

# FEMP First Thursday Update

FTU 01

## Strategic Portfolio Planning for Renewable Energy Deployment: REopt

This First Thursday Update provides current information about how to develop a strategic approach to enterprise-wide renewable energy deployment, including systematic approaches to meet agency-wide strategic sustainability goals. This update offers a special focus on the Renewable Energy Optimization Tool (REopt) as an expert service available through the Federal Energy Management Program.

REopt quickly and efficiently screens potential opportunities across a wide portfolio of agency sites, examines different scenarios and sensitivities, and quantitatively prioritizes opportunities for further study and investment.

This update will also include success stories on how agencies have implemented successful projects using REopt.

### Learning Objectives

- Develop systematic approaches to achieve enterprise-wide sustainability goals
- Gain insight from successful projects other agencies have implemented
- Take advantage of REopt, the Renewable Energy Optimization service

### Instructor Biographies

#### Brad Gustafson

Brad Gustafson, LEED AP, PE is a supervisor for the U.S. Department of Energy (DOE) Federal Energy Management Program (FEMP). In 1995, Gustafson began supporting Federal energy initiatives as an employee of Lawrence Berkeley National Laboratory. While at FEMP, he has served as energy savings performance contract project facilitator, technology transfer program manager, utility program manager, Federal fleet management program manager. In 2002, he served as Senate legislative advisor for Senator Lincoln Chafee.

#### Kate Anderson

Kate Anderson is a senior engineer and manager of the engineering and modeling group at the U.S. Department of Energy's National Renewable Energy Laboratory. Anderson leads a team of technical experts who support Federal, state, and local entities with techno-economic modeling and analysis, field assessments, design, and implementation of energy efficiency, renewable energy, and storage opportunities. Anderson is the program lead for the development of NREL's REopt model, a platform for energy system integration and optimization used to screen portfolios of sites for renewable energy

Course: FTU 01

Duration: 1 hour

Learning Units: N/A

Prerequisites: N/A

IACET CEUs: N/A



### Instructors:



**Brad Gustafson, LEED AP, PE**  
Supervisor, Technical Services

Federal Energy Management Program



**Kate Anderson**

Senior Engineer and Manager  
National Renewable Energy Laboratory



**Rachel Shepherd**

Renewable Energy Program Manager  
Federal Energy Management Program

### Related Resources

**FEMP Certificate Series**

**Renewable Energy  
Technology Applications**

[CLICK HERE](#)

potential and to evaluate cost-optimal selection and sizing of energy assets. Prior to joining NREL, Anderson was an officer in the United States Air Force.

### **Rachel Shepherd**

Rachel Shepherd, LEED AP, works within the technical services team as the renewable energy program lead for the U.S. Department of Energy (DOE) Federal Energy Management Program (FEMP). Prior to FEMP, Shepherd was a project engineer conducting energy audits and retro-commissioning studies for existing commercial and industrial facilities. She worked with building owners to identify and prioritize deployment of energy efficiency and renewable energy projects.



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**Strategic Planning for Renewable Energy Deployment: REopt**

Instructors:  
Brad Gustafson, LEED AP, PE  
Rachel Shepherd, LEED AP  
Kate Anderson

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Welcome to this First Thursday Update on Strategic Planning for Renewable Energy Deployment. This First Thursday Update will include a special emphasis on the Renewable Energy Optimization services (also known as REopt).

I'm Brad Gustafson, Supervisor of Technical Services for the U.S. Department of Energy's Federal Energy Management Program.

I will be one of your instructors for today's First Thursday Update.

FEMP's Renewable Energy Projects and Technologies

<http://energy.gov/eere/femp/federal-renewable-energy-projects-and-technologies>

Executive Order 13693

<https://www.whitehouse.gov/the-press-office/2015/03/19/executive-order-planning-federal-sustainability-next-decade>

E.O. 13693 Implementing Instructions

[https://www.whitehouse.gov/sites/default/files/docs/eo\\_13693\\_implementing\\_instructions\\_june\\_10\\_2015.pdf](https://www.whitehouse.gov/sites/default/files/docs/eo_13693_implementing_instructions_june_10_2015.pdf)

## Instructors



Energy Efficiency &  
Renewable Energy



**Brad Gustafson**  
LEED AP, PE  
Supervisor,  
Technical Services  
FEMP



**Kate Anderson**  
Senior Engineer and  
Manager,  
Energy and Modeling  
Group  
NREL



**Rachel Shepherd**  
LEED AP  
Renewable Energy  
Program Manager  
FEMP

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Our instructors for today's update are Kate Anderson and Rachel Shepherd.

