

# Working With Your Utility Series: Interconnection Basics

Rachel Shepherd (FEMP), Doug Gagne (NREL), Chandra Shah (NREL)

June 29th, 2021



# Webinar Logistics

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- **This webinar is being recorded. The Q&A portion will not be made publically available.**
- **Your phone will be muted throughout the webinar.**
- **Enter questions in the Q&A Box throughout the webinar.**
- **Instructions to take the quiz will be provided at the end of webinar.**
- **Slides will be sent out afterwards to those who attend the entire webinar**

# Webinar Overview

## Agenda

- |      |                           |
|------|---------------------------|
| I.   | Introduction              |
| II.  | Interconnection Process   |
| III. | Interconnection Agreement |
| IV.  | Resources and Q&A         |

## Learning Objectives

- Learn the typical interconnection process for connecting a distributed energy project to your serving utility's grid.
- Gain valuable strategies for siting distributed energy projects to minimize interconnection risk and cost.
- Understand technology-specific interconnection issues.
- Learn about interconnection agreements and common clauses that may require revision to conform to federal regulations.

# Webinar Team



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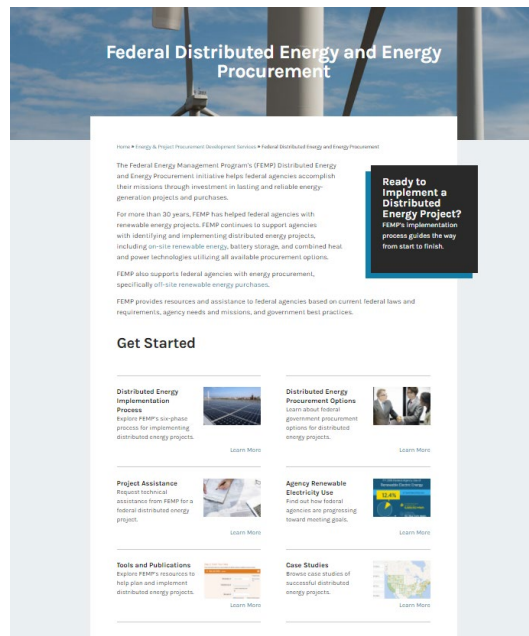
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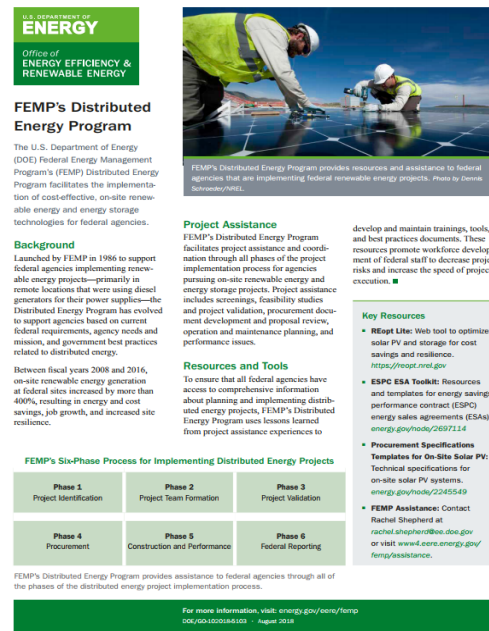
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# FEMP's Distributed Energy Program

FEMP's Distributed Energy (DE) Program facilitates the implementation of cost-effective on-site renewable energy, energy storage, and combined heat and power technologies for federal agencies.



FEMP's Distributed Energy Program Website



FEMP's Distributed Energy Program Factsheet



FEMP's Distributed Energy Implementation Process Website

# “Working With your Utility” Webinar Series

## Webinar #1

- Interconnection Basics  
(June 29<sup>th</sup>, 2021)

## Webinar #2

- Advanced Interconnection Topics  
(August 17<sup>th</sup>, 2021)

## Webinar #3

- Utility Cost Implications of a DE Project  
(October 19<sup>th</sup>, 2021)

# Introduction



# What is Interconnection?

## Interconnection Options

### Front of the Meter (FTM)



Utility-Scale Generation



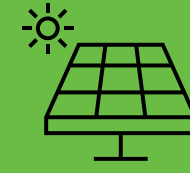
Transmission & Distribution



### Behind the Meter (BTM)



Federal Buildings



Distributed Energy



Storage

- DE systems are predominantly connected to an existing utility grid.
- For safety, grid reliability, and economic reasons, the serving utility has a set of requirements for customers installing DE systems on their grid.
- The most common interconnection process is for behind the meter (BTM) systems, although some large systems are installed in front of the meter.

