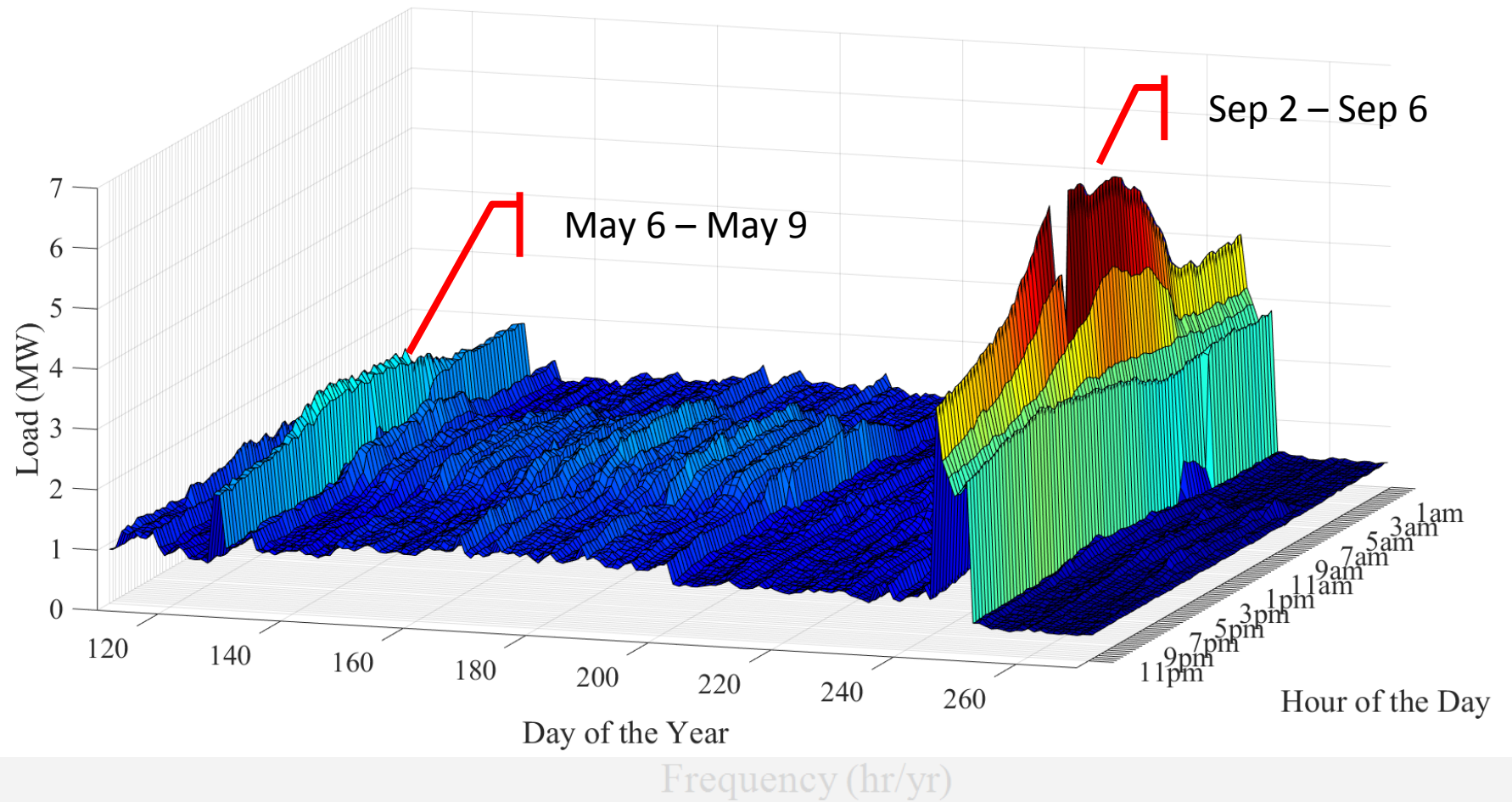
# Load Duration Curve



