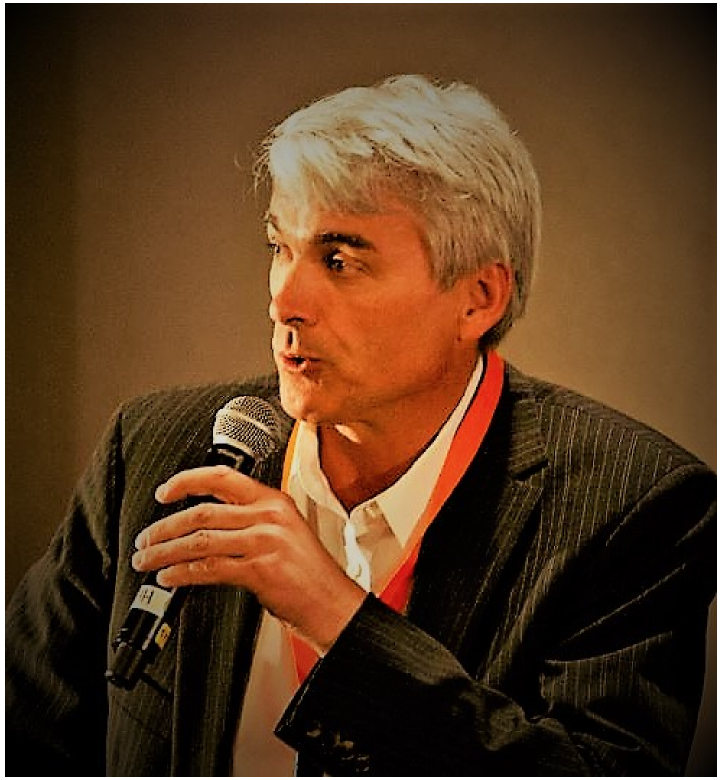
Moving the Mission Forward with Renewable Energy

Track E, Session 13

Presented August 13, 2020, 3:00 – 4:30 PM ET

Moving the Mission Forward with Renewable Energy

Performance Period Considerations



Andy Walker, NREL
andy.walker@nrel.gov

How can photovoltaic (PV) systems contribute to my agency's mission far into the future?

1. Are PV systems performing as expected?
2. How can systems being installed today be expected to perform far into the future?
3. What should I be thinking about in design and construction to ensure PV systems continue to support my facility mission?
4. How will repairs be funded & who will maintain the system?
5. What type of contract works best for PV O&M?

US DOE Federal Energy Management Program support for PV O&M

https://www.energy.gov/eere/femp/optimizing-solar-photovoltaic-performance-longevity

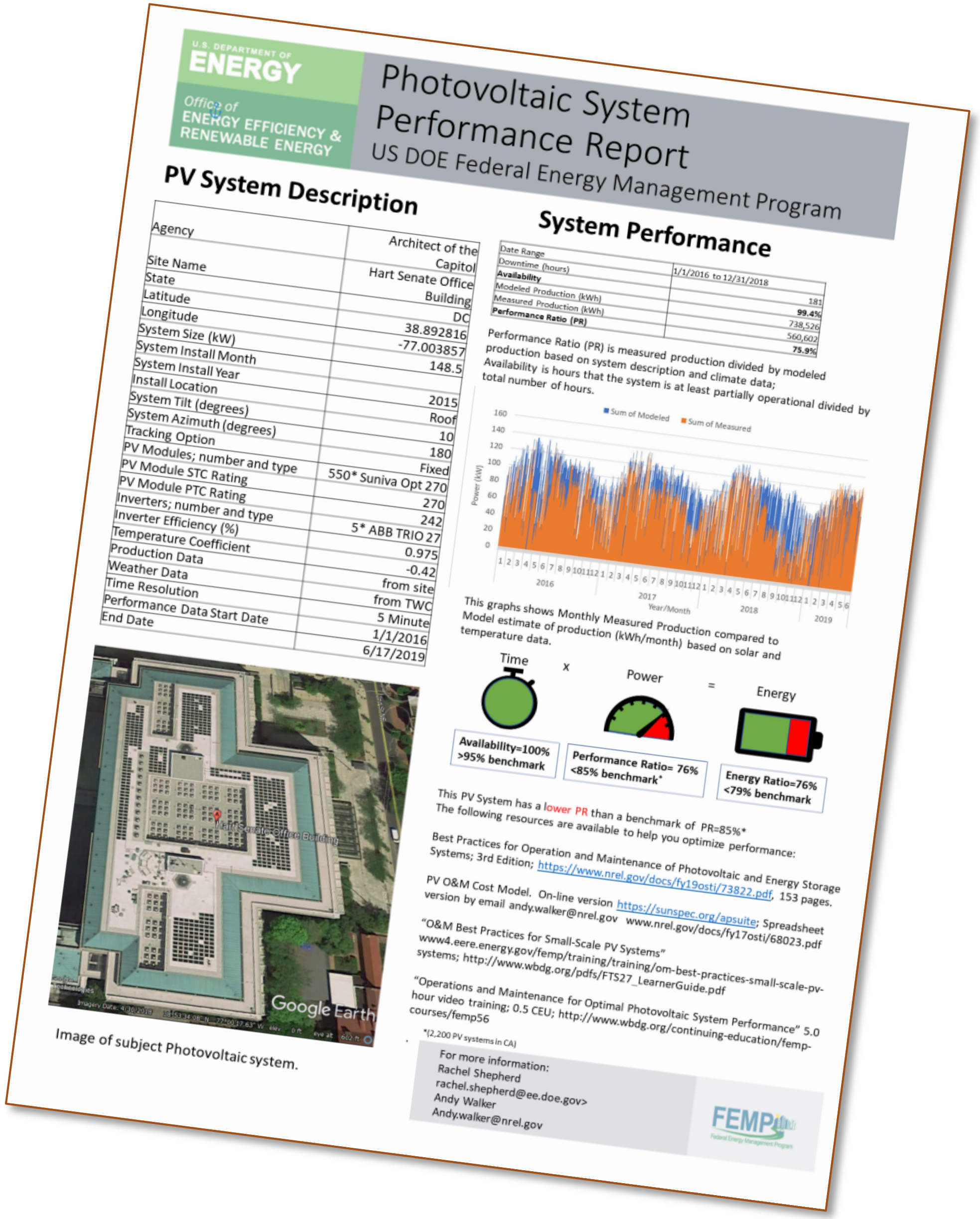
- **Development of REopt Project Screening Tool** https://reopt.nrel.gov/tool
- **FEMP Technical Assistance for Distributed Energy Projects**
  - https://www7.eere.energy.gov/femp/assistance/node/add/application-combined
- **FEMP Photovoltaic System Performance Assessment**
- **FEMP Fact Sheet on PV Systems and Severe Weather** https://www.energy.gov/sites/prod/files/2018/08/f55/pv_severe_weather.pdf
- **FEMP PV O&M Sample Procurement Specs** https://www.energy.gov/sites/prod/files/2020/04/f73/tech-specs.pdf
- **FEMP Trainings**
  - "O&M Best Practices for Small-Scale PV Systems" www4.eere.energy.gov/femp/training/training/om-best-practices-small-scale-pv-systems; http://www.wbdg.org/pdfs/FTS27_LearnerGuide.pdf
  - "Operations and Maintenance for Optimal Photovoltaic System Performance" 5.0 hour video training; 0.5 CEU; http://www.wbdg.org/continuing-education/femp-courses/femp56
- **SETO PV O&M Cost Model** https://www.nrel.gov/docs/fy20osti/74840.pdf
- **SETO Best Practices for Operation and Maintenance of Photovoltaic and Energy Storage Systems; 3rd Edition**; https://www.nrel.gov/docs/fy19osti/73822.pdf

FEMP PV System Performance Assessment

- **Information from Site**
  - System Description
  - Production Data (time series)
- **Information from NREL Analysis**
  - Solar Resource Data
  - Temperature Data
  - Performance Model (SAM https://sam.nrel.gov/)
- **Results:**
  - Availability (% “up-time”)
  - Performance Ratio (measured/modeled production)
  - Energy Ratio

For Sites - Identify performance potential and provide resources

For FEMP - Inform future feasibility studies; good discussions with site staff



U.S. DEPARTMENT OF ENERGY
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Photovoltaic System Performance Report

US DOE Federal Energy Management Program

PV System Description

Agency	Architect of the Capitol
Site Name	Hart Senate Office Building
State	DC
Latitude	38.892816
Longitude	-77.003857
System Size (kW)	148.5
System Install Month	
System Install Year	2015
Install Location	Roof
System Tilt (degrees)	10
System Azimuth (degrees)	180
Tracking Option	Fixed
PV Modules; number and type	550* Suniva Opt 270
PV Module STC Rating	270
PV Module PTC Rating	242
Inverters; number and type	5* ABB TRIO 27
Inverter Efficiency (%)	0.975
Temperature Coefficient	-0.42
Production Data	from site
Weather Data	from TWC
Time Resolution	5 Minute
Performance Data Start Date	1/1/2016
End Date	6/17/2019

Image of subject Photovoltaic system.

System Performance

Date Range	1/1/2016 to 12/31/2018
Downtime (hours)	181
Availability	**99.4%**
Modeled Production (kWh)	738,526
Measured Production (kWh)	560,602
Performance Ratio (PR)	**75.9%**

Performance Ratio (PR) is measured production divided by modeled production based on system description and climate data; Availability is hours that the system is at least partially operational divided by total number of hours.

This graphs shows Monthly Measured Production compared to Model estimate of production (kWh/month) based on solar and temperature data.

Time x Power = Energy

Availability=100% >95% benchmark

Performance Ratio= 76% <85% benchmark*

Energy Ratio=76% <79% benchmark

This PV System has a lower PR than a benchmark of PR=85%*
The following resources are available to help you optimize performance:

Best Practices for Operation and Maintenance of Photovoltaic and Energy Storage Systems; 3rd Edition; https://www.nrel.gov/docs/fy19osti/73822.pdf, 153 pages.

PV O&M Cost Model. On-line version https://sunspec.org/apsuite; Spreadsheet version by email andy.walker@nrel.gov www.nrel.gov/docs/fy17osti/68023.pdf

“O&M Best Practices for Small-Scale PV Systems” www4.eere.energy.gov/femp/training/training/om-best-practices-small-scale-pv-systems; http://www.wbdg.org/pdfs/FTS27_LearnerGuide.pdf

“Operations and Maintenance for Optimal Photovoltaic System Performance” 5.0 hour video training; 0.5 CEU; http://www.wbdg.org/continuing-education/femp-courses/femp56

*(2,200 PV systems in CA)

For more information:
Rachel Shepherd
rachel.shepherd@ee.doe.gov>
Andy Walker
Andy.walker@nrel.gov