# Overview of Interconnection Topics



Interconnection Process



Design and Engineering



Interconnection Application



Interconnection Agreement



Permission to Operate

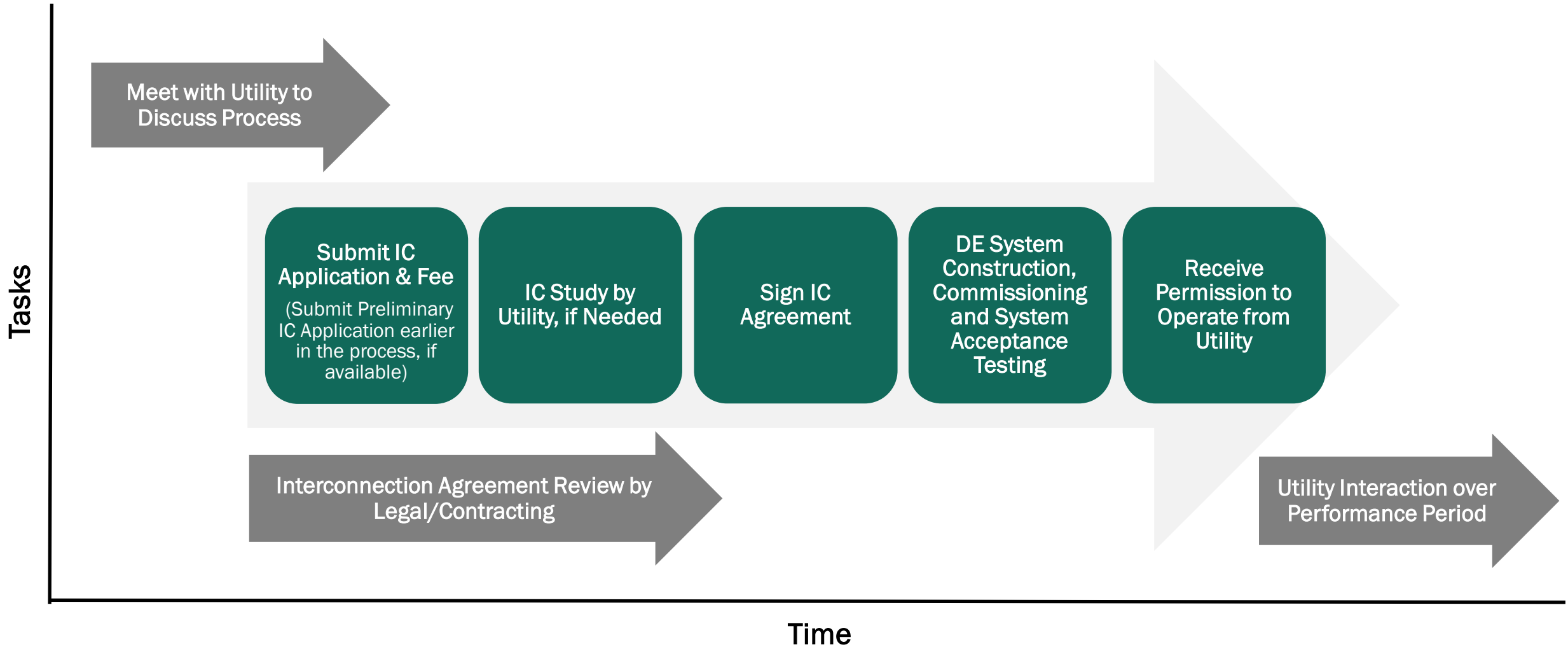


Net Metering

# Interconnection Process

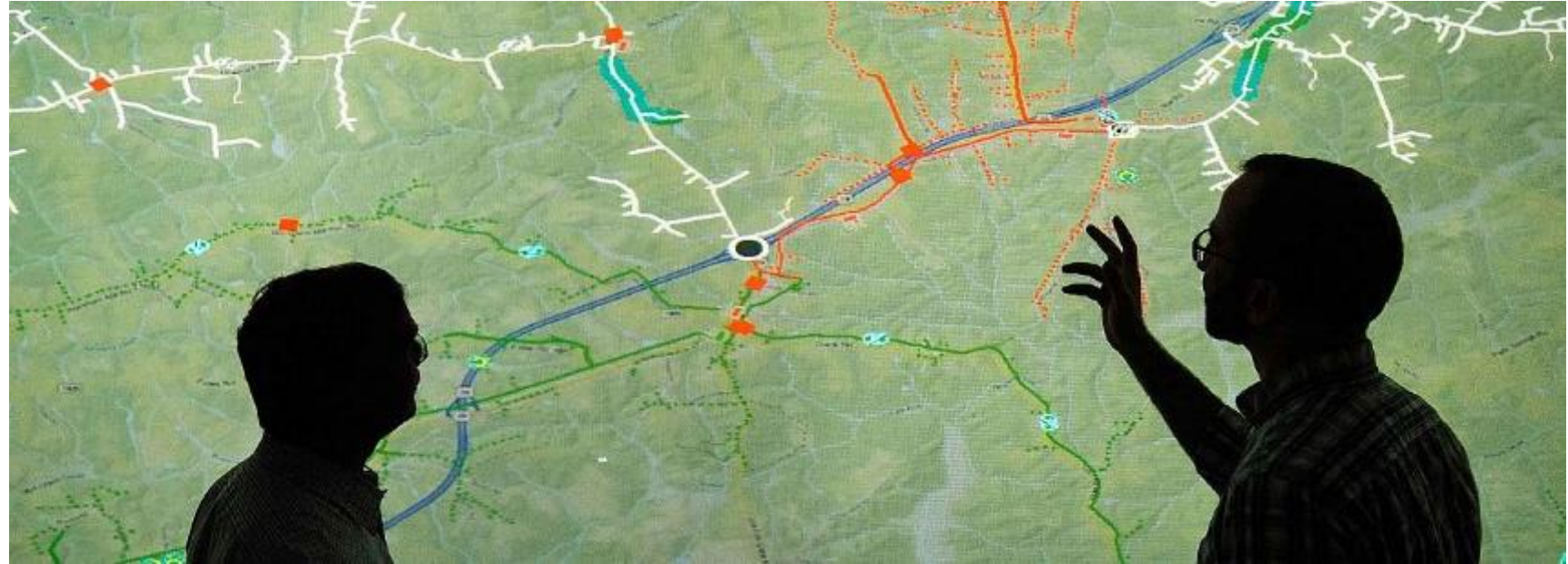


# Interconnection (IC) Process



# Interconnection Process Best Practices

- Notify your utility of planned distributed energy (DE) projects early in the planning process



- Ensure close communication between agency, contractor, and utility
- Clarify roles and responsibilities among the parties