Kate is a senior engineer and manager of the energy and modeling group at the National Renewable Energy Laboratory.

Rachel Shepherd is the renewable energy program manager at FEMP.

We'll be hearing from both of them shortly.

## Introduction

### Learning Objectives



- Develop systematic approaches to achieve enterprise-wide sustainability goals
- Gain insight from successful projects other agencies have implemented
- Learn about REopt, the Renewable Energy Optimization service, and other renewable energy services from FEMP

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Here are the learning objectives for this First Thursday Update. Please take a moment to review them on your screen.

REopt enables enterprise-wide evaluations and cataloging of renewable energy opportunities.

Today we will provide some real world project examples and information to help you get started using REopt services.

## Access to Program Resources

Download Instructor PowerPoints

Submit questions/comments  
in center box below

Complete an evaluation and quiz for  
a Certificate of Completion



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Before we get started, here are a few housekeeping items.

To download the presentations, click the link titled "Instructor PowerPoints" in the lower left box of your screen.

During the session send in questions or comments in the center box below. We will collect all of them, sort and organize them, and send responses to all of the participants.

At the conclusion, please click the link in the lower right box, to complete a brief evaluation and quiz and receive a Certificate of Completion.

After this presentation, an archived version of this First Thursday will be available for viewing.

The archived version will include a course supplement containing resources and links.

## Overview

### Order of Presentations:

#### Brad Gustafson

- E. O. 13693 requirements
- Overview of RE resources/  
clean energy goals

#### Kate Anderson

- REopt software tool and services
- REopt success stories

#### Rachel Shepherd

- FEMP tools and resources
- Strategic Partnerships



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Here's the order of today's presentations:

I will start with the requirements of Executive Order 13693 and an overview of renewable resources, as well as a summary of clean energy goals.

Next, Kate Anderson will present the capabilities and features of REopt and provide a few successful examples of how REopt was used in the public and private sectors.

Finally, Rachel Shepherd will talk about FEMP tools and resources, as well as Strategic Partnership opportunities that may be available to you.

## Strategic Planning for Renewable Energy Deployment: REopt



FEMP's Renewable Energy Projects and Technologies

<http://energy.gov/eere/femp/federal-renewable-energy-projects-and-technologies>

Executive Order 13693

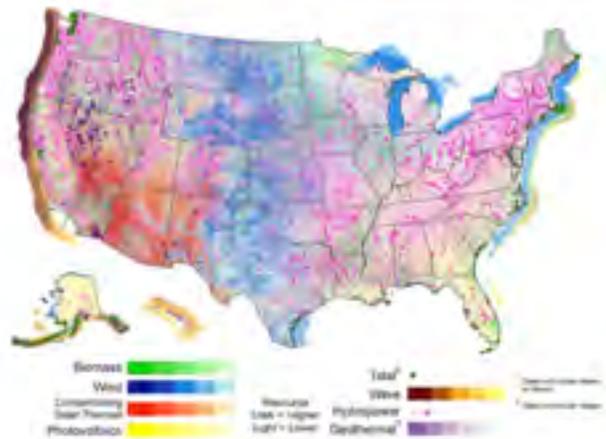
<https://www.whitehouse.gov/the-press-office/2015/03/19/executive-order-planning-federal-sustainability-next-decade>

E.O. 13693 Implementing Instructions

[https://www.whitehouse.gov/sites/default/files/docs/eo\\_13693\\_implementing\\_instructions\\_june\\_10\\_2015.pdf](https://www.whitehouse.gov/sites/default/files/docs/eo_13693_implementing_instructions_june_10_2015.pdf)

## Renewable Resource Potential in the United States

Resource	Theoretical Potential
Solar PV/CSP	155,000 GW (PV) 38,000GW (CSP)
Wind	11,000 GW (onshore) 4,200 GW (offshore to 50 nm)
Geothermal	38 GW (conventional) 4,000 GW (EGS)
Water Power	68 GW
Biopower	62 GW



<http://www.nrel.gov/gis>

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Renewable energy is everywhere. Based on the varied geography of the United States, there is vast potential for increased use of different renewable energy technologies.

Available natural resources are substantial and dependent on the location of your site.

REopt services can help you determine the greatest potentials at your site, the best technologies, and the lifecycle costs and benefits?

