DER-VET Task Force

ESIC Working Group 1: Grid Services and Analysis

Suma Jothibasu | EPRI
Miles Evans | EPRI
Halley Nathwani | EPRI
Giovanni Damato | EPRI

August 6, 2020

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Agenda

- Announcements
- Microgrid Design for Customer Reliability & Resilience
- Key Microgrid Design Factors
  - Scenario Analysis

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Announcements

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DER-VET Task Force Presentations and Recordings Moved

- www.der-vet.com/esictf

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| DER-VET™ | ESIC Task Force | Help | Forums |

You Are Here: Home > ESIC Task Force

Energy Storage Integration Council (ESIC)
Working Group 1 DER-VET™ Task Force Meeting Recordings

DER-VET™ Task Force : Presentations

- 2020-07-02 Meeting: PDF | recording
- 2020-06-04 Meeting: PDF | recording
- 2020-05-07 Meeting: PDF | recording
- 2020-04-02 Meeting: PDF | recording
- 2020-03-05 Meeting: PDF | recording
- 2020-02-06 Meeting: PDF | recording
- 2020-01-09 Meeting: PDF | recording
- 2019-12-05 Meeting: PDF | recording

DER-VET™ Task Force : Office Hours

- 2020-04-23 Office Hours: recording
- 2020-04-16 Office Hours: recording

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DER-VET Framework Change

- Ditching the locally-hosted asp.NET framework, which required
  - SQL server
  - IIS
  - Extensive setup
- Moving to Electron framework, which will behave like a desktop application
  - Working on getting the licenses sorted out for seamless install

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Upcoming Virtual Meeting – August 25-27 with ESA Conference

Polling Procedure

- On a computer, phone, etc., navigate to

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- Enter a name to associate with your responses

- Respond to poll questions when prompted

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# Microgrid Design for Customer Reliability & Resilience

DER Technology Mix:
- BTM DERs
- **Blue sky:** ES+PV
- **Island:** ES+PV+DG

DER Sizing & Operation:
- **Primary Objective**: Customer Reliability/Resiliency e.g., 100% for 4 hours
- **Secondary Objective**: Maximize economic benefits (e.g., Bill Reduction)

Cost Effectiveness:
- DER ownership model: Customer owned and operated
- Life time of assets and replacement costs
  - ES – 10 years, PV – 20 years, DG – 15 years
- Analysis time horizon: 20 years
- CBA Metrics: Cost of serving critical load, Annual bill reduction, Total project NPV

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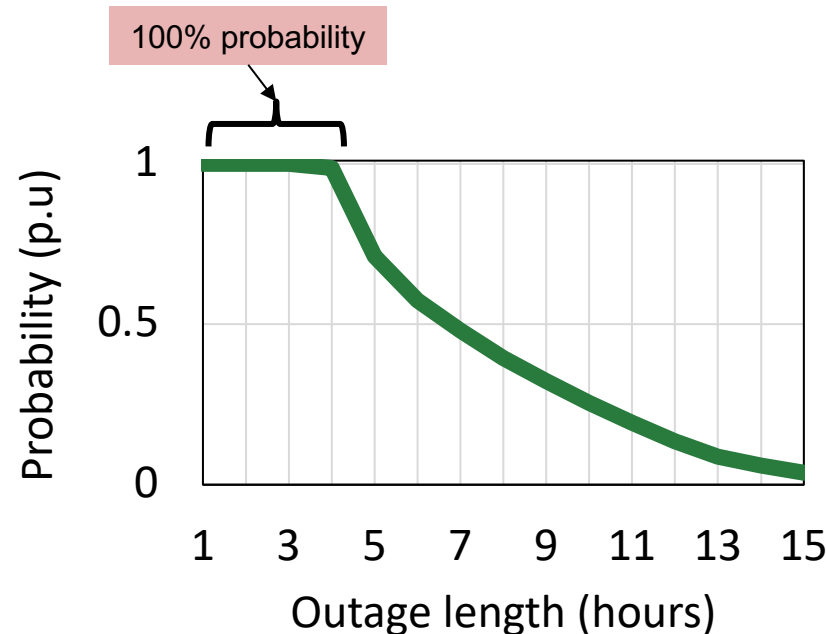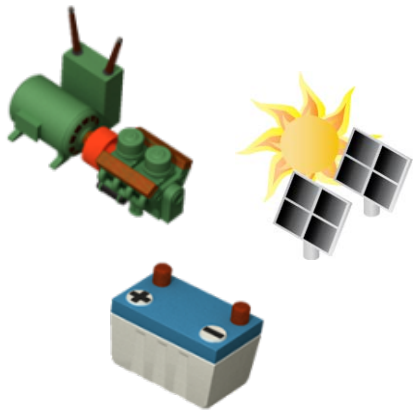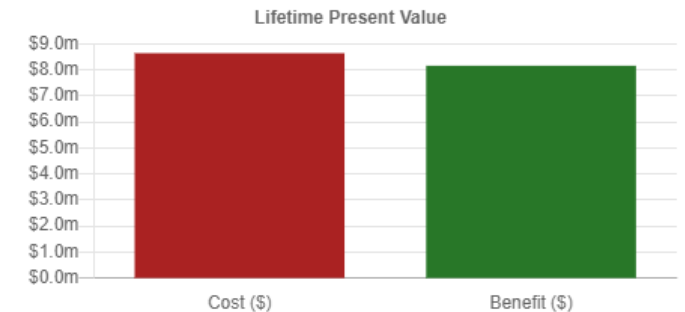
Key Factors - Microgrid Design