- Request written responses from your utility
- Identify points of non-agreement early and address them

# Interconnection Process Best Practices (2)

- Understand your utility's interconnection process, including:

- Published policies, regulations, and orders
- If a pre-application report is available to obtain early-stage feedback on interconnection limitations
- Application requirements (equipment details, one-line diagrams, inverter specifications)
- Specific requirements if batteries/microgrid included



# Design and Engineering



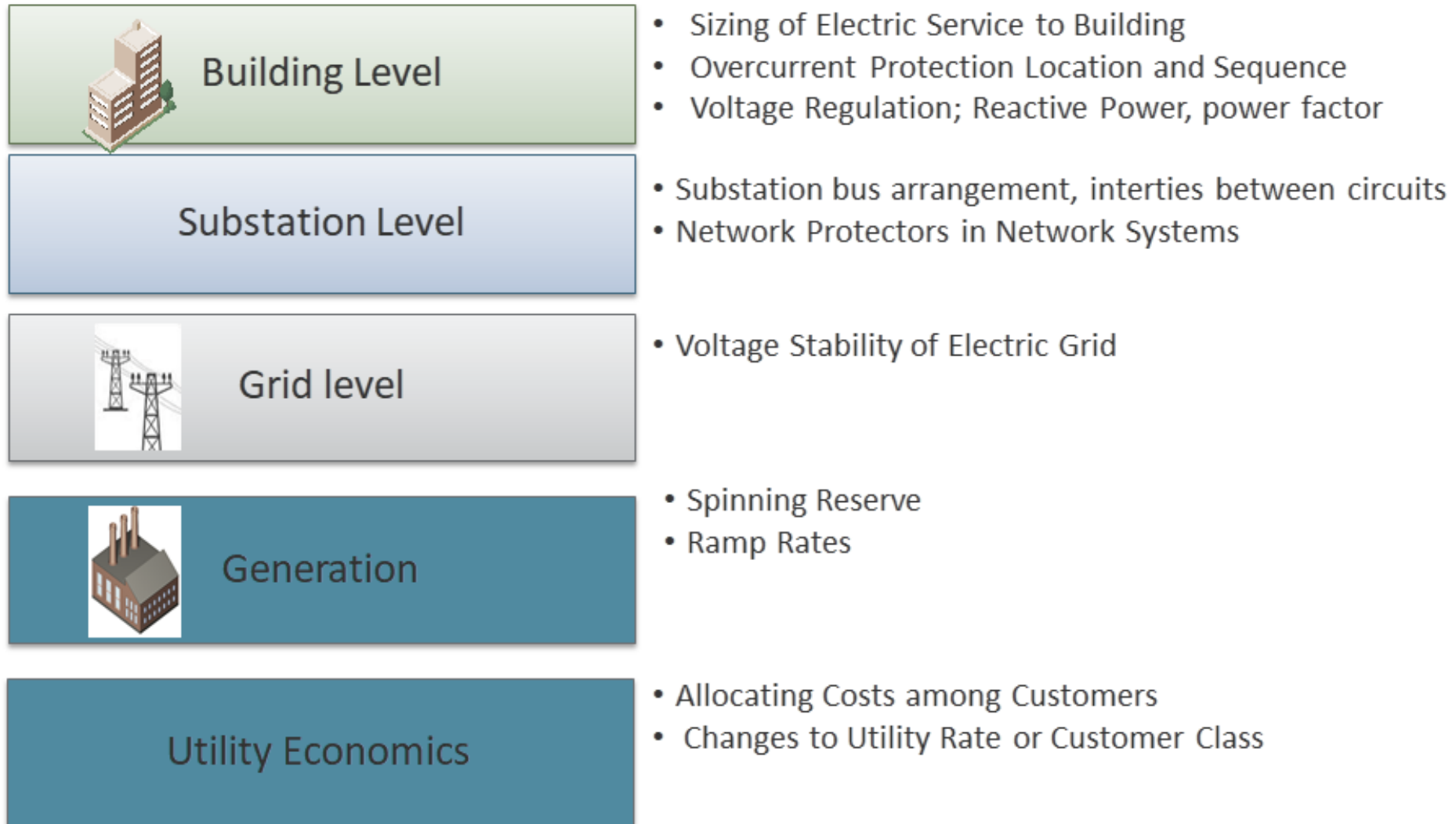
# Interconnection Design & Engineering Considerations