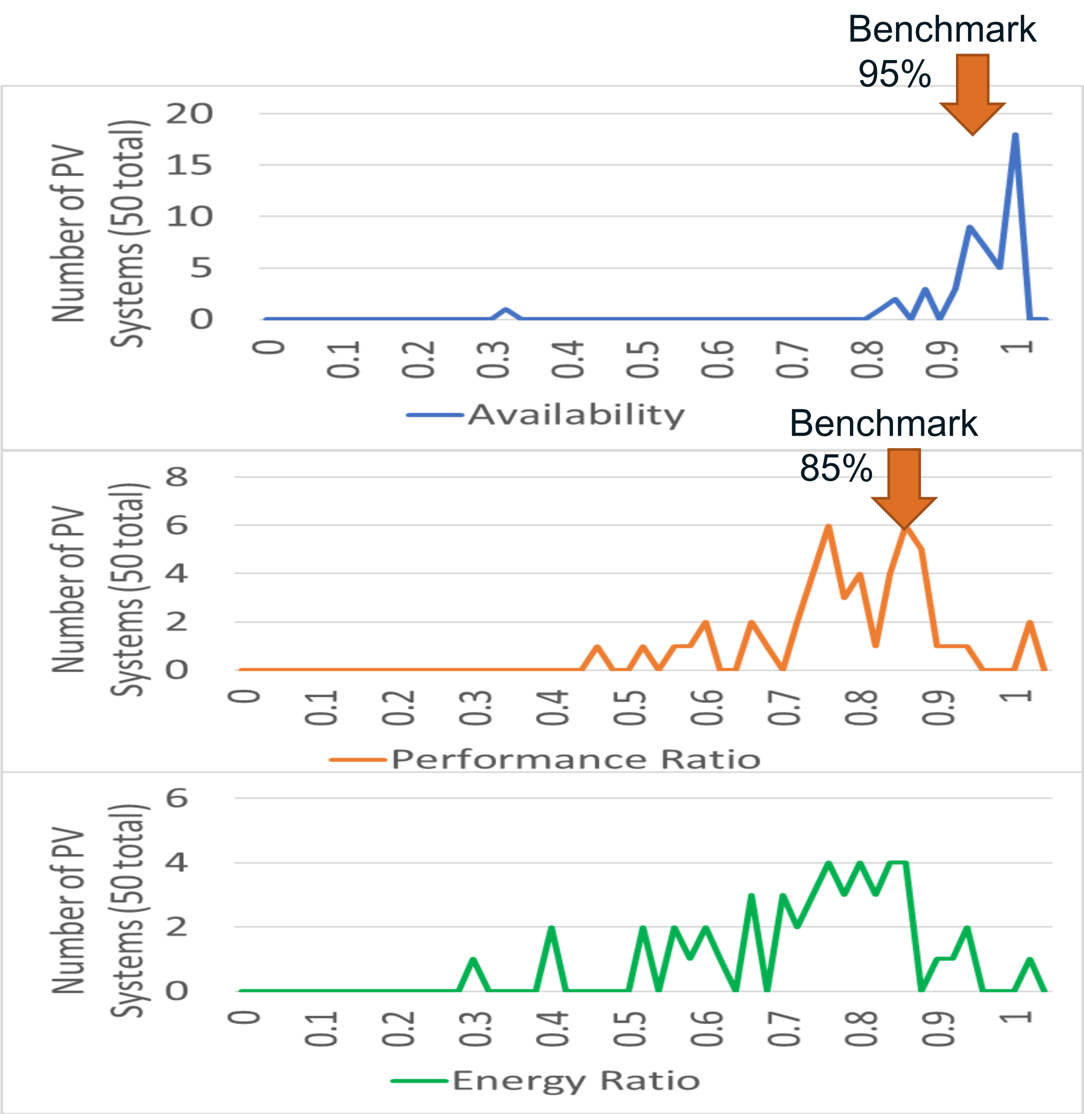
FEMP Federal Energy Management Program

FEMP PV System Performance Assessment

- **Approximately 2,900 Federal PV Systems**
  - Government-Owned; ESPC Contracts; PPAs
- **Sample Size: 75 systems for 5% margin of error**
- **Progress to date: 50 PV systems with 11 Agencies**
- **Sites volunteer: not entirely random sample**

Key Performance Indicator	Availability	Performance Ratio	Energy Ratio
Average	0.94	0.78	0.73
Benchmark	0.95	0.85	
Std Deviation	0.10	0.12	0.15

Results for Fleet (50 PV Systems)

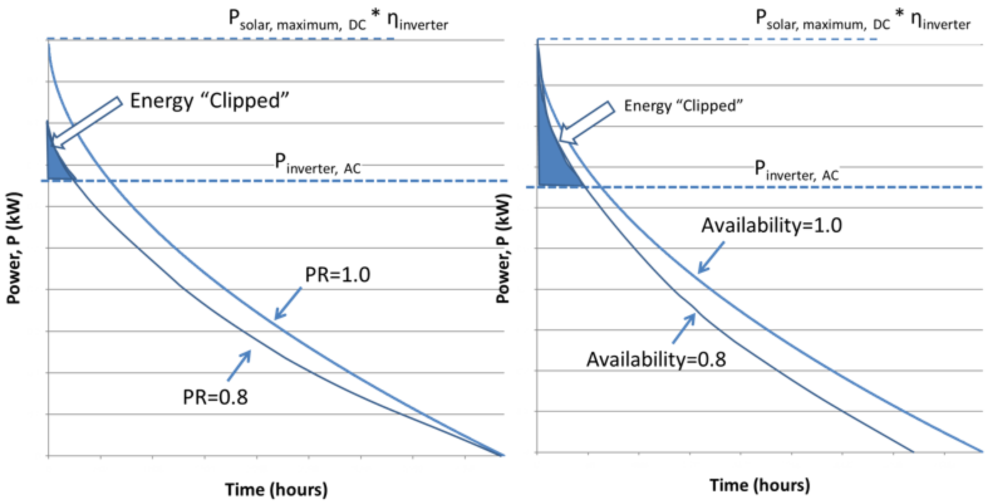


Results indicate that production could be increased around 7% with optimal O&M

Consider PR<1 and A<1 in Design and Life Cycle Cost Analysis

$$P = PR\ P_{rated}\left(1-\left(t/(AT)\right)^{n}\right)$$

Where P=Power output (kW)
Prated=nameplate Power Rating (kW)
t=hours through the year
T=total number of hours in the year
n=CF/(1-CF) where CF=annual capacity Factor



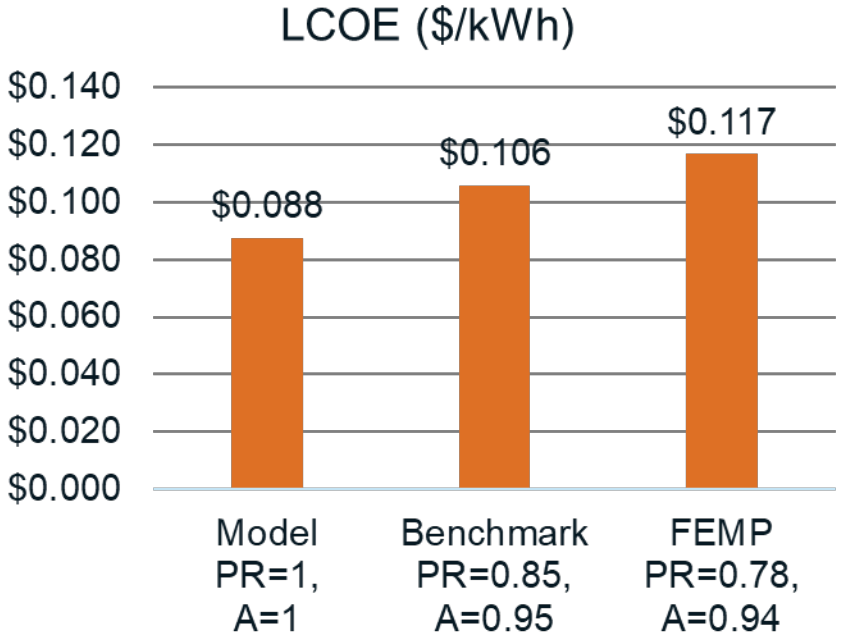
(a) Effect of Performance Ratio (b) Effect of Availability

Walker, Andy, Jal Desai, and Ammar Qusaibaty. 2020. "Life-Cycle Cost and Optimization of PV Systems Based on Power Duration Curve with Variable Performance Ratio and Availability". Golden, CO: National Renewable Energy Laboratory. NREL/TP-5C00-73850.https://www.nrel.gov/docs/fy20osti/73850.pdf.

Inverter Sizing:
Optimal AC/DC Ratio as a Function of Varying PR

PR	1	0.9	0.8	0.7
Optimal DC/AC Ratio	1.30	1.45	1.63	1.86

Levelized Cost of Energy with varying PR and A



From 100 kW PV system described in the reference

O&M Plan Details

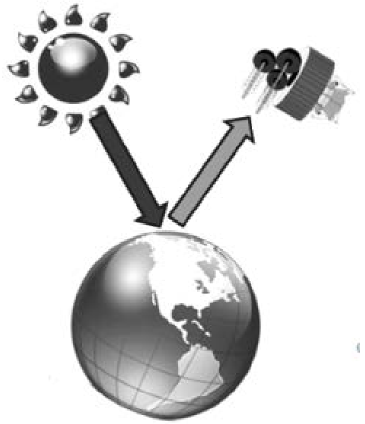
- **Administration**
  - Budget, accounting
  - Billing, Hiring subcontractors
  - Enforcement of warranties
  - Management of budget and reserves
- **Operations**
  - Controls
  - Utility interaction
- **Monitoring**
  - Metering for revenue
  - Alarms
  - Diagnostics
- **Preventive Maintenance**
  - Scheduled and planned
  - Expenditure is budgeted
- **Corrective Maintenance (repair)**
  - Unplanned or condition-based
  - Possible expenditure is kept in reserve or line-of-credit
  - Must be timely and effective

PV O&M Manual

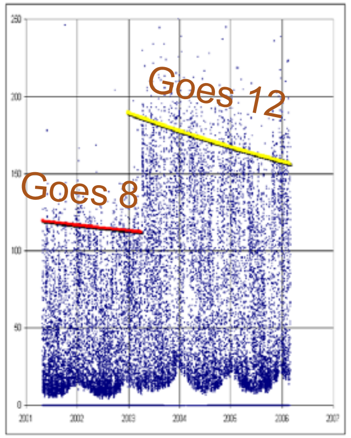
Table of Contents

1. Contact information
2. System descriptions
3. Performance estimates and shade studies
4. Training plans
5. Chronological O&M log
6. Operational indicators, error messages
7. Manufacturer's preventive maintenance
8. Responding to alerts and re-acceptance
9. Troubleshooting guide
10. Criteria for repair or replacement
11. Equipment lists
12. Inventory of spare parts
13. Operator manuals
14. Warranties
15. Commissioning, inspection, work order, repair reports
16. Contracts
17. O&M budget

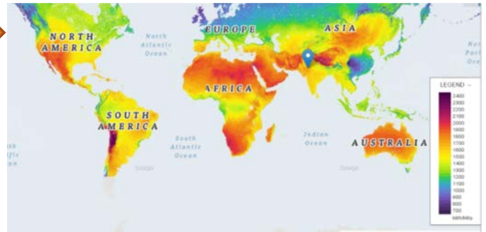
Sophisticated Software, Comms and Data Science



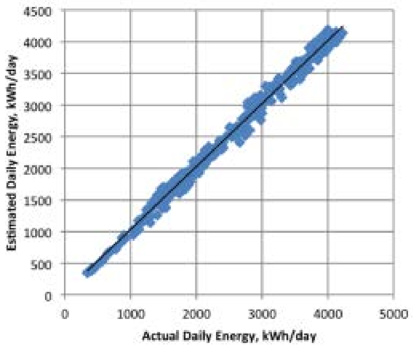
Satellite Data



Models of incident solar radiation



Resource Estimates



Near-real-time Performance Evaluation

Production Meter

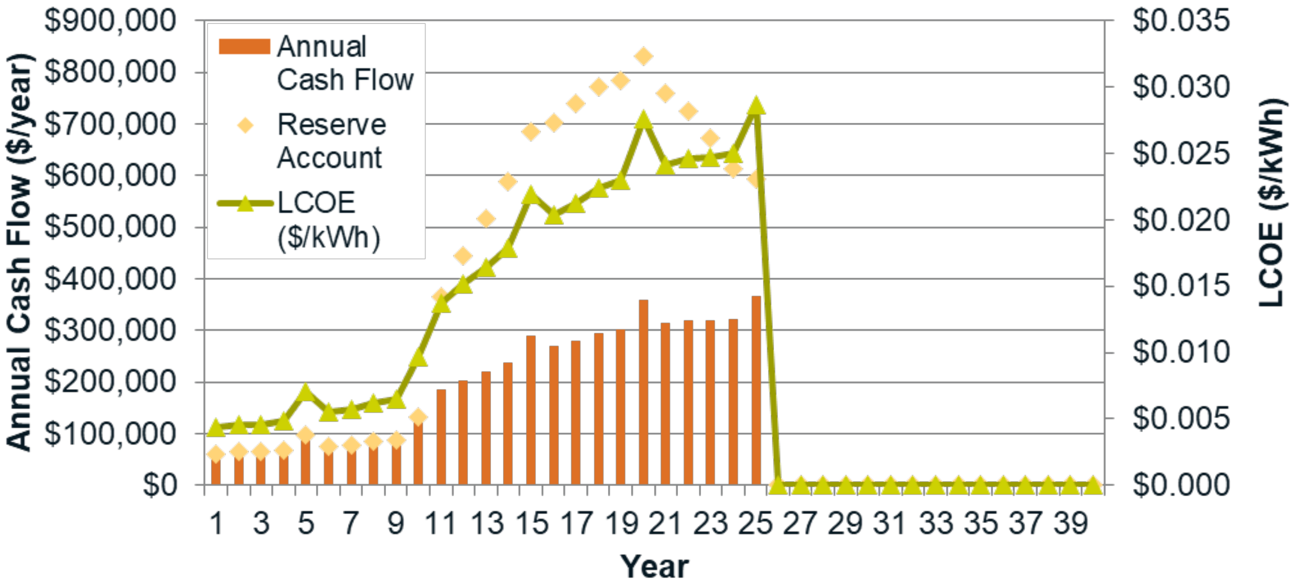
Telemetry
Utility Monitoring and Control
Grid and Microgrid Operations
Control Center