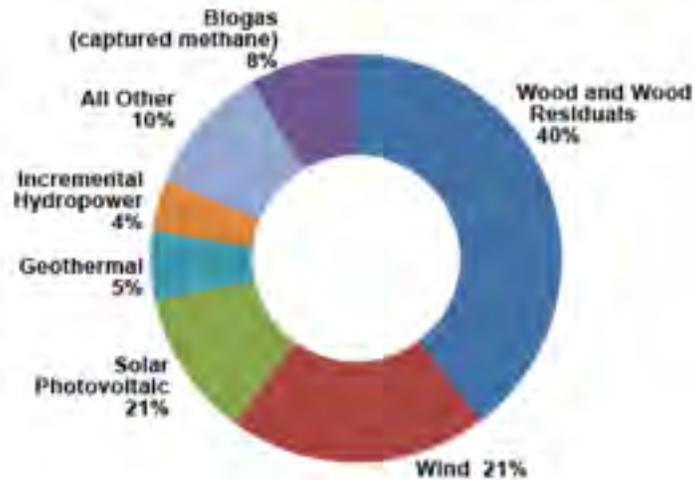
Kate will discuss these topics in detail.

FEMP Renewable Energy Screening Map:

<http://www.nrel.gov/gis/maps.html>

## State of Renewable Energy in the Federal Sector

### Total Federal Renewable Energy Use by Technology, FY13



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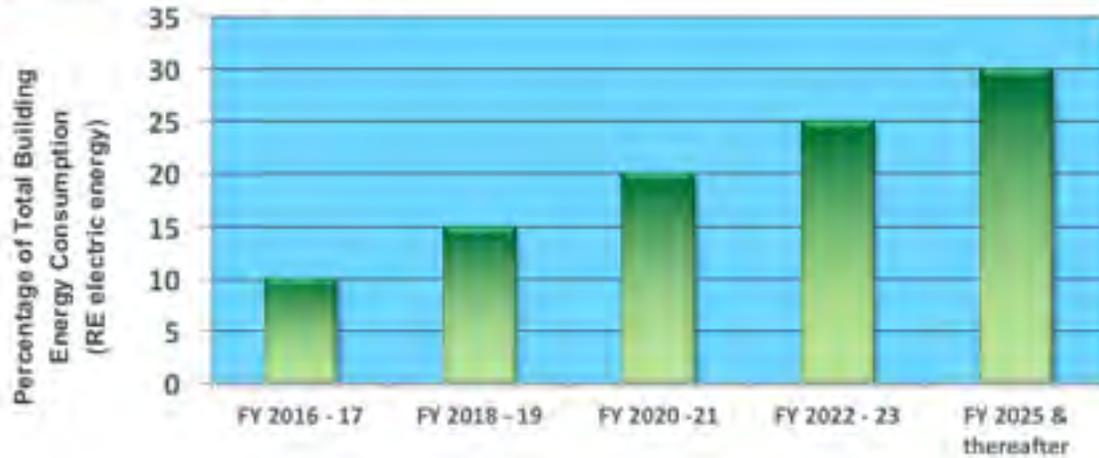
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In FY 2013, 9.2% of total federal electricity came from renewable sources. This illustration shows the breakdown of those sources.

Federal agencies have done an excellent job increasing the use of renewable energy. But there is much more that can be done!

## RENEWABLE Energy Goals in the Federal Sector

### Renewable Energy Goals



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E.O. 13693 revised the federal renewable energy goals by increasing the goals from previous Executive Orders.

The Order requires that a certain percentage of federal building electric energy consumption comes from renewable electric energy.

This chart shows that agencies must increase their use of renewable electric energy by 5% every two years.

Agencies must obtain no less than 30% of total facility electrical energy use from renewable energy sources by 2025.