- **Project Size Considerations**
  - Potential for export
  - Interconnection requirements typically increase with project size
- **Point of interconnection**
  - Acceptable connection options
  - DE distance from the interconnection point
- **Energy Storage**
  - Clarify how existing interconnection standards apply, and if additional/specific requirements apply
  - Separate vs. combined application process



- **Electrical considerations**
  - Interconnection standards (NEC, IEEE 1547)
  - Existing distribution lines and ownership
  - Site electrical system impacts, potential upgrade requirements
  - Acceptable inverter and meter locations

# Utility System Impacts



# Interconnection Application and Study Process



# Interconnection Application

- Application requirements depend upon project type and size:
  - Application fees
  - Affected utility account(s)
  - System design
    - DE project size (kW)
    - Inverter size if applicable (kW)
    - Equipment details
    - Location
  - Intended use (e.g. non-export, net metering, battery applications)

## Maryland Level 2, Level 3 & Level 4 Interconnection Request Application Form (Greater than 10 kW to 10 MW or less)

### Electrical Contractor (if different from Equipment Contractor):

Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
City: \_\_\_\_\_ State: \_\_\_\_\_ Zip Code: \_\_\_\_\_  
Telephone (Daytime): \_\_\_\_\_ (Evening): \_\_\_\_\_  
Facsimile Number: \_\_\_\_\_ E-Mail Address: \_\_\_\_\_  
License number: \_\_\_\_\_

### Electric Service Information for Customer Facility Where Generator Will Be Interconnected

Capacity: \_\_\_\_\_ (Amps) Voltage: \_\_\_\_\_ (Volts)  
Type of Service:  Single Phase  Three Phase  
If 3 Phase Transformer, Indicate Type  
Primary Winding  Wye  Delta  
Secondary Winding  Wye  Delta  
Transformer Size: \_\_\_\_\_ Impedance: \_\_\_\_\_

### Intent of Generation

- Offset Load (Unit will operate in parallel, but will not export power to EDC)  
 Net Meter (Unit will operate in parallel and will export power pursuant to Maryland Net Metering or other filed tariff(s))  
 Wholesale Market Transaction (Unit will operate in parallel and participate in PJM market(s) pursuant to a PJM Wholesale Market Participation Agreement)  
 Back-up Generation (Units that temporarily parallel for more than 100 milliseconds)  
Note: Backup units that do not operate in parallel for more than 100 milliseconds do not need an interconnection agreement.