Sophisticated Software

- Info Dashboard
- Production Forecasts
- Utility Communications
- Website Subscription
- Performance Assessment
- Machine Learning Diagnostics
- AI Preventative Scheduling
- Condition-based maintenance
- Trends and serial problems
- Optimum Cleaning
- Etc etc etc

Budgeting for Optimal PV O&M

- Recognize balance between cost of O&M and cost of lost production
- 2020 PV O&M Cost Benchmark
  - $28.94/kWdc/yr (residential)
  - $18.55/kWdc/yr (commercial; roof mount)
  - $18.71/kWdc/yr (commercial; ground mount)
  - $16.32/kWdc/yr (utility-scale, fixed-tilt)
  - $17.46/kWdc/yr (utility-scale, single-axis tracking)
  - Total including management, land lease, security, etc
- PV O&M Costs depend on:
  - System Type (string inverter, tracking, etc)
  - Installation (roof, ground)
  - Market (utility, DER)
  - Site (remote, urban)
  - Environmental conditions
    - Soiling, hail, etc



- Costs increase over time:
  - Warranties expire
  - Inflation raises parts and labor prices
  - The Weibull failure distributions show high failure rates in later years
  - On a per kWh basis, performance had degraded (1%/year)

SETO PV O&M Cost Model - https://www.nrel.gov/docs/fy20osti/74840.pdf

PV O&M Depends on System Type

Photos by Andy Walker

Roof mounts
- attached or ballasted

Ground mounts
- tracking or fixed

Inverter type
- Central
- String Inverter
- Micro-inverter

Energy Exchange
U.S. Department of Energy

PV O&M Depends on Site Conditions

Photos by Andy Walker

Remote vs. accessible

Sources of Soiling:

- agriculture
- diesel soot
- birds, etc

Snow and ice problems

Windy

Extreme Heat

Site Security (theft, vandalism)

Severe Weather

Severe Weather Events

Hurricanes
- Eastern Seaboard, FL, TX, NC, SC, Caribbean

Tornadoes
- TX, OK, KS, NE, CO, SD and Southeast

Earthquakes
- AK, CA, NV, HI, WA, WY, ID, MT, others

Hail
- CO, WY

Flooding
- FL, LA

Wildfires
- Western States

- **Prepare -** inspect for defects, secure any loose items, enhance stormwater runoff
- **Recover -** render site safe from physical and electrical hazards, estimate, budget and contract for repairs
- **Improve -** don't just "bounce back", rather "bounce forward" to an improved system

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Solar Photovoltaic Systems in Severe Weather: Hurricanes

Torqued and Locked Fasteners

Module Clamping Fasteners

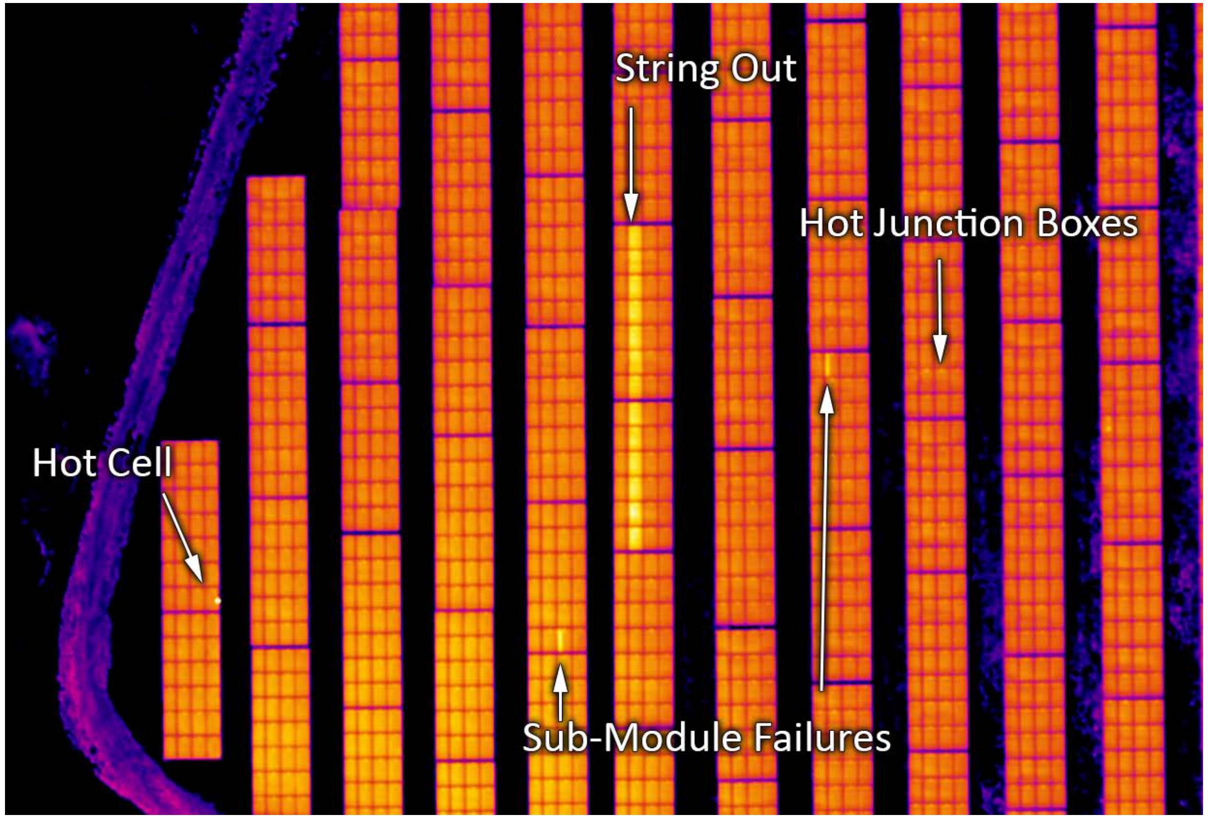
Module Selection

Pre- and Post-Storm Recovery

FEMP Severe Weather Fact Sheet

https://www.energy.gov/sites/prod/files/2018/08/f55/pv_severe_weather.pdf

Innovations to reduce the cost and improve the effectiveness of O&M



Infrared camera can spot loose connections in fuseboxes and switchgear, and can spot failed modules in the PV Array

- Remote web-based monitoring platforms
- Data science to understand and address the source of problems
- Infrared and other advanced inspection techniques
- New products and services to reduce O&M costs (eg dirt-repelling coatings)
- Innovations in sourcing O&M services and supplies (aggregated procurement, sharing of resources)

Energy Exchange

In-house, outsourced, or performance contract for PV O&M

- Federal Challenges
  - Large number of small systems
  - Geographically separated and/or remote
  - Little expertise and no inventory of spare parts
  - Inadequate maintenance budgets
  - No reserve account for timely repairs
  - Low priority since grid is providing power
- Result: low performance & long down-times for repairs

	Directly Funded	Privately Financed	
Questions to Consider	Government Owned	Government Owned	Privately Owned
Is the government responsible for operation & maintenance (O&M), equipment repair & replacement?	Yes[1]	Yes[1]	No

[1] Unless specified otherwise

Of the 2,900 Federal PV systems, only 11% from ESPC, UESC or PPA where O&M is covered contractually

- ESPC authority allows for improvements in O&M efficiencies or retrofit activities (42 U.S.C. § 8287 and 10 CFR § 436.31)
- ESPC could provide financing of expensive repairs or component replacement and then ongoing O&M
- ESPC Payments < savings from ongoing O&M, repairs, increased utility cost savings
- Performance based O&M recommended- pay <= $0.01/kWh delivered

Key Takeaways

1) **Even with no moving parts, PV systems do require preventative maintenance and repairs in order to ensure that they contribute to an agency's mission over a very long performance period (30 years).**
2) **Performance Ratio (PR) is the ratio of actual power delivery of a PV system divided by delivery as predicted by a computer model, and the PR=0.78 reported for 50 Federal PV systems is less than an emerging benchmark of PR=0.85.**
   a) Increase monitoring and awareness of system performance
   b) Consider outsourcing of O&M and Performance Contract (ESPC ESA)
   c) Consider the possibility of under-performance and down-time in feasibility studies
3) **O&M costs depend a lot on the type of system components and environmental conditions including severe weather**
4) **O&M costs increase over time as warranties expire, aging equipment fails, and inflation increases prices.**
5) **Stay abreast of new developments to reduce O&M cost**
   1) Remote web-based monitoring platforms
   2) Infrared and other advanced inspection techniques
   3) New products and services to reduce O&M costs (eg dirt-repelling coatings)
   4) Innovations in sourcing O&M services and supplies (aggregated procurement, sharing of resources)

Andy Walker
andy.walker@nrel.gov

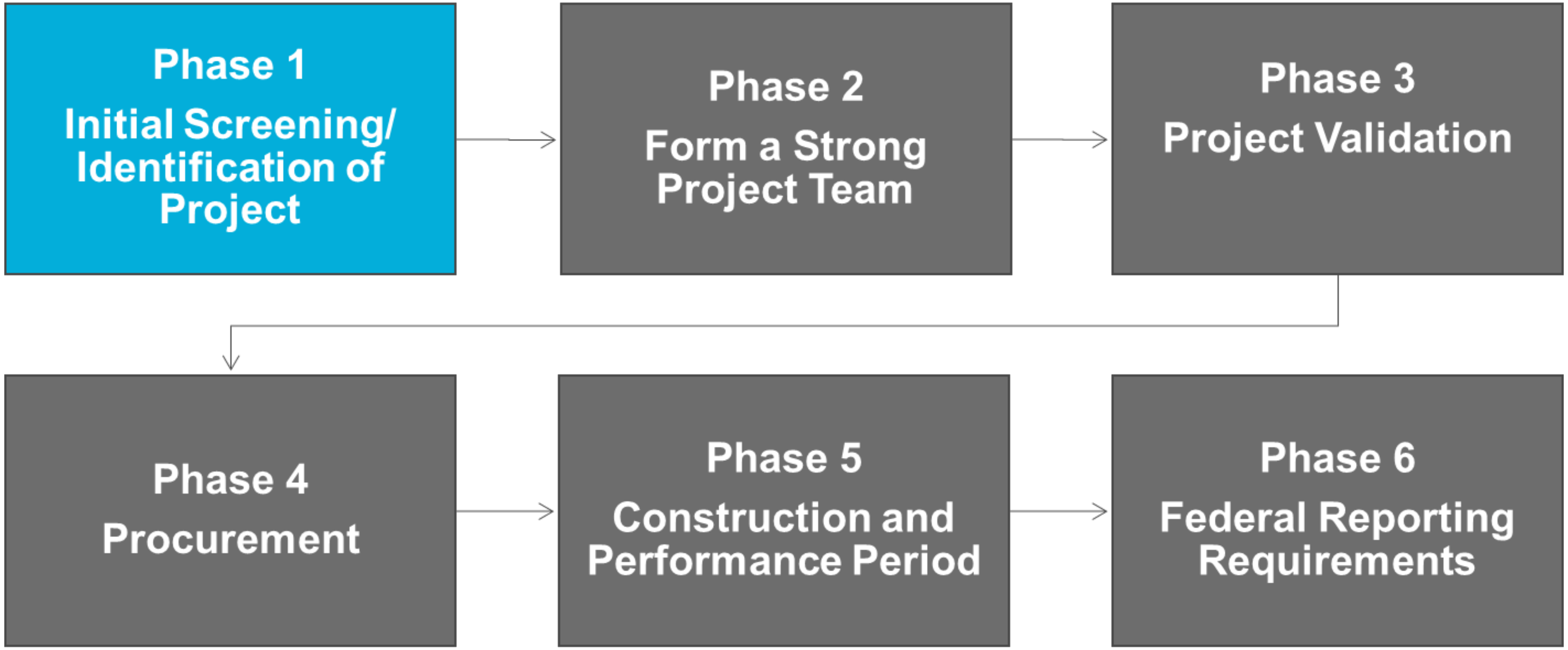
Moving the Mission Forward with Renewable Energy