Microgrid Design Factors

a) Microgrid User-Defined Reliability Target

b) Microgrid DER Portfolio

c) DER Location

d) Solar Intermittency/ Variability Assumptions

e) Energy Storage's SOC Reservation

f) …

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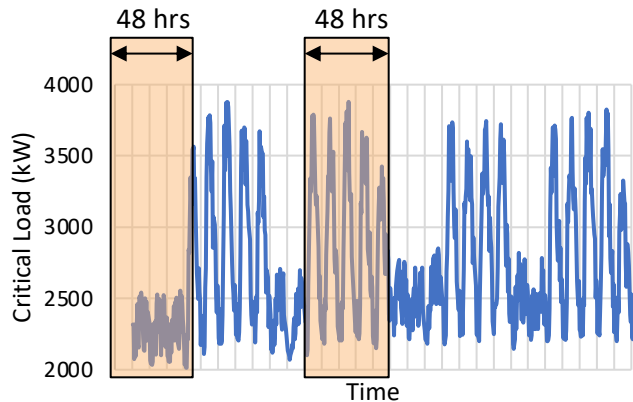
Polling Question

- On a computer, phone, etc., navigate to

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- Are there other factors that affect microgrid design?

- Polling Response

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How User-Defined Reliability Target can vary Design?

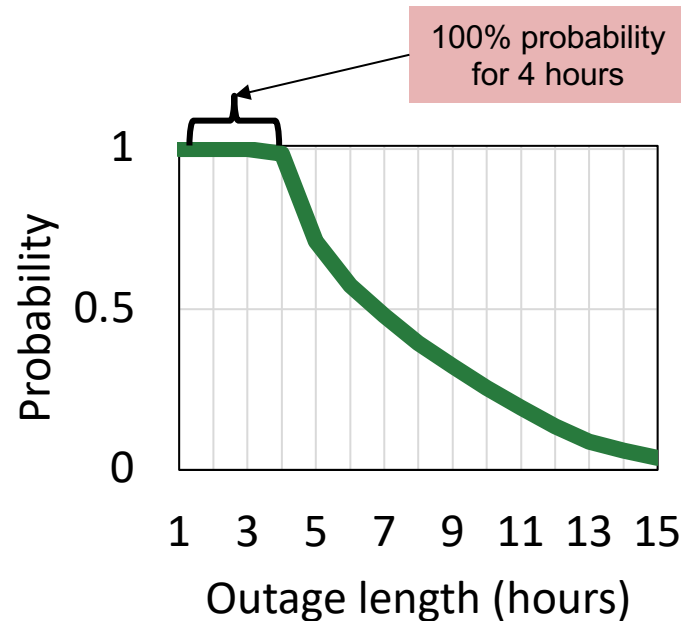**Planned Outages:**

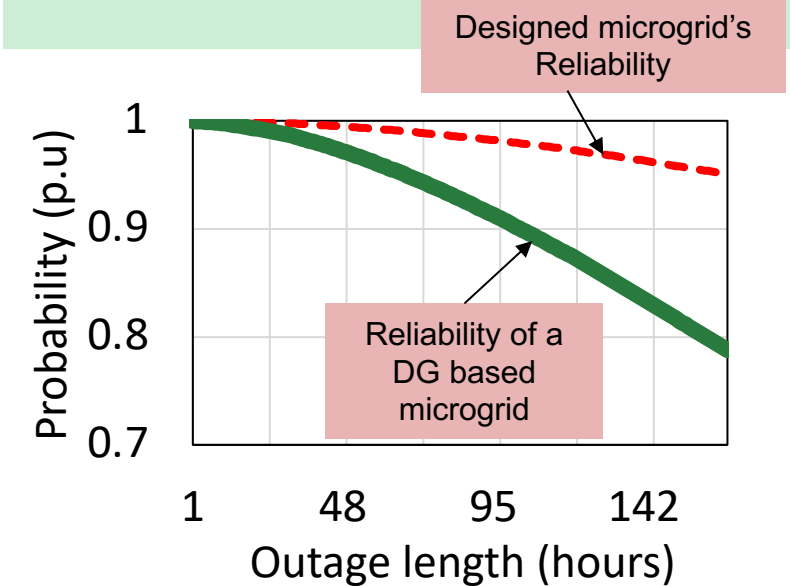100% or <100% load coverage for target hours of **planned** outages

Un-planned Outages:

100% or <100% load coverage for target hours (ex. 4 hours) of any possible un-planned outages