### Generator & Prime Mover Data

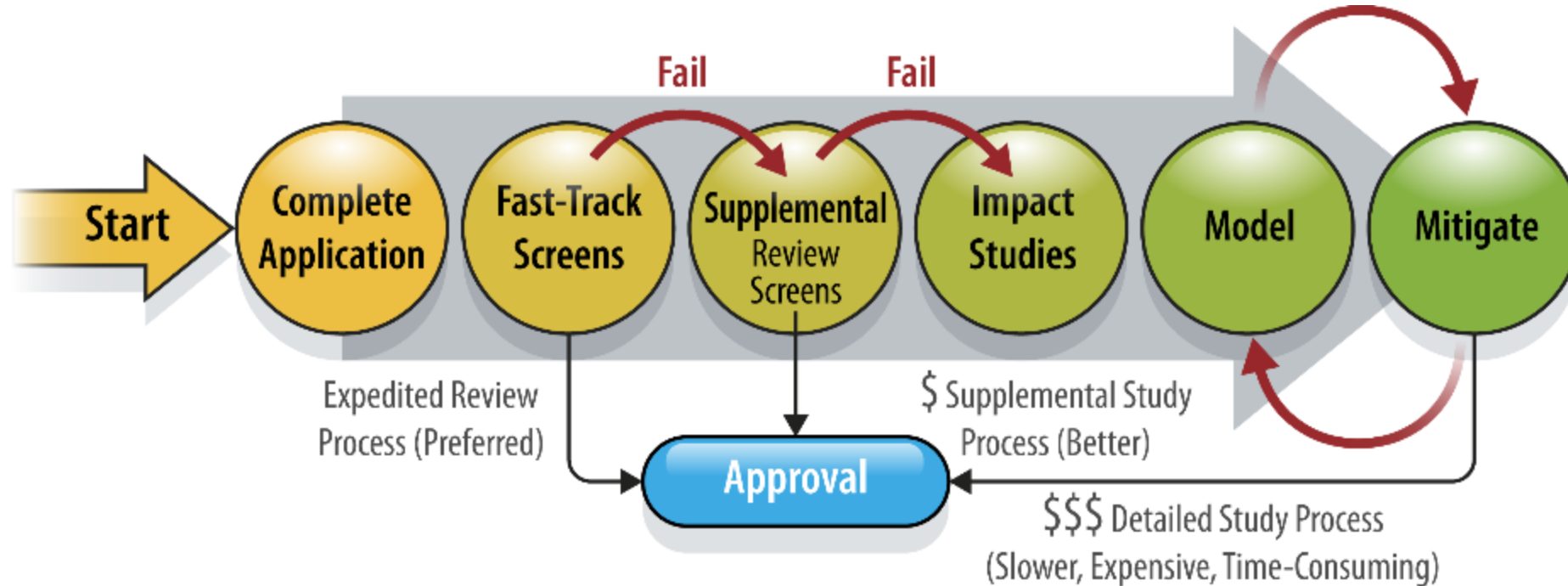
Type of Application Initial  Addition  <sup>1</sup>  
Initial Rating: DC System Design Capacity: \_\_\_\_\_ (kW) \_\_\_\_\_ (kVA), Inverter Capacity \_\_\_\_\_ (maximum AC kW), AC System Design Capacity: \_\_\_\_\_ (kW) \_\_\_\_\_ (kVA)  
Added Rating: DC System Design Capacity: \_\_\_\_\_ (kW) \_\_\_\_\_ (kVA), Inverter Capacity \_\_\_\_\_ (maximum AC kW), AC System Design Capacity: \_\_\_\_\_ (kW) \_\_\_\_\_ (kVA)  
Total Rating: DC System Design Capacity: \_\_\_\_\_ (kW) \_\_\_\_\_ (kVA), Inverter Capacity \_\_\_\_\_ (maximum AC kW), AC System Design Capacity: \_\_\_\_\_ (kW) \_\_\_\_\_ (kVA)

# Interconnection Application Best Practices

- Check your utility's website for information on their interconnection process
- Ask if the utility offers:
  - A simplified interconnection process for smaller systems
  - An application checklist summarizing all requirements
  - A point of contact to answer questions about the process
  - Hosting capacity maps or other utility system information
- **Carefully review the utility's documentation requirements. Submitting incorrect documentation can prolong process**