Screening for Distributed Energy Projects

Emma Elgqvist, NREL
emma.elgqvist@nrel.gov

On-Site Project Implementation Process

- Distributed energy resources (DERs) include renewable energy (RE) technologies, storage, and combined heat and power (CHP)
- Identifying a project is the first step in the implementation process, and can be done through a techno-economic screening



https://www.energy.gov/eere/femp/process-planning-and-implementing-federal-distributed-energy-projects

RE Resource | **Technology Costs & Configuration** | **Site Goal & Use Case** | **Utility Cost & Consumption** | **Financial Parameters**

- Many factors affect whether distributed energy technologies can provide cost savings and resilience to your site
- With increasingly integrated and complex systems, back-of-the envelope calculations are no longer sufficient to determine distributed energy project potential

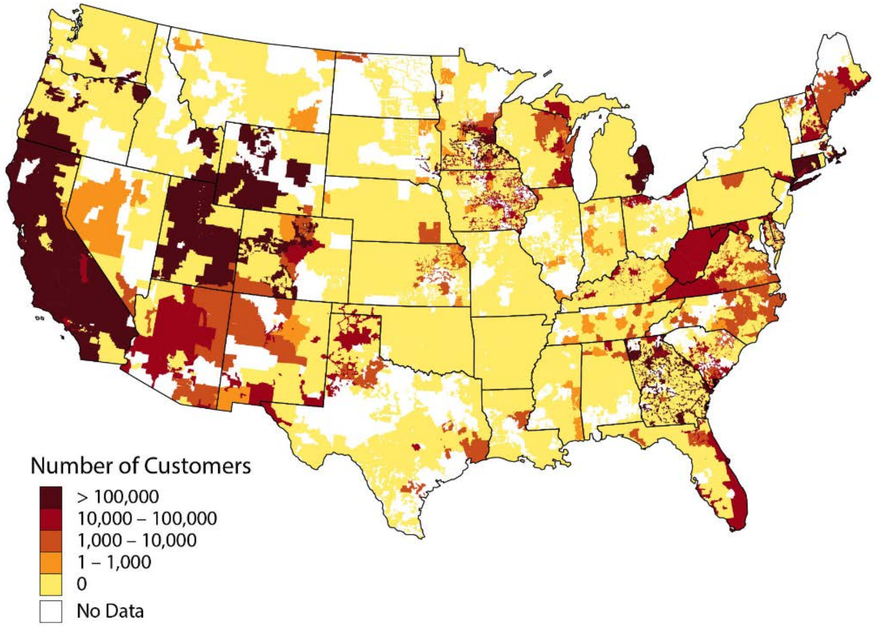
Data Needed for a Distributed Energy Screening

- Some data and inputs needed for a distributed energy screening have remained static
  - Location of sites
  - Wind and solar resources
- Others have changed or become more important over the past few years
  - Timing of electricity consumption (not just monthly or annual values)
  - Detailed utility rate structure (not just blended $/kWh)
  - Goals or use cases
- These inputs are all needed for a screening

Utility Rate Structures

Typical Electricity Bill Components

Bill Component	How It's Billed	How to Lower this Charge
Energy Charges	• Billed based on amount of electricity (kWh) consumed • Cost can vary by time of use [TOU] and by season	• Reduce overall consumption • Shift usage from high TOU periods to low TOU period
Demand Charges	• Billed based on maximum demand (kW) during certain period, typically maximum demand each month • Cost can vary by time of use and by season	• Reduce usage during peak demand period
Fixed Charges	• Fixed cost billed monthly • Determined by rate schedule, not consumption	• Not typical



Number of commercial customers who can subscribe to tariffs with demand charges over $15/kW

Identifying Potential Markets for Behind-the-Meter Battery Energy Storage: A Survey of U.S. Demand Charges
https://www.nrel.gov/docs/fy17osti/68963.pdf

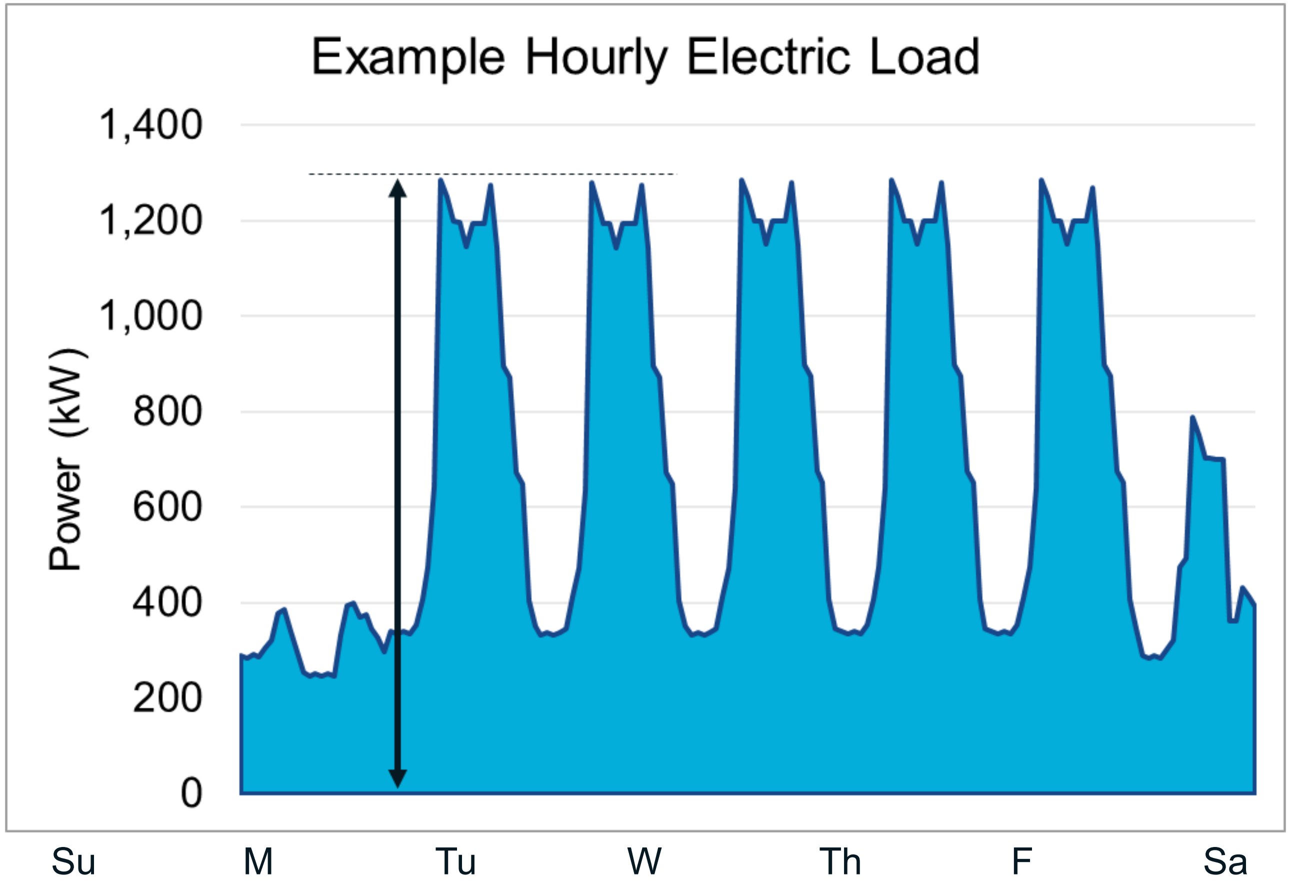
https://www.energy.gov/eere/femp/evaluating-your-utility-rate-options

Electricity Bill Components and Concepts

Term	Definition
Bundled rate	Both the electric supply (kWh consumed) and the electric delivery (transmission and distribution) are provided by the same provider.
Unbundled rate	The electric supply (kWh consumed) and the electric delivery (transmission and distribution) are provided by different providers. These can be billed separately (site receives two separate bills) or together (site receives one bill that includes both charges).
Time-of-use demand charges	Demand charge based on the site's maximum demand only during specified hours. Can have multiple time-of-use periods (for example, a rate may have both an on-peak demand charge during the middle of the day, and a separate shoulder or part-peak demand charge. Can vary by season (for example, summer on-peak demand charges may be higher than winter on-peak demand charges, or winter on-peak demand charges may be non-existent).
Non-coincident demand charges	Demand charge based on the highest monthly demand, regardless of time of day. Can be instead of or in addition to on-peak demand charges.
Demand charge look-back (ratchet)	Methodology of calculating demand charge by considering both the current month and previous months' peaks. Often calculated as the maximum of current month's peak demand, and X% of previous 11 months' peak demand. Applies to both time-of-use and non-coincident demand charges. This means that occasional high spikes in electricity consumption can set the demand charge for the rest of the year.
System-peak demand charge	Based on site's contribution during utility system peak. Examples include PJM's 5CP charge (applied to average load usage during PJM's 5 highest non-coincident peaks) and ERCOT's 4CP charge (applied to average load during system coincidental peaks occurring in June, July, August, and September).
Standby and departing load charges	Charges based on site electric load, not utility purchases, that cannot be offset by distributed energy projects.
Minimum import requirement	The minimum amount of electricity that a site must purchase from the utility provider at all times. Can be based on size of distributed generation assets.