Relational Definition:

Reliability target for every outage length

48 hrs   48 hrs

Critical Load (kW)

4000
3500
3000
2500
2000

Time

100% probability for 4 hours

Probability

1

0.5

0

1   3   5   7   9   11   13   15

Outage length (hours)

Designed microgrid's Reliability

Reliability of a DG based microgrid

Probability (p.u)

1
0.9
0.8
0.7

1   48   95   142

Outage length (hours)

Microgrid is designed to have probabilistic reliability equal to or greater than the target

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Planned Outage – Microgrid Design

- 100% load coverage for a 24-hour period in Summer

Critical Load (kW)
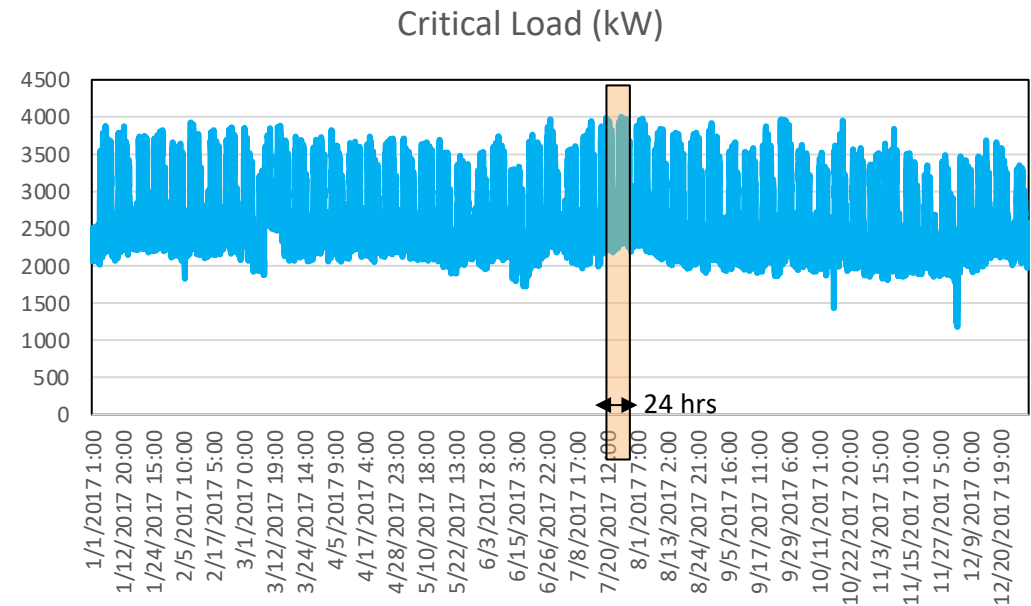
- Microgrid design:

	Energy storage	Solar PV	Diesel Generator
Microgrid Components	2.6MW 10h	200 kW	2 x 750kW DG

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Same Microgrid for Unplanned Outages – Probability