# Interconnection Study Process

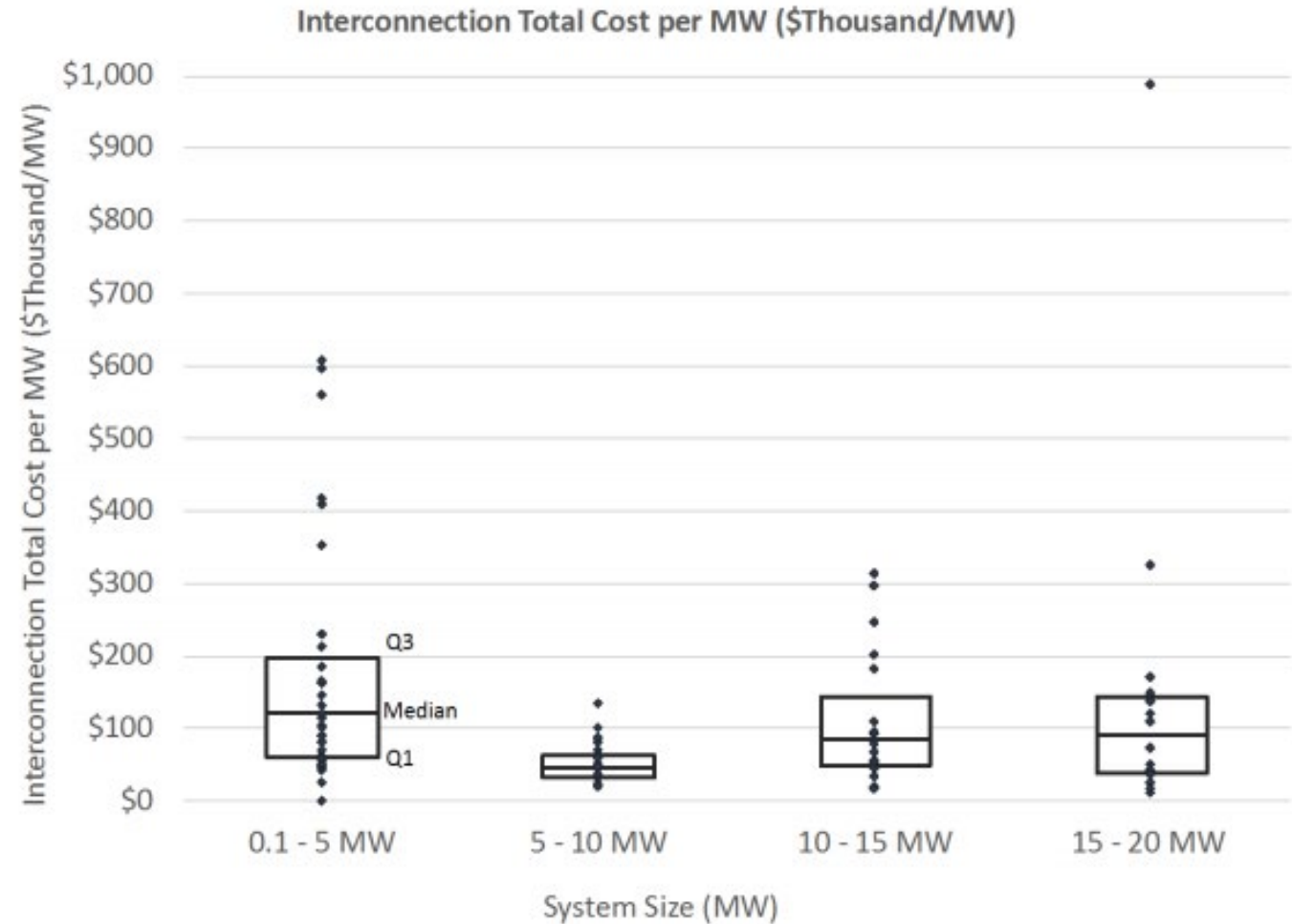
- Additional interconnection studies may be required for larger systems or in certain constrained areas
- **Fees, timelines and queue vary by project size, technology type, utility jurisdiction, and point of interconnection**



Note: A site distribution system study may also be required

# Interconnection Upgrade Costs

- For larger DE systems, upgrades to the utility's system may be required to mitigate impacts
- The cost of interconnection studies and resulting system upgrades are typically paid by the agency or their project developer
- Based on a review of large systems in the western US, most interconnection upgrade costs ranged from \$50,000/MW to \$200,000/MW



[Review of Interconnection Practices and Costs in the Western States](https://www.nrel.gov/docs/fy18osti/71232.pdf)  
<https://www.nrel.gov/docs/fy18osti/71232.pdf>

# Interconnection Agreement



# Interconnection Agreement Overview

- A signed interconnection agreement (ICA) with your utility is typically required to connect distributed energy projects
- ICAs may have problematic terms/conditions for federal agencies (e.g. indemnification)
- Negotiations may be necessary and can be lengthy
- GSA Areawide Contract Exhibit may be used

**Bottom Line: Review ICA language carefully and coordinate with utility early**



# ICA: Questions to Ask Utility

- Which party will sign the ICA?
  - Agency or private owner for privately owned projects (e.g. PPA, ESPC ESA)?
  - Is a tri-party agreement needed?
- Does the utility have a template ICA?
  - Is there a Federal (or government-specific) ICA template?
  - Government-specific ICA templates can ease the process, if available, however, solutions do not always translate across agencies
- Can the ICA be modified and if so, what PUC and/or other approvals are required?



# Permission to Operate



# Permission to Operate (PTO) Requirements

- Confirm technical and administrative requirements for utility to issue PTO early in design process
- Clarify agency and contractor's roles and responsibilities in obtaining PTO
- Obtain initial utility approval to test the system prior to commissioning/system acceptance testing
- Obtain written utility PTO before commercial operation begins



# Project Inspection and Acceptance

- How can you ensure that your project is designed and installed as intended?
  - Inspection and commissioning ensures system is complete and performs as expected
    - Safely put the system into operation
    - Often required by utility and/or for warranty
    - Ensures complete and accurate documents
- What are system acceptance testing requirements?
  - Recommend thirty (30) continuous days operation at estimated energy production levels, with 100% system availability
  - Reference IEC 62446 for PV commissioning standards
  - Reference [EPRI's Energy Storage Commissioning Guide 2016](#)
  - Meet all utility requirements