Electricity Usage

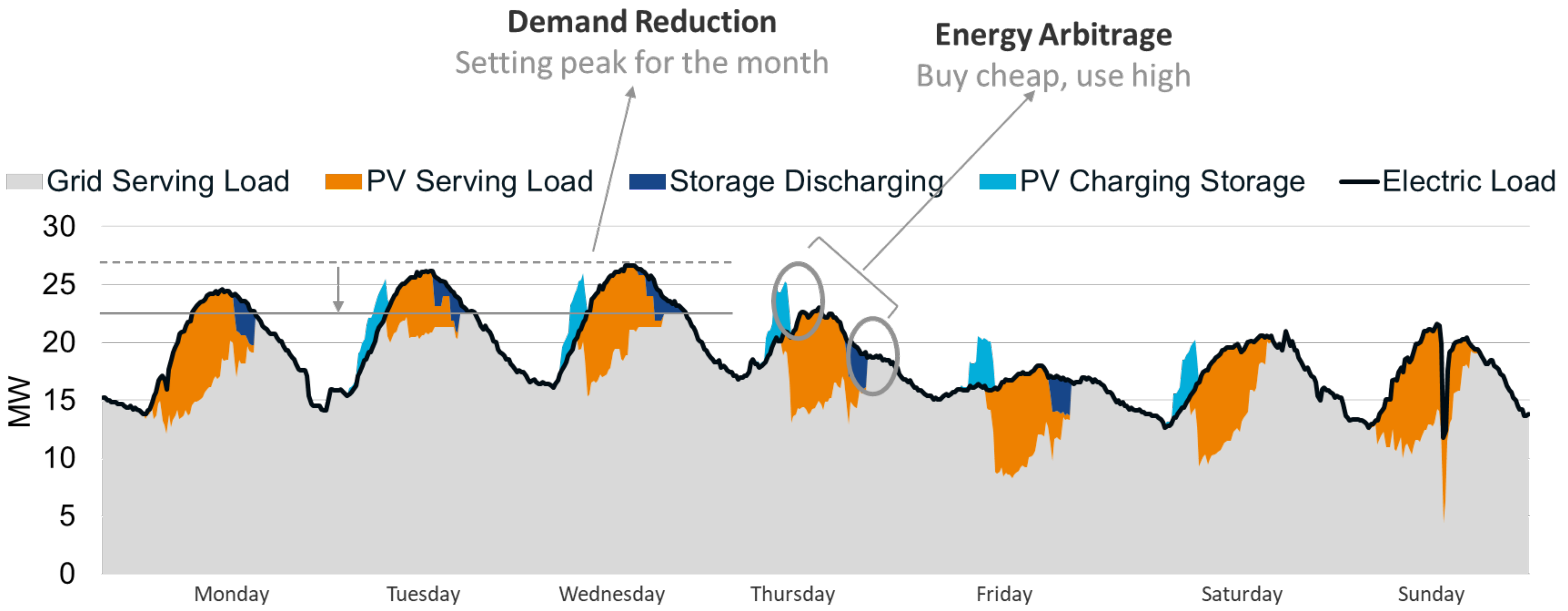
- A site's electric load is characterized by the amount of electricity consumed (load magnitude) and when that electricity is consumed (load shape)
- Advanced meters typically track a site's electricity consumption on an hourly or 15-minute basis; this is referred to as interval data
- Common electricity use characteristics include total electricity consumption (light blue shaded area) and maximum electricity consumption at a given time (blue line)



Coupling Storage with Renewables

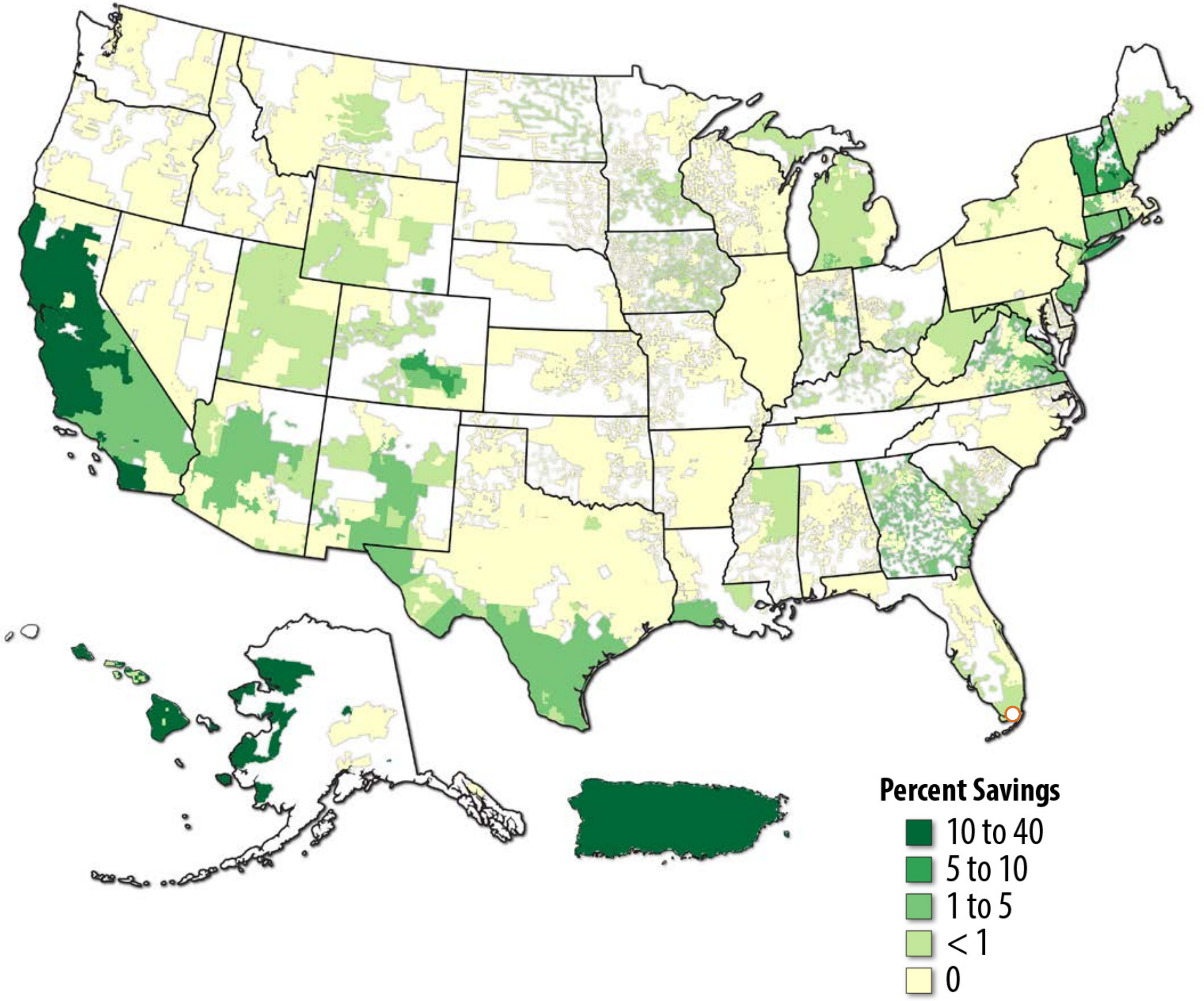
Coupling Storage with Renewables

- Lithium ion battery storage costs have decreased recently so on-site, behind-the-meter (BTM) storage can be cost effective
- Value streams include demand charge reduction, energy arbitrage, and demand response participation



Where Storage Might Make Sense when Coupled with PV

- These maps show regions (shaded in green) in the US where battery storage and PV could provide enough savings to recuperate capital costs
- Darker green shade indicates greater savings
- Analysis uses simulated annual loads for office building and the most common electricity rate in the utility (along with capital costs, solar resource etc.)

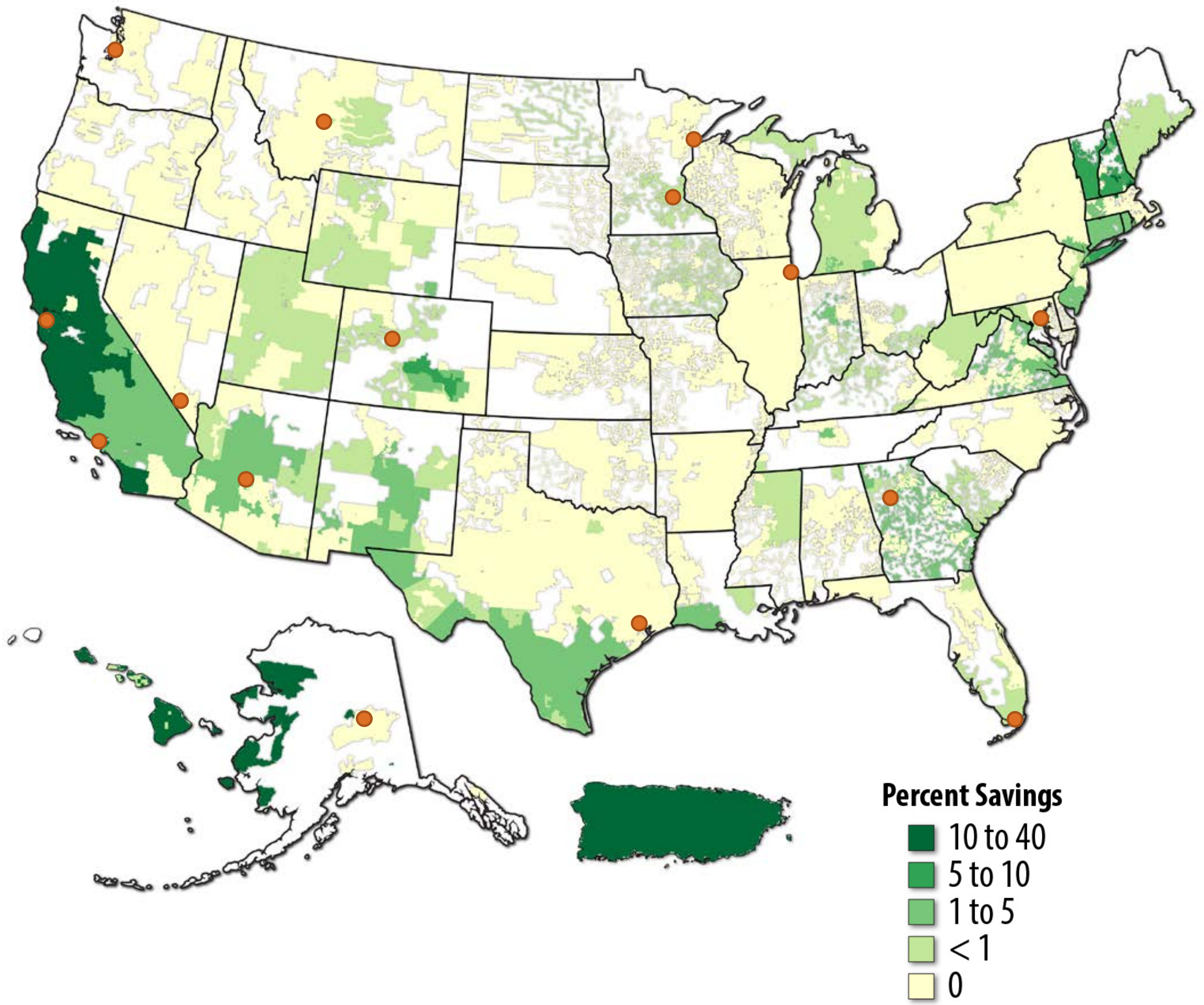


Where Storage Might Make Sense when Coupled with PV for an Agency

- Maps will be made publicly available through open carto platform
- One use of the maps may be for agencies to overlay locations of sites, to prioritize sites
- Example of this using ASHRAE representative climate zones shown on the right

ASHRAE climate zones representative cities

- Miami
- Houston
- Phoenix
- Atlanta
- Los Angeles
- Las Vegas
- San Francisco
- Baltimore
- Albuquerque
- Seattle
- Chicago
- Boulder
- Minneapolis
- Helena
- Duluth
- Fairbanks



Use Cases for Distributed Energy

Different Use Cases for Distributed Energy (PV + Storage)