- Load coverage probability for any possible unplanned outages

Load Coverage Probability
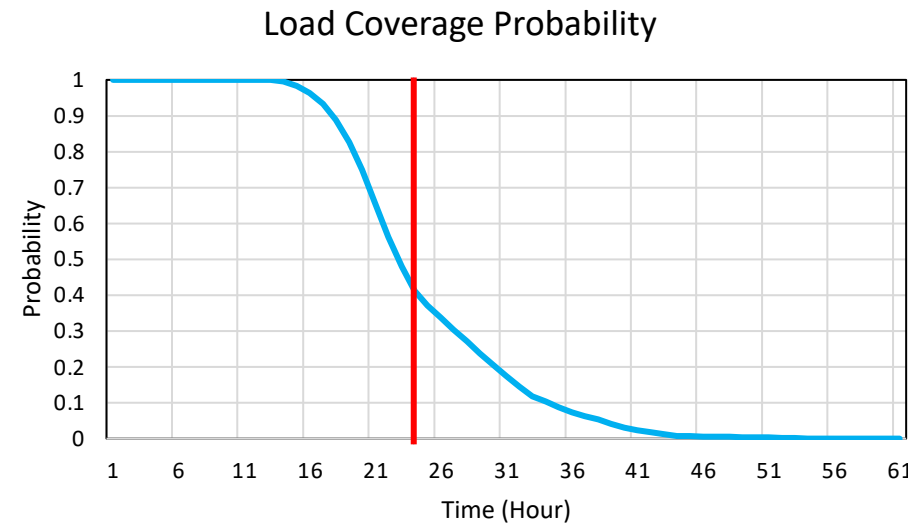
Assuming 100% SOC reservation for Reliability

- Probability of covering any (planned and unplanned) 24-hour outage is ~40%

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Relational Reliability Target Definition

- Design Energy storage based microgrid that has similar or better reliability than DG only microgrid

|	DG based Microgrid	DER based Microgrid 1	DER based Microgrid 2
Microgrid Components	7 x 750kW DG	875 kW 1.5 h ES + 5 x 750kW DG	4375 kW 4 h ES + 5 x 750kW DG
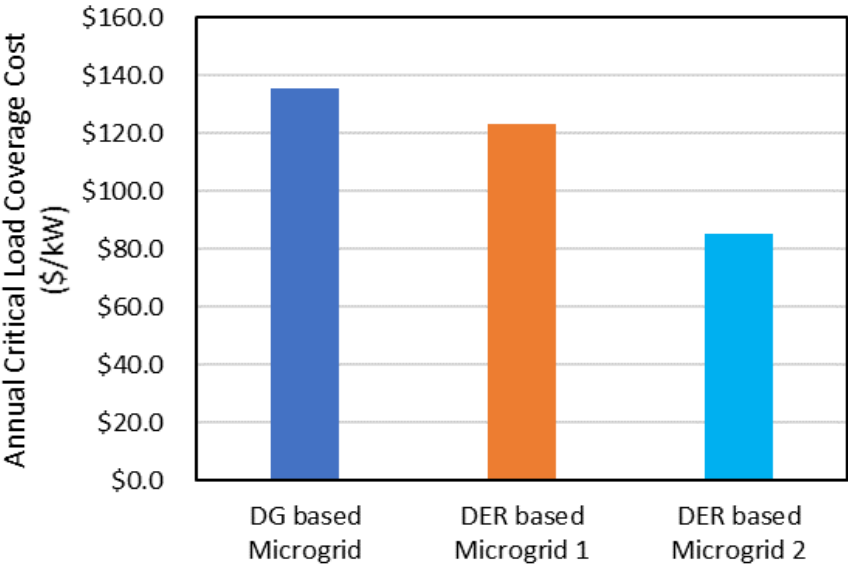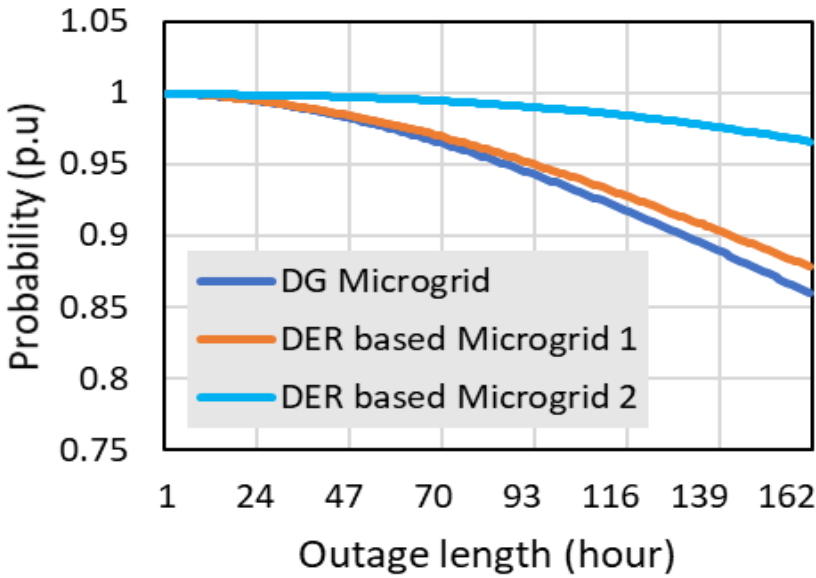
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Polling Question