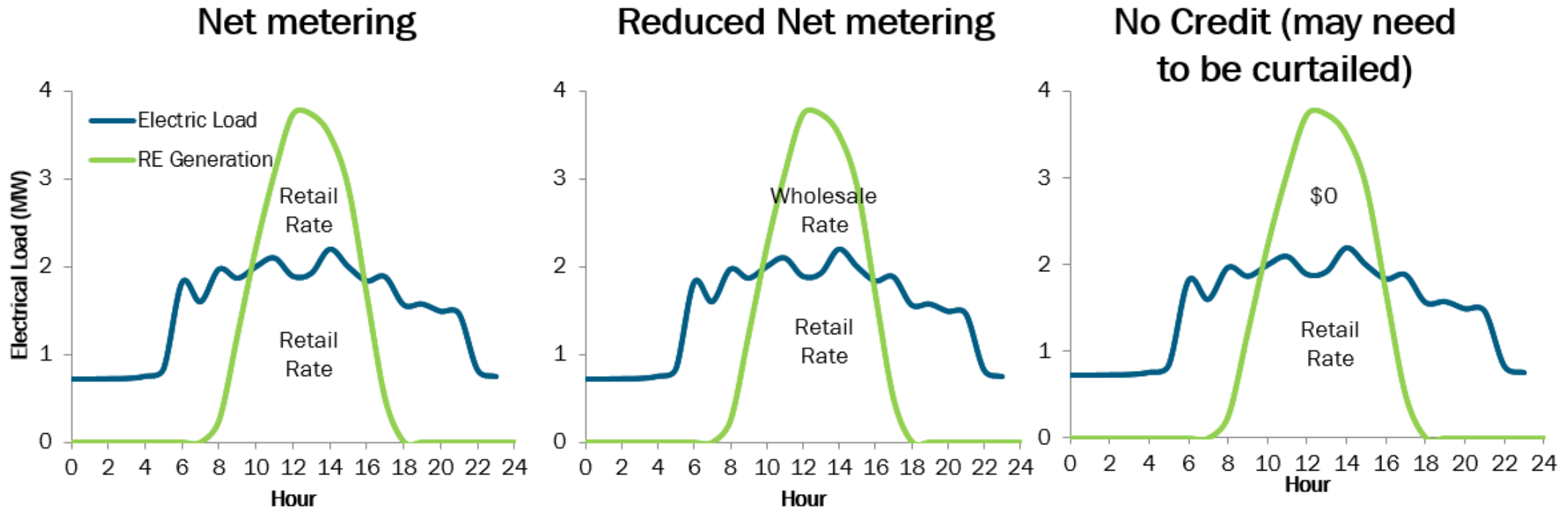
# Net Metering



# Net Metering

*Net metering is a billing arrangement in which the utility credits a customer for excess electricity from an onsite DE project that is fed onto the utility grid.*

- **What is your site load compared to estimated DE project generation?**



# Net Metering: Questions to Ask Your Utility

- Does utility offer net metering or other similar policies (such as feed-in tariffs or virtual net metering)?
- Will net metering requirements be included in the ICA or as a separate agreement?
- What is the maximum allowable project type/size?
  - How is project size measured (DC or AC; based on inverter size)?
- What are the metering requirements and who will pay for the meter?
- What is the value of exported electricity? How is net excess generation treated?
  - At the end of the month/year
- Who owns the project RECs?

# Utility Coordination: Other Topics

- ✓ Available incentives, application process, other requirements
- ✓ Understand rate structure so that DE project cost effectiveness can be accurately evaluated: demand charge, time-of-use rates, seasonal rates, etc.
- ✓ Also discuss with utility:
  - ✓ Any expected tariff change due to reduced energy import from utility (the site load does not change)
  - ✓ Any standby, departing load or other applicable charges?

# Resources



# Key Interconnection Resources

- Your Utility's Website
- [DSIRE](#)
- **Interconnection Checklist** →
- [Overview of DER Interconnection](#)
- [Review of Interconnection Practices and Costs in the Western States](#)

## Distributed Energy Interconnection Checklist

### Tasks for Federal Site Managers and Questions to Ask Their Utility

This interconnection checklist provides federal agencies with a series of tasks and questions to ask their utility, broken out by each interconnection process step. These checklist items are applicable to most types and sizes of distributed energy (DE) projects (regardless of implementation method), but this is not a comprehensive list - additional tasks may be required for a complicated project. Some utilities may require additional steps to complete their interconnection review. Consult your utility early and often and determine the responsible party for each task to ensure that all DE interconnection review steps are met. Many of the items below are often the responsibility of the contractor implementing the DE project.