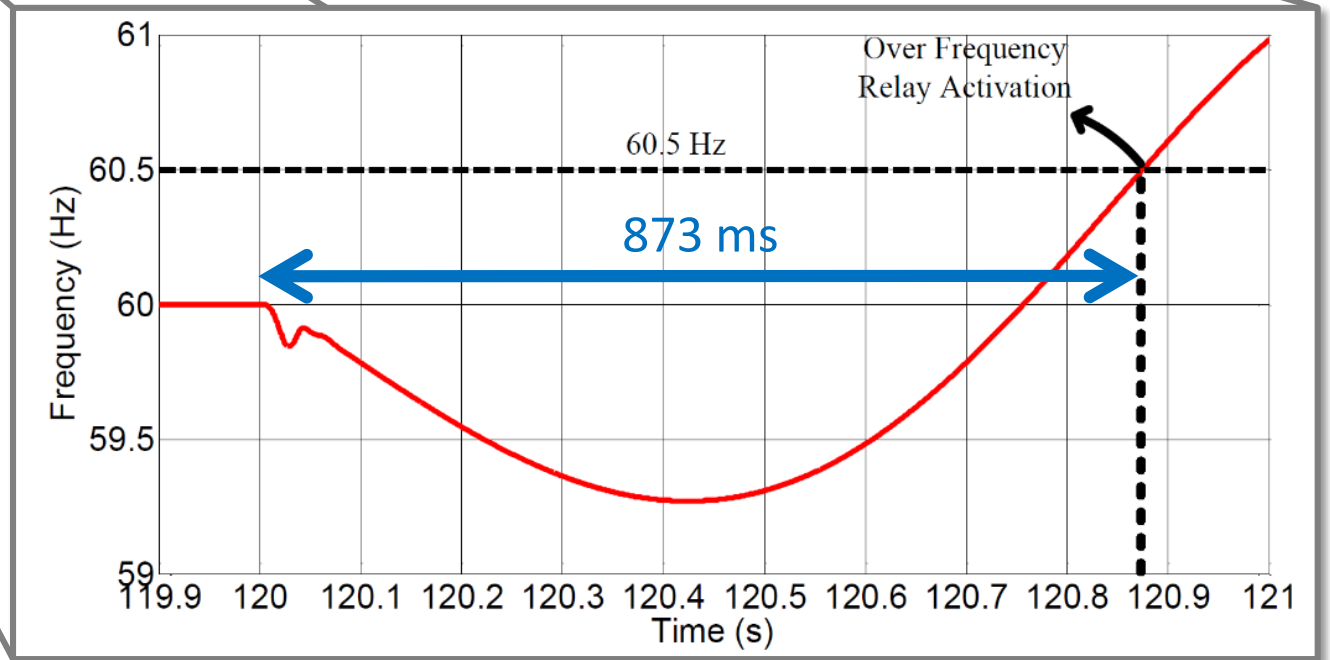
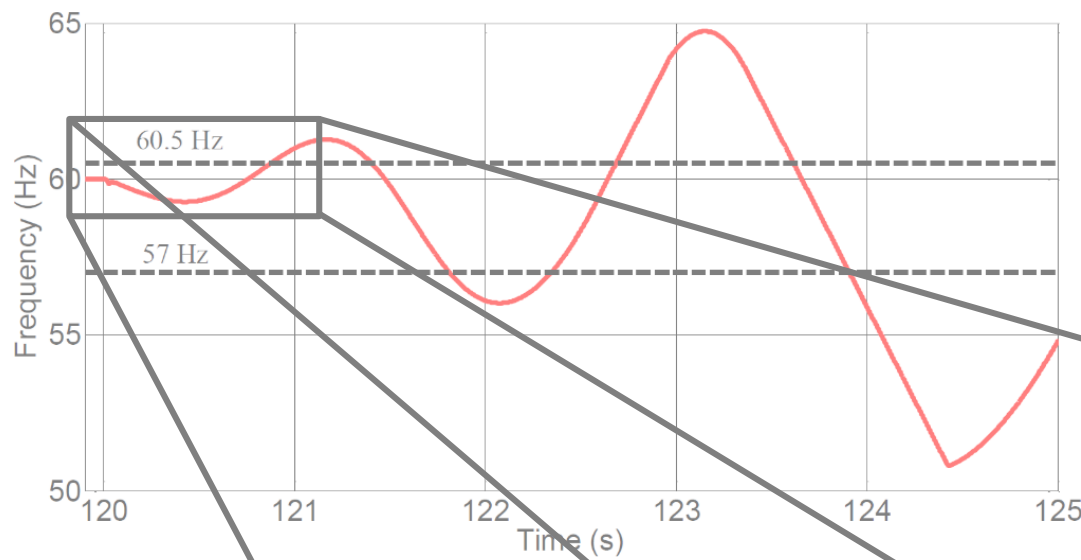
## LOAD PDF 1 PM