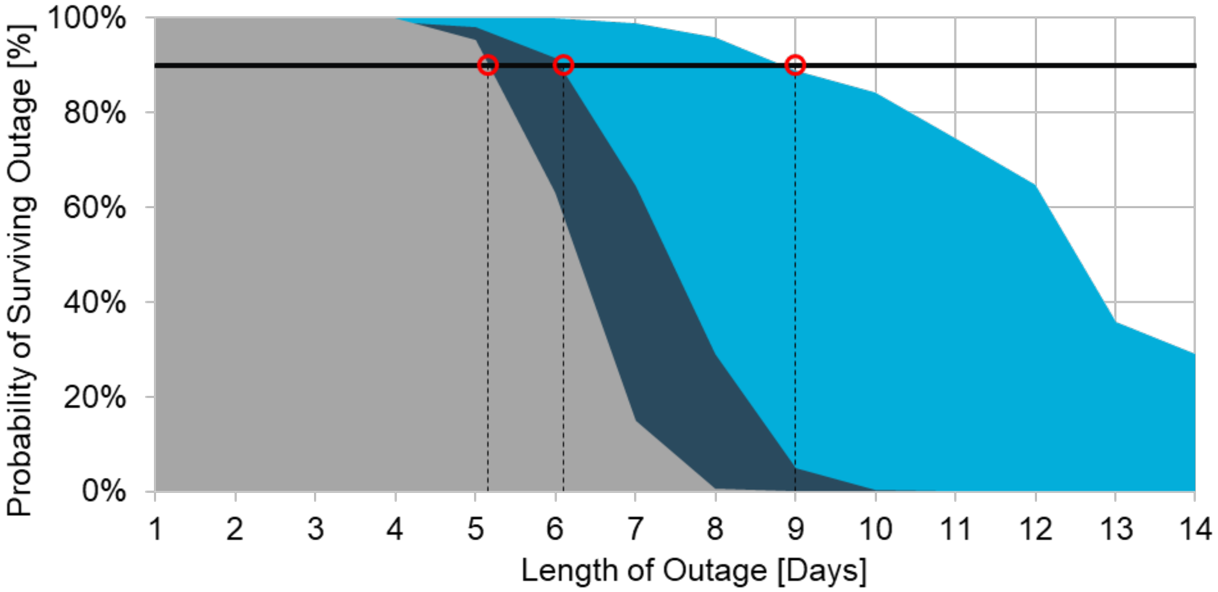
	Off Grid PV + Storage	Grid Connected PV + Storage	Islandable PV + Storage	PV + storage for Large-scale Power Generation
Purpose	Providing continuous power in lieu of utility	Lowering cost of utility purchases	Lowering cost of utility purchases **and** Providing power during grid outage	Large-scale generation for off-site sale
Why/Where it works	• Remote sites with high fuel costs • Low grid reliability	• High demand charges • TOU rates • Ancillary service markets	• High demand charges • TOU rates • Ancillary service markets • Resilience requirements	• Deregulated market • Interested offtaker • Large land-availability
Primary Power Supply	DERs (typically including generators)	Grid + DERs	Grid + DERs	Grid only
Back-up	None	None	DERs	Typically none but could be possible

https://www.energy.gov/eere/femp/distributed-energy-technologies-resilience

Islandable PV + Storage

- DERs can provide revenue streams and savings while grid connected
- Savings may allow for the incorporation of additional microgrid components
- When integrated into a microgrid, DERs can also increase survival time during a grid outage when fuel supplies are limited
- This analysis considers tradeoffs between length of grid outage sustained and lifecycle cost of various technology combinations

	Generator	Solar PV	Storage	Lifecycle Cost	Outage
1. Base case	2.5 MW	-	-	$20 million	5 days
2. Lowest cost	2.5 MW	625 kW	175 kWh	$19.5 million	6 days
3. Proposed system	2.5 MW	2 MW	500 kWh	$20.1 million	9 days

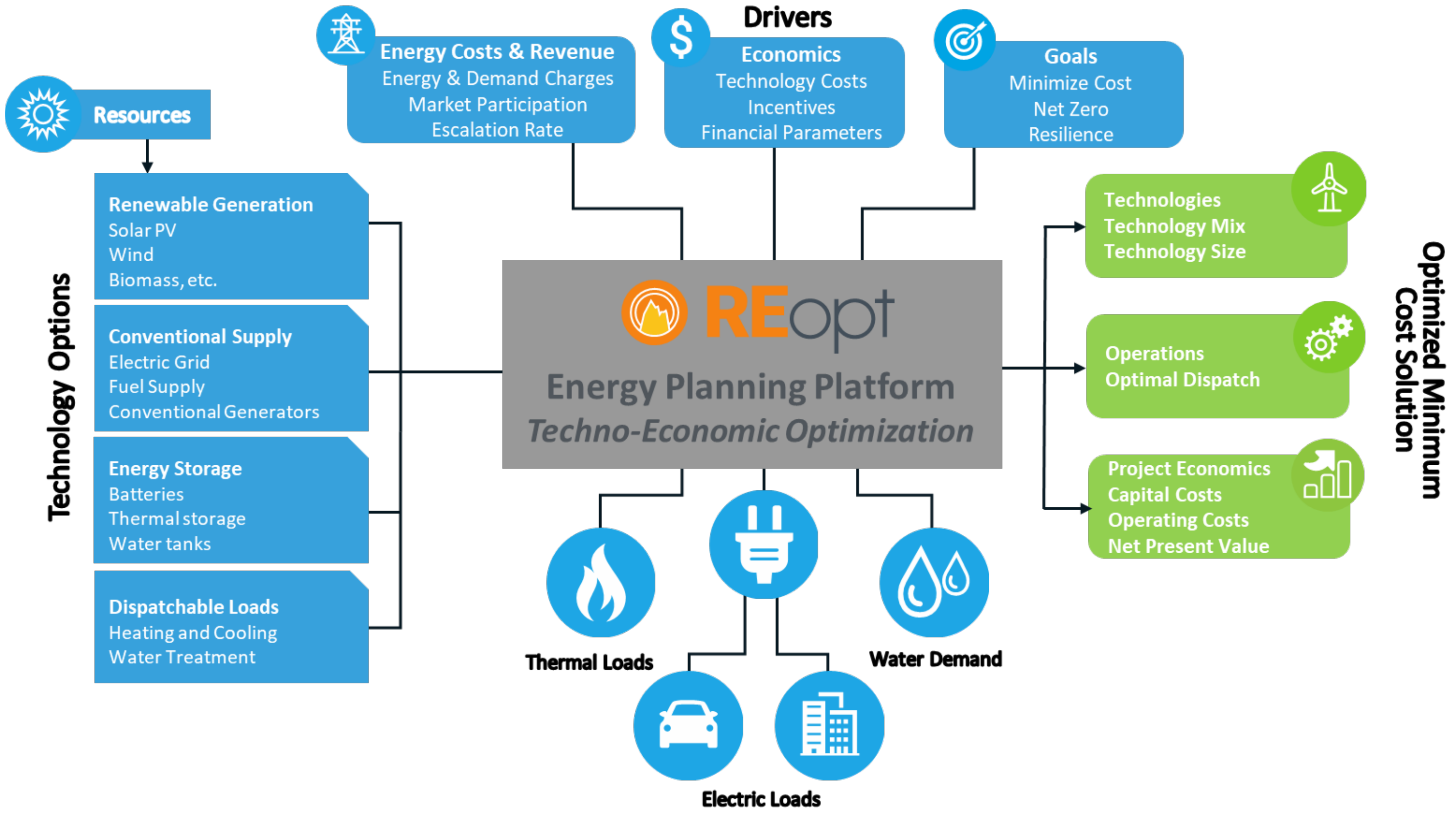


K. Anderson et al., "Increasing Resiliency Through Renewable Energy Microgrids". SCTE Journal of Energy Management Vol.2 (2) August 2017 https://www.nrel.gov/docs/fy17osti/69034.pdf

Energy Modeling Tools

REopt Energy Planning Platform

- Energy modeling tools like REopt evaluate distributed energy project drivers concurrently
- Energy modeling tools allow decision makers to find optimal solutions given a specific goal, perform sensitivity analysis, and evaluate different technology configurations



https://reopt.nrel.gov/

Gap Analysis

- NREL and FEMP are evaluating the role of energy decision tools in distributed energy deployment decisions, and what adjustments to tool capabilities and communication of results could increase deployment

- Input provided will be used to develop recommendations for how REopt can be improved to better support distributed energy (i.e., PV, wind, battery, etc.) implementation at federal agencies

Sample Questions

General

- Describe your agency's projects
- Why did you decide to implement (or not implement) a project?
- What were the key factors that informed your decision?
- Where did you get the information you needed to make your decision?

Tools

- Did you use tools or models to inform your decision? Which one(s)?
- What were the most helpful parts of the tools?
- What was missing from the tools or results?
- What did the tool recommend? What did you do?
- What other resources helped you make your decision?
- What was the one most important factor that made (or broke) the project?
- If you could improve the tools or resources available to others now making a similar decision, what would you change?

Poll Question

- What renewable or distributed energy projects are you currently considering?
  - Solar PV
  - Battery storage
  - Wind
  - Combined heat and power (CHP)
  - Other

Poll Question

- For a successfully implemented renewable energy project, what was the most important factor(s)?
  - Project economics
  - Clean energy goals
  - Resilience goals
  - Renewable energy resource
  - Land availability
  - Project champion

Poll Question

- What is the biggest barrier(s) to implementing renewable energy projects?
  - Lack of procurement mechanisms
  - Lack of funding
  - Lack of project champion or agency support
  - Lack of economics/savings
  - Lack of space/in leased space
  - Other

Poll Question

- Do you use energy models or tools to inform your renewable energy decision?
  - Yes
  - No

Poll Question

- What would you change about energy models or tools to make them more useful?

Preliminary Findings on Tool and Resource Improvements

Additional Capabilities

- Accurate sizing and production estimates
- Accurate cost estimates
- Complete representation of laws, taxes, and incentives
- Additional representation of technologies
- Site-specific factors taken into consideration for viability assessment
- Assistance collecting data

Additional Resources

- Support from experts
- Recommendations for next steps
- Updates on new tools, technologies, and resources
- Access to example projects and contact list

Key Takeaways

- Many factors affect whether distributed energy technologies can provide cost savings and resilience to your site
- It is important to consider a site’s specific load profile, utility rate structure, and value streams available when assessing techno-economic potential
- There are many different use cases for on-site DERs, and no one-size-fits-all solution
- Energy modeling tools allow decision makers to find optimal solutions given a specific goal, perform sensitivity analysis, and evaluate different technology configurations

Thank you!

Emma Elgqvist
emma.Elgqvist@nrel.gov

Moving the Mission Forward with Renewable Energy

On-site RE Project Procurement Options

Chandra Shah, NREL
chandra.shah@nrel.gov

Selecting an On-Site Renewable Energy (RE) Procurement Option

1. What are the primary project goals?
2. How will the project be funded & who will own the system?
3. What type of contract works best for the project?

1. What are the primary project goals?

Project Goal Development

- Form a strong project team
- Discuss project goals with the team members
- Renewable energy conservation measure (ECM) only or bundled with other ECMs?
- Ensure organization consensus and buy-in, from top to bottom
- Possible goals include:
  - Renewable microgrid or microgrid-ready
  - Cost savings
  - Demand management
  - Meeting Energy Policy Act of 2005 renewable goal
  - Net zero
  - Electrical vehicle charging