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#### ▶ Project Planning, Design, and Engineering

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#### ▶ Interconnection Application and Study Process

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#### ▶ Interconnection Agreement (ICA)

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#### ▶ Net Metering, Rate Impacts, and Incentives

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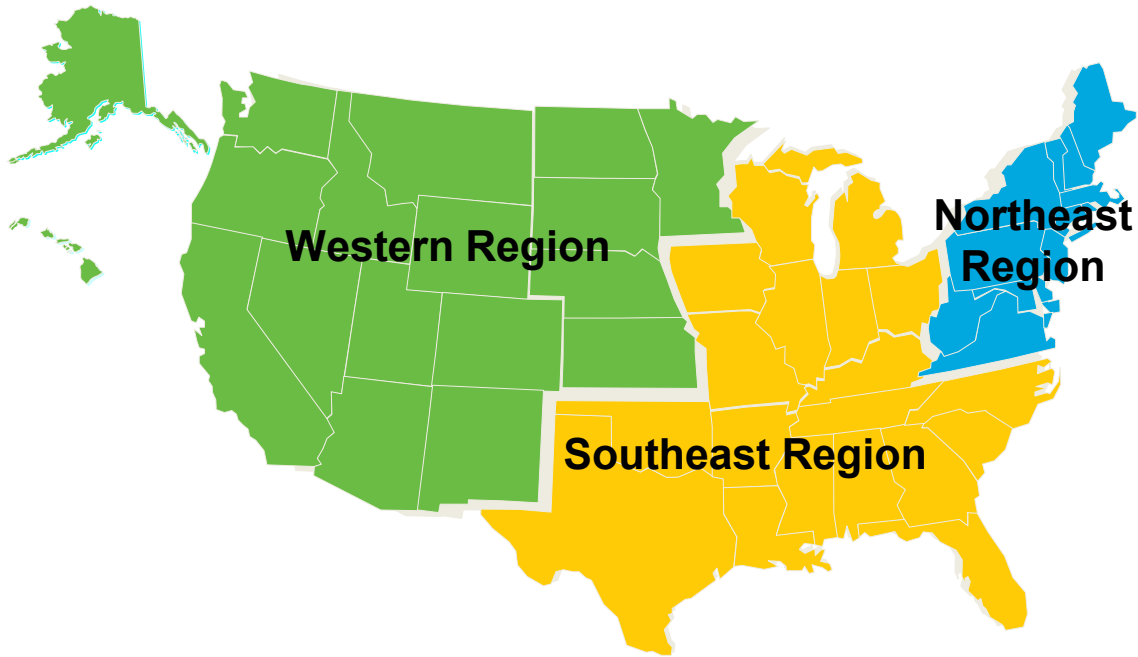
#### Commissioning, System Acceptance Testing, and Permission to Operate (PTO)

- Clarify the agency's and DE project contractor's roles and responsibilities in obtaining PTO.

Clarify whether the agency or DE project contractor will submit documentation to obtain written PTO, if required. Establish a schedule for when documents must be provided to the utility and designate an agency or contractor individual to follow-up periodically with the utility to keep the PTO process moving.

- ▶  Confirm technical and administrative requirements early in the design process for the utility to issue PTO.
- ▶  Obtain initial utility approval to test the system prior to commissioning/system acceptance testing and obtain written utility PTO before commencing commercial operations.
- ▶  Schedule a witness test as early as possible, if applicable.

# Contact Information



## Federal Project Executives (FPEs)

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# PV Performance Webinar Series



Webinar recordings will be posted to WBDG

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CONNECTING THE FUTURE



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- Request help with your project today!
- Fill out a quick and easy application through the FEMP portal

Submit a Request  
[Here](#)

The screenshot shows the top navigation bar with the ENERGY.GOV logo and the Office of Energy Efficiency & Renewable Energy. The main header is the Federal Energy Management Program. Below this is the breadcrumb trail: FEMP Assistance Request Portal » FEMP Technical Assistance for Distributed Energy Projects. The main heading is FEMP Technical Assistance for Distributed Energy Projects. A paragraph explains that users should fill out three form categories: Contact Information, Project Information, and Project Description and Status. A note indicates that asterisks denote required fields. The form fields are: Contact Information (empty), Project Information (Project Name \*, Project Location \*, Project Description and Status \*), and Project Champion and Team Members (empty). A brief instruction to describe the project is provided below the description field.

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FEMP Assistance Request Portal » FEMP Technical Assistance for Distributed Energy Projects

## FEMP Technical Assistance for Distributed Energy Projects

To request technical assistance for federal distributed energy projects, fill out the fields in the three form categories below. A FEMP project specialist will review your request and contact you shortly. [Contact FEMP](#) with questions.

\* Required

**Contact Information**

**Project Information**

Project Name \*

Project Location \*

Project Description and Status \*

Briefly describe the project you are pursuing and the current status of it.

Project Champion and Team Members



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