- On a computer, phone, etc., navigate to

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- Is one, two, or three the usual method of defining? OR

- Are there other methods of defining microgrid design target?

- Polling Response

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How DER Portfolio Choice can affect Design?

- DER Portfolio Choices and Associated characteristics
  - Diesel Genset – Fuel tank capacity, start-up time
  - Solar PV – Forecast, variations
  - Energy Storage – Round trip efficiency
- Dispatch strategy definition
- Service territory restrictions
- Life-cycle of DERs
- Degradation

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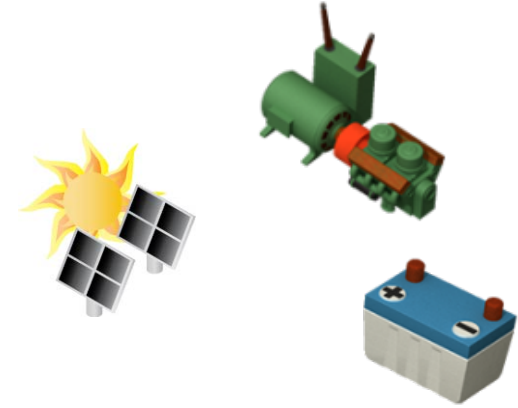
DER Portfolio Choice

- Reliability target of 100% Probability for 4 hours
- Three microgrids – ES, ES+DG, ES+DG+PV

|	Energy Storage	Diesel Generators	Solar PV
ES Microgrid	4MW 16.5MWh	-	-
ES +DG Microgrid	2.5 MW 10.22MWh	2 x 750 kW	-
ES + DG +PV Microgrid	2.36 MW 9.128MWh	2 x 750 kW	800 kW

Microgrid variation with different DER choices

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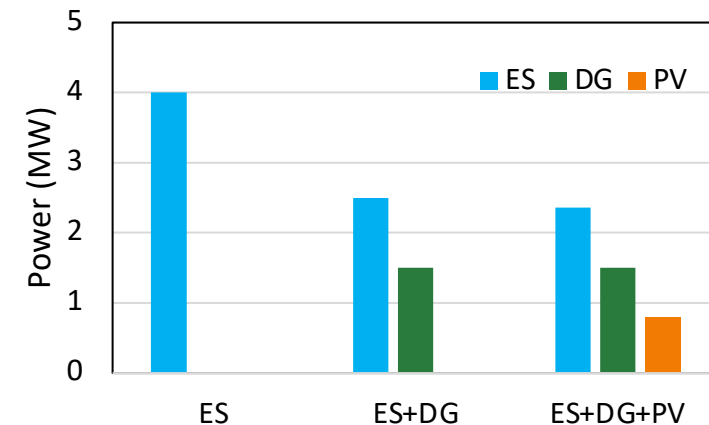
Load Coverage Probability for the 3 Microgrids

▪ All microgrids meet the set reliability target – 100% for 4 hrs

Load Coverage Probability
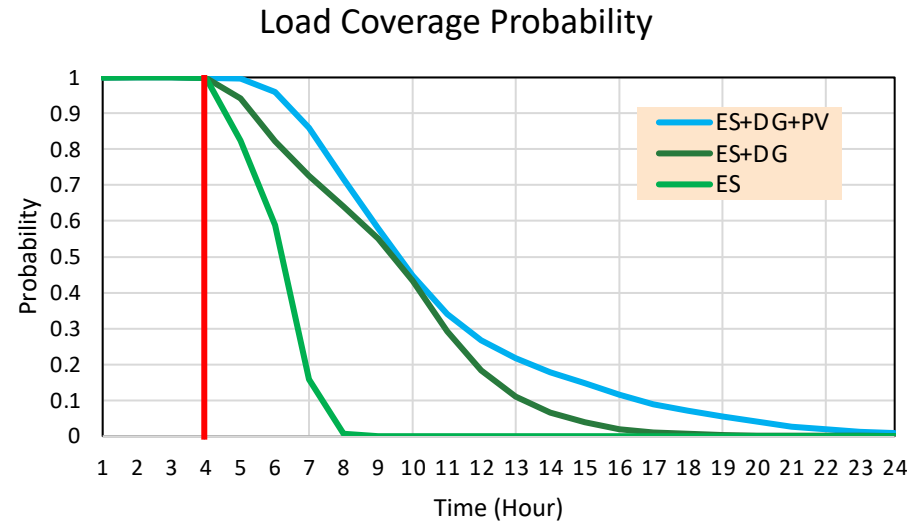
Assuming 100% SOC reservation for Reliability