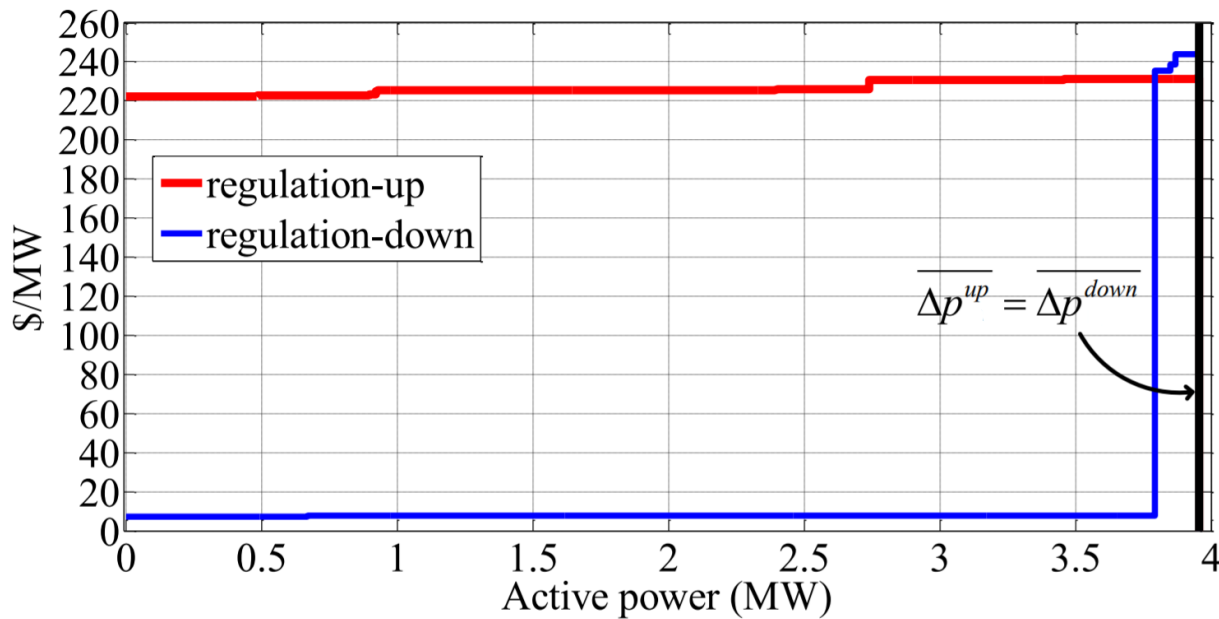
# Load Characteristics



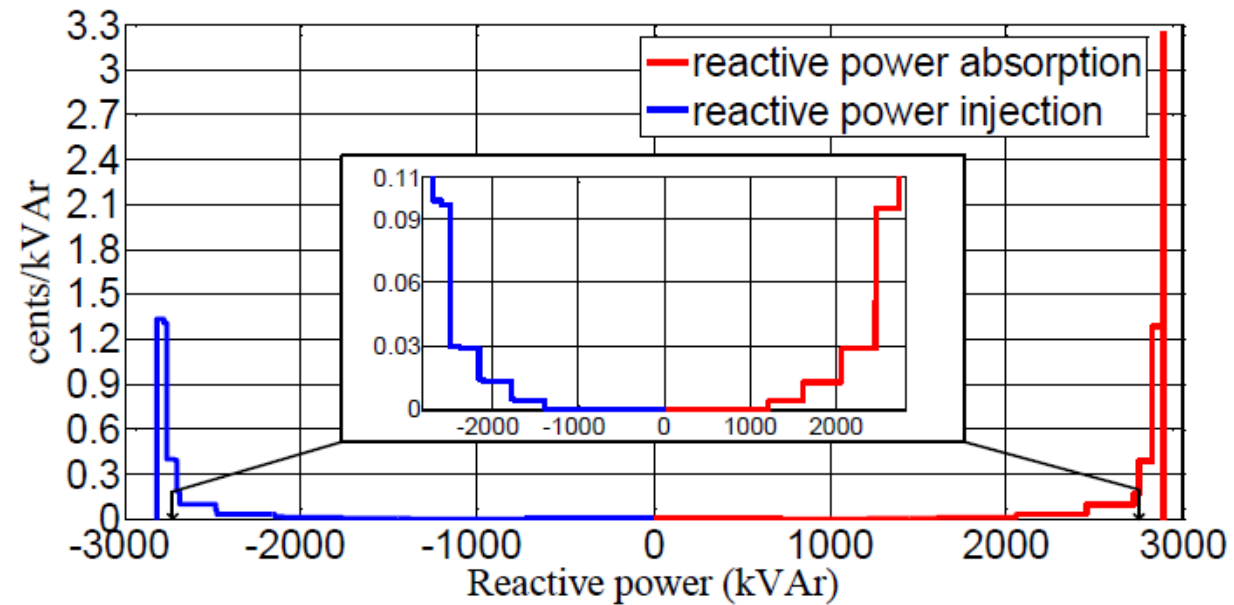
# Ride Through Capability for Critical Load



# Ancillary Services



Regulation Service Supply Function



Reactive Power Support Service Supply Function





# STATE OF TECHNOLOGY



Degree of integration with the utility/ISO to Stack Different Values



Islanding Capability with intermittent renewable generation



Dynamic Load Shedding Scheme





OBG | THERE'S A WAY

Thank you!