2. How will the project be funded & who will own the system?

System Ownership & Funding Source Options

Funding Source

System Ownership

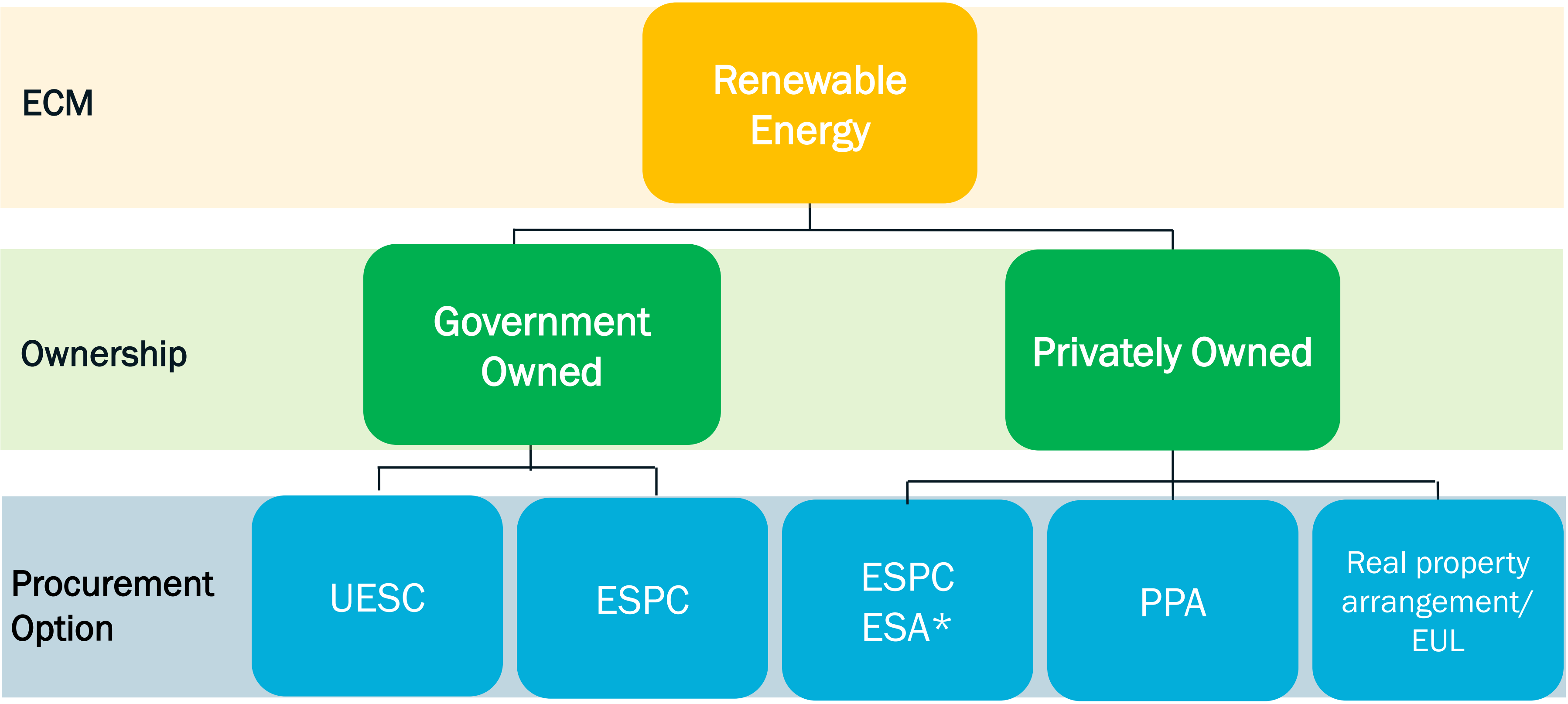
Directly Funded

- Government Owned

Privately Financed

- Government Owned
- Privately Owned

Privately Financed RE Project Procurement Options



Legend & Abbreviations

ECM	Energy Conservation Measure	ESPC ESA	ESPC Energy Sales Agreement
UESC	Utility Energy Service Contract	PPA	Power Purchase Agreement
ESPC	Energy Savings Performance Contract	EUL	Enhanced Use Lease

*System is privately owned initially, government must retain title by end of the contract (OMB Memo requirement)

Polling Question

What contract vehicles have you used at your site (or your agency)?

1. Appropriations
2. UESC
3. ESPC
4. PPA
5. ESPC ESA
6. EUL
7. Other

Government Owned Procurement Options

Energy Savings Performance Contract

Privately Financed

Government Owned

Partnership with an energy service company (ESCO) to procure energy saving and facility improvements

- ESCO guarantees sufficient energy cost savings to pay for the project over the term of the contract
- Main types of federal ESPCs:
  - DOE indefinite-delivery, indefinite-quantity (IDIQ)
  - DOE ENABLE
  - U.S. Army Corps of Engineers MATOC (IDIQ)
  - Site-specific/stand-alone with DOE-qualified ESCOs
- RE projects can be bundled with other measures

Legal Authority

42 USC § 8287 et seq.

Max. Contract Length

25 years

Payment Structure

Privately Financed

Government Owned

Utility Energy Service Contract

Limited-source contract with serving utility for energy- and water-efficiency improvements, and demand-reduction services

- During the contract period, agency payments come from resulting savings (or agency funds)*
- UESCs can be executed under one of the following:
  - Areawide contracts (AWCs)
  - Basic ordering agreement (BOAs)
  - Separate contracts
  - Interagency Agreements (when working with a Federal utility)
- RE projects can be bundled with other measures

** Unlike ESPCs, UESCs do not have a statutory annual savings requirement but must still be lifecycle cost effective. Performance assurance required for annual scoring.*

Legal Authority

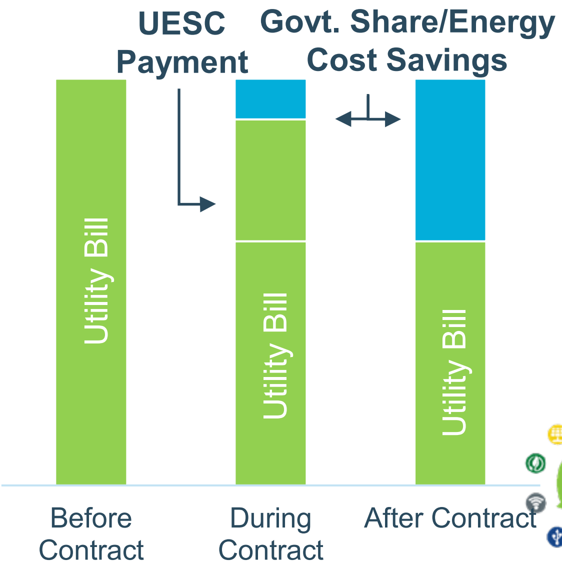
42 USC 8256

10 USC 2913 (DOD)

Max. Contract Length:

Up to 25 years

Payment Structure



Privately Owned Procurement Options

Privately Financed

Privately Owned

Power Purchase Agreement

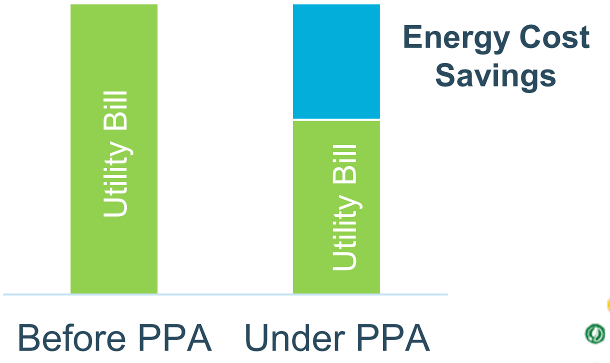
Developer installs, owns RE project on federal land/buildings; agency purchases electricity

- Developer provides O&M, repair/replacement
- Often separate site access agreement
- Agency can include option to purchase the system at end of contract
- Long-term contract required. Authority options:
  - 10 USC 2922a (DOD only, 30 years)
  - Civilian agencies have limited options:
    - 40 USC 501 (FAR Part 41, GSA authority requiring delegation, 10 years)
    - WAPA (20 years, possibly longer)
    - FAR Part 12 (typically 5 years depending on agency policy, no examples)

Legal Authority & Max. Contract Length:

Shown to left

Payment Structure



Privately Financed

Privately Owned

ESPC Energy Sales Agreement

Uses ESPC authority for privately-owned RE project ("ESA ECM") on federal buildings/land; agency purchases electricity

- Long term contract option for civilian agencies
- Similar to PPA, but must meet all ESPC requirements
- ESCO captures tax incentives to reduce ESA ECM price (may sell RECs also)
- ESPC ESA benefits:
  - No up-front capital for equipment
  - O&M, repair/replacement provided
  - Known price for portion of load

Privately Financed

Privately Owned

ESPC ESA cont.'

- ESA ECM can be bundled with other ECMs
- Unique requirements and considerations
  - OMB Memo M-12-21: Agency must retain equipment title by end of contract for annual scoring
  - IRS Revenue Procedure 2017-19: safe harbor*
    - Maximum contract term: 20 years
    - Title transfer must be at fair market value
- Differences from typical ESPC
  - Payment is based on kWh generation; price is in ¢/kWh
  - Private ownership initially
  - Savings accrue immediately
- Contract vehicle options: DOE IDIQ, DOE ENABLE or site-specific/stand-alone contract

** ESCO responsible for tax incentive due diligence*

Legal Authority

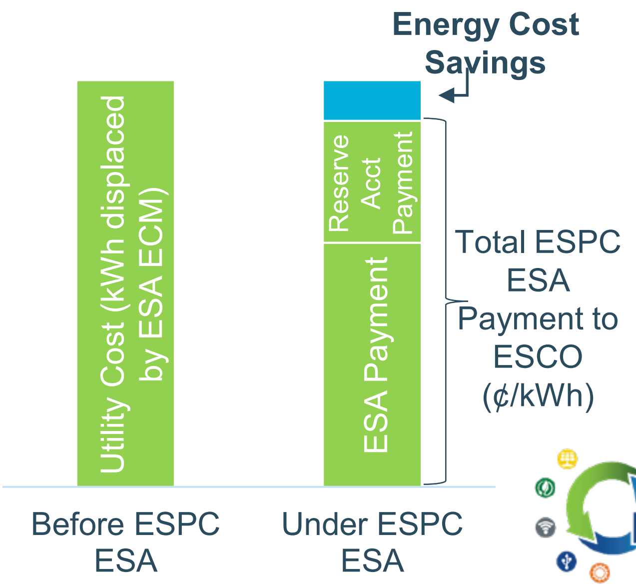
42 USC 8287 et seq.

40 USC 501/FAR Part 41

Max. Contract Length:

20 years*

Payment Structure



Recent ESPC ESA Project Examples

Agency and Location	Drug Enforcement Administration (DEA) in El Paso, TX	National Institute of Standards and Technology (NIST) in Gaithersburg, MD
System	2.5 MW-DC, fixed-tilt ground-mounted PV system	5 MW-DC, fixed-tilt ground-mounted PV system
Contract Vehicle	ENABLE with ESA ECM and other ECMs (lighting, water)	ENABLE with PV ESA ECM (no other ECMs)
Estimated First Year Production	~4.4 million kWh	~6.1 million kWh
Guaranteed Annual Cost Savings from PV	~$300,000	~$500,000
Case Study Factsheet Link	DEA ESPC ESA Case Study	NIST ESPC ESA Case Study
System Picture		

Privately Financed

Privately Owned

Real Property Arrangement/EUL

Agency contracts with private company (could be serving utility) that builds, owns, operates and maintains a DE project on federal land

- Most/all electricity sold by private company to utility or another party
- Typical real property instruments include leases, easements and licenses
- Some agencies have an enhanced-use lease (EUL) authority
  - Out-lease of underutilized property
  - Payment to agency: cash or in-kind consideration