▪ Probability of covering outages >4hrs, vary for the microgrids

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Polling Question

- On a computer, phone, etc., navigate to

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- Is one, two, or three the usual method of defining? Are there other factors that affect microgrid design?

- Polling Response

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How DER Location Can affect Design

- DER benefits vary based on location

| Bill Reduction	Wholesale Market
- Energy charge reduction, - Demand charge reduction, - Demand response	- Energy arbitrage, - Frequency regulation, - Non/Spinning reserves - Load Following

- AC or DC coupled - Solar plus Storage assets

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Net Benefits of Microgrid Variation based on Location

- DER benefits can vary depending on Electricity market structure
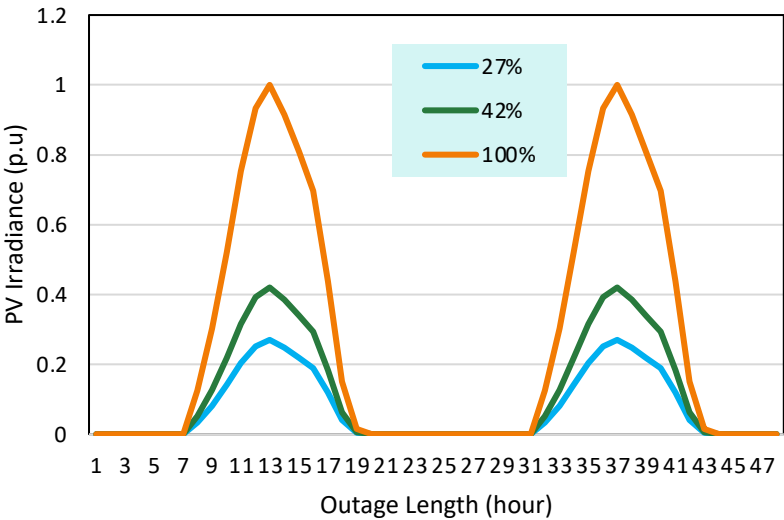- Three example microgrids and their net benefits are below,
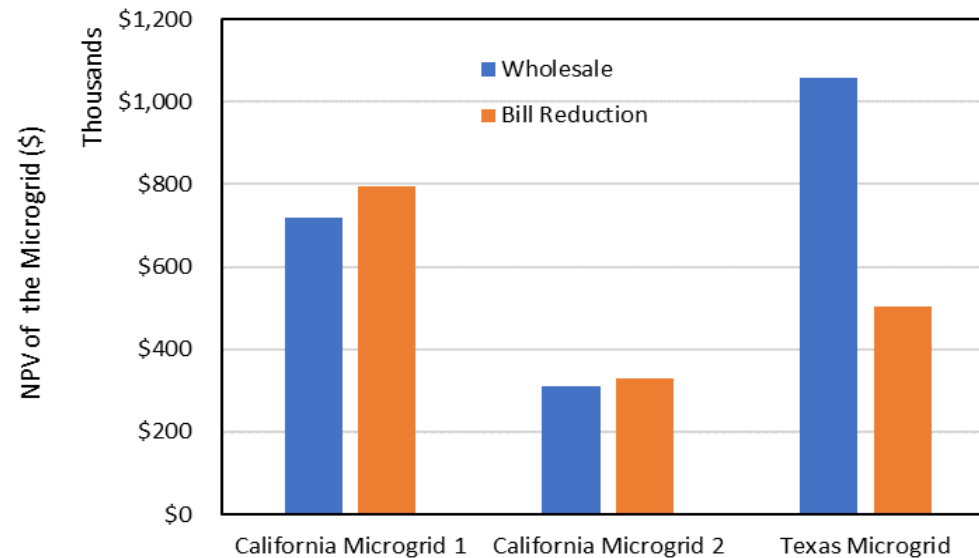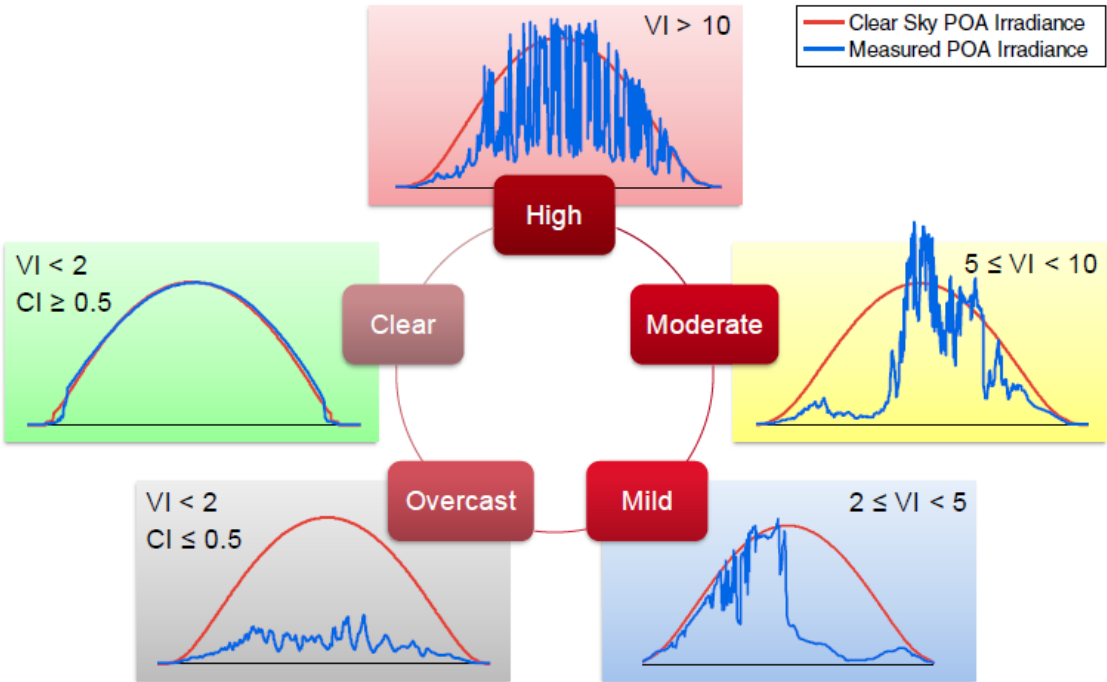
Polling Question