Legal Authority & Max. Contract Length

Varies depending upon agency

Payment Structure

Payment to agency varies depending upon project and agency authority

3. What type of contract works best for the project?

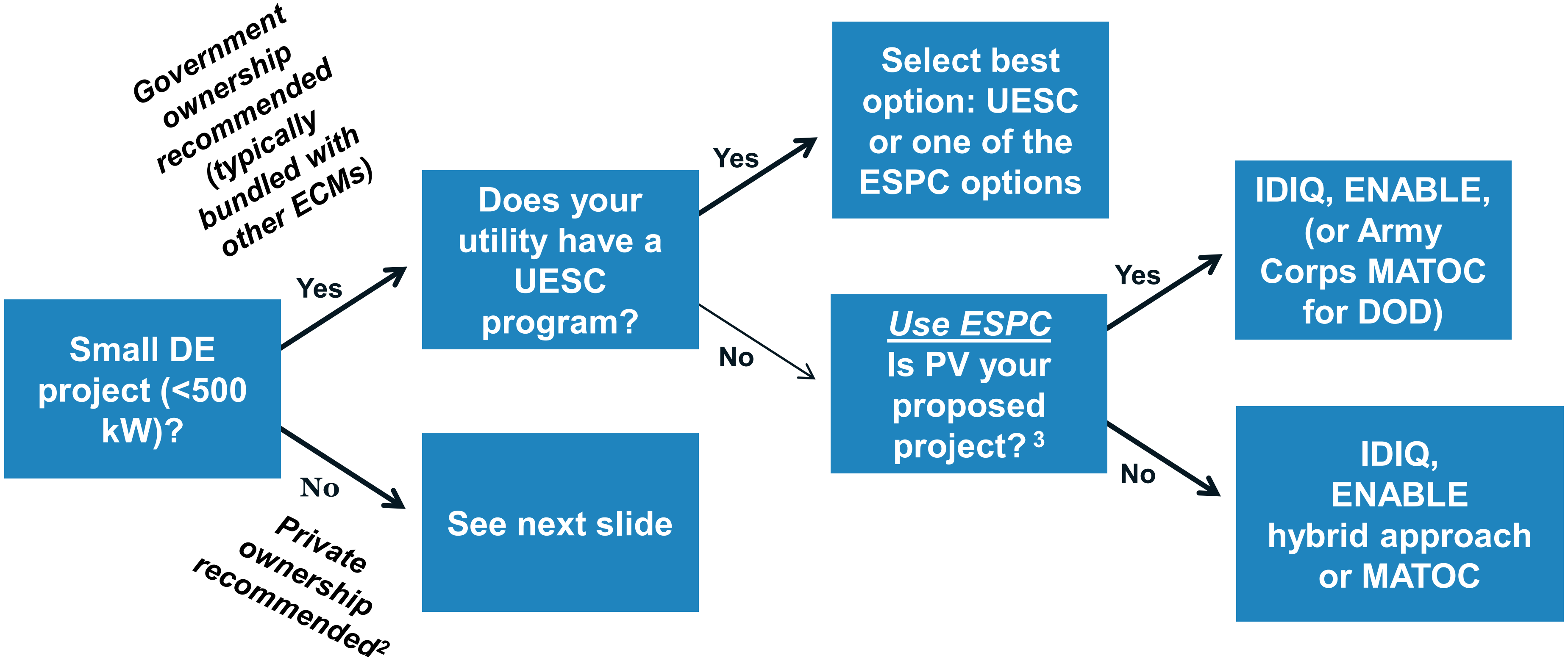
Government vs. Privately Owned Considerations

	Directly Funded	Privately Financed	
Questions to Consider	Government Owned	Government Owned	Privately Owned
Is upfront funding required?	Yes	No	No
Can the project take advantage of tax incentives?	No	No	Yes
Is there financing costs associated with the project?	No	Yes	Yes
Is the government responsible for operation & maintenance (O&M), equipment repair & replacement?	Yes[1]	Yes[1]	No
Can the associated RECs be sold to improve the project economics?	Depends on the agency	Depends on the agency	Yes
In general, will the contract be easy to execute?	Yes	Depends on the agency	Depends on the agency

[1] Unless specified otherwise

Energy Exchange

Selecting a Procurement Option[1]: Small DE Projects



[1]General decision-making framework only. Assume appropriations not available.
[2]Private ownership recommended due to tax incentives (and REC sales in some markets).
[3]Site-specific is also an option but generally not recommended, especially for bundled project.

Selecting a Procurement Option: Large DE Project[1]

Department of Defense → **PPA using 10 USC 2922a is usually the best option [2]**

Civilian Agency → **In WAPA's service territory?**

- Yes → **Consider PPA through WAPA**
- No → **Use ESPC ESA?[2]**
  - Yes → **IDIQ or ENABLE (or site-specific if ESA is only ECM)**
  - No → **Explore other options**

FAR Part 41,
FAR Part 12,
EUL[3]

[1] *Assumes PPAs are legal in state/utility service territory.*
[2] *Large DE project could also be government owned and bundled with other ECMs in an ESPC or UESC.*
[3] *A real property arrangement can be considered for agencies with EUL or similar authority.*

ESPC ESA Contract Vehicle Options

All requirements (ESPC, OMB, IRS) apply regardless of ESPC ESA contracting option.

DOE Indefinite-Delivery, Indefinite-Quantity (IDIQ)

- A streamlined master contract that allows federal agencies to work with 21 DOE qualified ESCOs holding the current DOE ESPC IDIQ contract.

DOE ESPC ENABLE

- A standardized and streamlined procurement process to implement basic ECMs under an ESPC. There are 25 DOE qualified ESCOs on GSA's Supply Schedule SIN 334512.

Site-Specific/Stand-Alone*

- An ESCO is selected through a request for proposal (RFP) process. The selected ESCO must be on DOE's Qualified List of ESCOs prior to contract award. The Qualified List currently includes over 100 ESCOs.

* Only recommended for a single ESA ECM. Not recommended for comprehensive ESPCs such as an ESA ECM bundled with other ECMs.

ESPC ESA Contract Vehicle Selection

- Will the RE ECM be bundled with other ECMs?
  - If so, site-specific not recommended
- Will RE be included in a complicated project (such as a microgrid)?
  - If so, the IDIQ contract vehicle may be desirable since it includes both a Preliminary Assessment (PA) and an Investment Grade Audit (IGA) whereas ENABLE is a streamlined process with just an IGA, no PA
- Does the site/agency have more experience with one type of contract vehicle?
- Do the ESCOs on the pertinent list have the required expertise?

Polling Question

What barriers have you encountered with RE procurement?

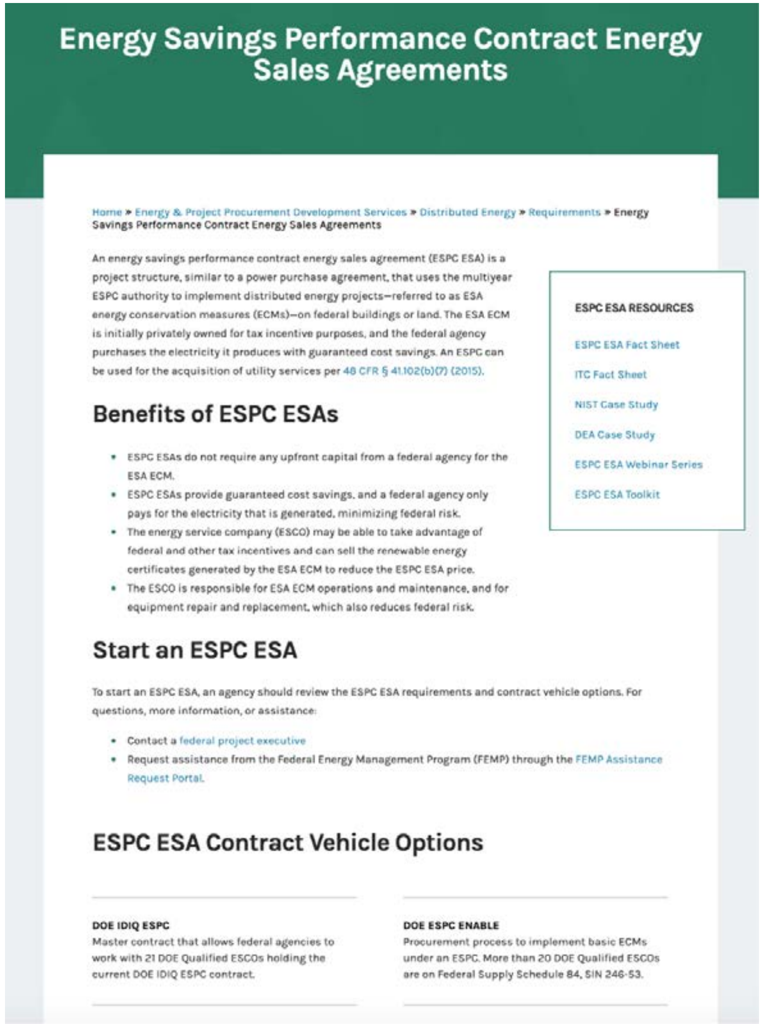
1. Utility interconnection requirements
2. Contracting officer/other staff availability
3. Management approval
4. Cost
5. Meeting National Environmental Policy Act requirements
6. Other

Online Resources

General	• FEMP's Energy and Project Procurement Development Services • FEMP's Distributed Energy Program • FEMP Renewable Energy Trainings
RFP Using Appropriations	• FEMP Support for Appropriations-Funded Projects • Federal Distributed Energy Projects & Technologies
UESCs	• UESC for Federal Agencies • FEMP UESC and Utility Engagement Trainings
ESPCs	• ESPCs for Federal Agencies • ESPC ENABLE for Federal Projects • FEMP ESPC Trainings
ESPC ESAs	• ESPC Energy Sales Agreements
PPAs	• Federal On-Site PPAs • Sample Documents for Federal PPAs • FEMP Federal On-Site PPAs Training

ESPC ESA Website

- Fact sheets, case studies, webinars, toolkit
- New information: diagram & FAQ
- Contract vehicle information & templates
  - DOE IDIQ ESPC
  - DOE ESPC ENABLE
  - Site-Specific/Stand-Alone ESPC
  - Procurement Specifications Templates for On-Site Solar Photovoltaic: For Use in Developing Federal Solicitations


Energy Savings Performance Contract Energy Sales Agreements

Home » Energy & Project Procurement Development Services » Distributed Energy » Requirements » Energy Savings Performance Contract Energy Sales Agreements

An energy savings performance contract energy sales agreement (ESPC ESA) is a project structure, similar to a power purchase agreement, that uses the multiyear ESPC authority to implement distributed energy projects—referred to as ESA energy conservation measures (ECMs)—on federal buildings or land. The ESA ECM is initially privately owned for tax incentive purposes, and the federal agency purchases the electricity it produces with guaranteed cost savings. An ESPC can be used for the acquisition of utility services per 48 CFR § 41.102(b)(7) (2015).

ESPC ESA RESOURCES

- ESPC ESA Fact Sheet
- ITC Fact Sheet
- NIST Case Study
- DEA Case Study
- ESPC ESA Webinar Series
- ESPC ESA Toolkit

Benefits of ESPC ESAs

- ESPC ESAs do not require any upfront capital from a federal agency for the ESA ECM.
- ESPC ESAs provide guaranteed cost savings, and a federal agency only pays for the electricity that is generated, minimizing federal risk.
- The energy service company (ESCO) may be able to take advantage of federal and other tax incentives and can sell the renewable energy certificates generated by the ESA ECM to reduce the ESPC ESA price.
- The ESCO is responsible for ESA ECM operations and maintenance, and for equipment repair and replacement, which also reduces federal risk.

Start an ESPC ESA

To start an ESPC ESA, an agency should review the ESPC ESA requirements and contract vehicle options. For questions, more information, or assistance:

- Contact a federal project executive
- Request assistance from the Federal Energy Management Program (FEMP) through the FEMP Assistance Request Portal.

ESPC ESA Contract Vehicle Options

DOE IDIQ ESPC
Master contract that allows federal agencies to work with 21 DOE Qualified ESCOs holding the current DOE IDIQ ESPC contract.

DOE ESPC ENABLE
Procurement process to implement basic ECMs under an ESPC. More than 20 DOE Qualified ESCOs are on Federal Supply Schedule 84, SIN 246-53.

ESPC ESA Webinar Series

Webinar #1	• ESPC ESA Overview and Requirements (March 12, 2019)
Webinar #2	• PV Project Considerations (April 23, 2019)
Webinar #3	• ESPC ESA Site-Specific/Stand-Alone (July 23, 2019)
Webinar #4	• ESPC ENABLE with an ESA (October 8, 2019)
Webinar #5	• ESPC IDIQ with an ESA (December 10, 2019)
Webinar #6	• ESPC ESAs for Resilience (July 28, 2020)

All webinars (except #6) are now available on-demand

Energy Exchange

Key Takeaways

- Develop clear project goals and obtain consensus
- Determine best contract vehicle based on goals and whether the RE ECM will be bundled with other ECMs
- ESPC ESAs are an excellent long-term contract option for civilian agencies
- FEMP has substantial ESPC ESA training, resources and templates to assist agencies with projects

Chandra Shah
chandra.shah@nrel.gov

NREL/PR-7A40-77808

This work was authored by the National Renewable Energy Laboratory, operated by Alliance for Sustainable Energy, LLC, for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308. Funding provided by the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Federal Energy Management Program. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government. The U.S. Government retains and the publisher, by accepting the article for publication, acknowledges that the U.S. Government retains a nonexclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this work, or allow others to do so, for U.S. Government purposes.

Q&A

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