- On a computer, phone, etc., navigate to

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- What DERs would you consider when designing for Reliability

- Polling Response

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How PV Variability Assumptions vary Design?

PV Dependability Assumptions
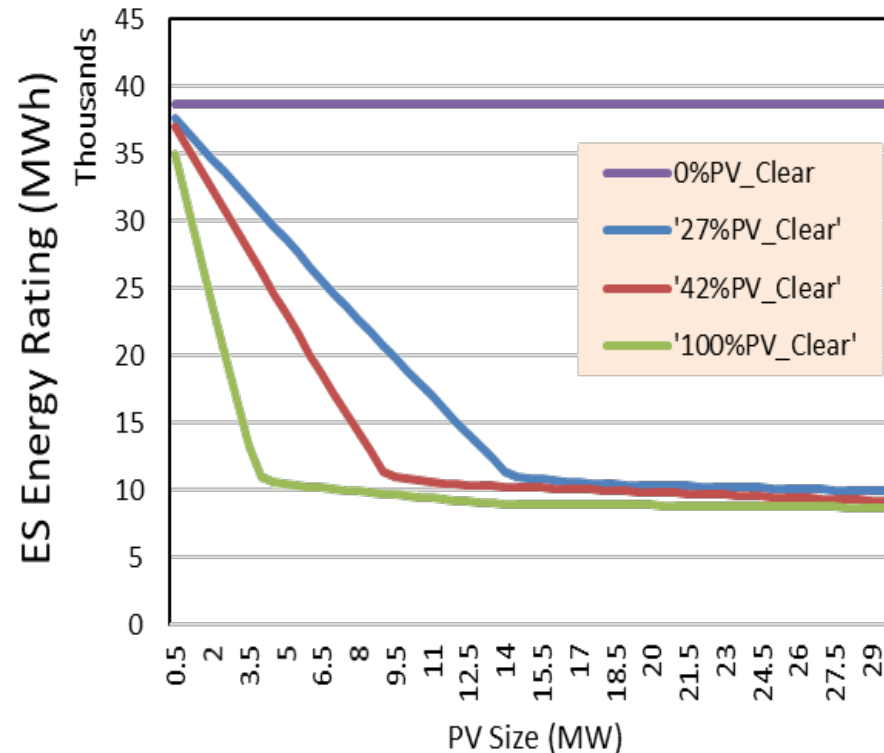

Intra-Hourly PV Assumptions

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Solar plus Storage Design – PV Dependability Effect

- Reliability target – 24 hours of planned outage
- Solar plus Storage for different PV dependability%

Solar plus Storage Design – PV Intra-Hour Variability

Services: Services Settings

Do not optimize DER size/operation for reliability -- only calculate the reliability benefit of the DERs	○ Yes ● No
How many hours of guaranteed outage coverage does the project need to supply based on the load?	[4] hours — How many hours of guaranteed outage coverage does the project need to supply based on the load?
Minimum Percentage of PV Generation	[20] % — Minimum percent of PV generation one can expect within a timestep
Timestep Percentage of PV Minimum Generation	[43] % — Percent of the timestep for which PV is at it's minimum generation
Maximum Outage Duration to Plot	[24] hours — Calculate the post-facto reliability for an outage that can last up to this value

Critical load data has already been uploaded for this project. Do you want to use the existing data?

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Polling Question

- On a computer, phone, etc., navigate to

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- How do you model PV Variability?

- Polling Response

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How Storage SOC Reservation can affect Design?

- High SOC for Reliability -> Less headroom for stacked benefits
  - Can Affect cost-effectiveness of the microgrid

- Low SOC -> longer storage life

- Low SOC reservation assumption -> large energy storage required for the same reliability service

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SOC Vs Reliability

- Reliability target 95% for unplanned outages of 24-hr duration
- The relation between SOC and Reliability is non-linear

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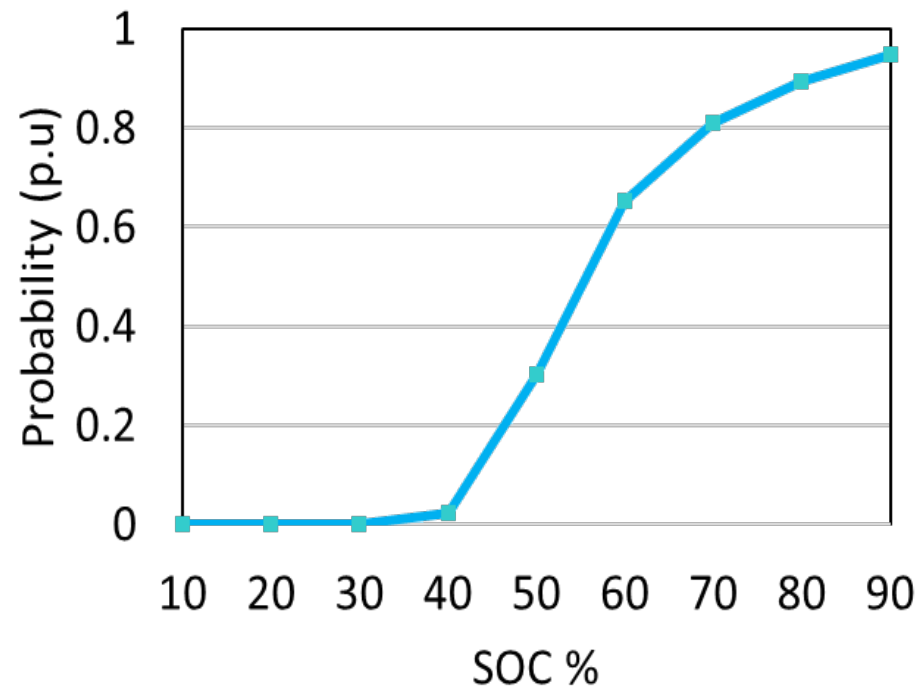
Polling Question

- On a computer, phone, etc., navigate to

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- What is the usual SOC reservation?

- Polling Response

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Next Meeting

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Regularly-Scheduled Meetings

- Next Meeting – **Thursday September 3, 11:00 am Pacific Time**

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