## E.O. 13693 Goals: Clean Energy and Renewables

### Renewable Electric Energy

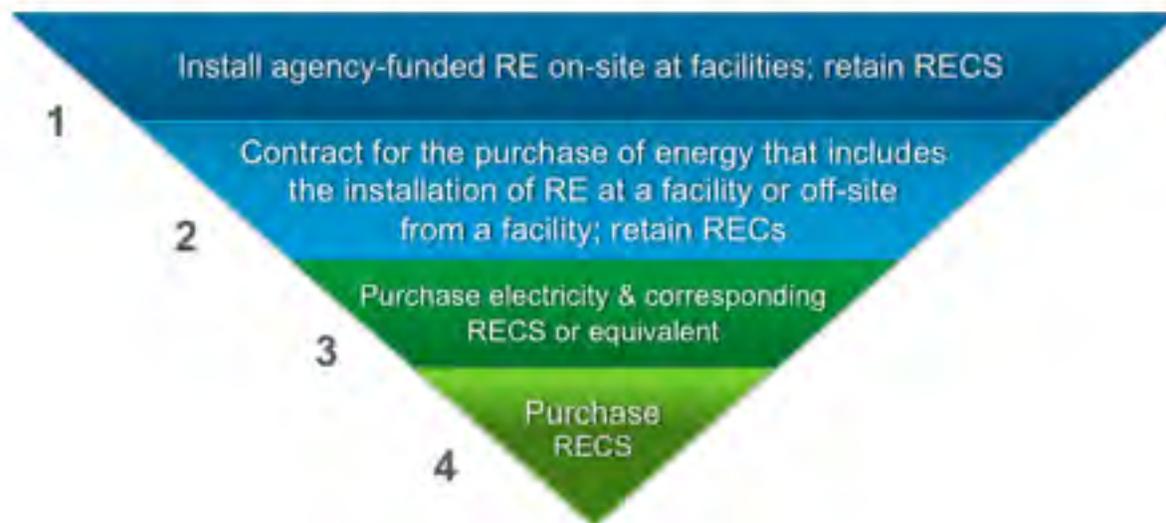
*Definition:*

Electricity produced or displaced by solar, wind, biomass, landfill gas, ocean, geothermal, ground source heat pumps, micro-turbines, municipal solid waste, or new hydro capacity



This is how E.O 13693 defines renewable electric energy. It's electricity produced or displaced by the technologies listed here.

## RENEWABLE Energy Priorities - In Order of Importance



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There are four options explicitly cited in Section 3 of the Executive Order to meet the new renewable energy goals.

Here they are listed in order of priority:

1. When feasible, agencies should install agency-funded renewable energy systems on-site, and retain corresponding Renewable Energy Certificates—or RECS.
2. If this is not possible, agencies should contract to purchase energy generated by another Federal installation, and retain corresponding RECS.
3. As a lower priority, agencies should purchase electricity and corresponding RECS from a non-federal entity.
4. Finally—if none of these options are possible—agencies should purchase RECS.

## CLEAN Energy Goals in the Federal Sector

### Clean Energy Goals



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In addition to the renewable goals, E.O. 13693 also established clean energy targets for federal facilities.

Agencies must ensure that a percentage of their facilities' total electric and thermal energy is *clean energy* from renewable or alternative sources.

Rather than a 5% increase every two years, there is a gradual, accelerated target, no less than 25% by 2025.

## CLEAN Energy in E.O 13693

$$\text{Clean Energy} = \frac{\text{Renewable Electric Energy} + \text{Alternative Energy}}{\text{Total Facility Energy}}$$

### Alternative Energy includes:

- Thermal renewable energy (including from CHP and fuel cell systems)
- Small modular nuclear reactor output
- CHP and fuel cells powered by fossil fuels, but only the amount of output left after subtracting the amount of natural gas (thermal component) and/or electricity (eGRID factor) that would produce the same amount of BTUs/electricity
- Other alternative energy: if agreed, FEMP can petition CEQ on behalf of agencies to include mechanical, ocean/aquifer, and daylighting in the "Other" category

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The Order defines "*Clean Energy*" as renewable electric energy and alternative energy. Its use is determined by the formula shown here.

Alternative energy technologies are defined as shown and can be updated by petition to CEQ as new technologies enter the marketplace.

## E.O. 13693 Goals: Clean Energy and Renewables

### ALTERNATIVE Energy Strategies

On-site  
renewable  
thermal  
(solar thermal,  
biomass boiler)

On-site  
combined  
heat and  
power  
(CHP)

On-site  
fuel cells

Energy from  
small modular  
nuclear  
reactors  
(SMR)

Energy  
generation  
with carbon  
capture and  
storage  
(CCS)

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Executive Order 13693 also outlines additional alternative energy strategies that agencies should follow.

Where feasible, agencies should attempt to:

1. Install thermal renewable energy on-site, such as solar hot water, and production of steam using biomass. As with the renewable energy goals, the environmental attributes must be retained.
2. Install Combined Heat and Power on-site.
3. Install fuel cell systems on-site.

Agencies can also implement other alternative energy approaches that advance the policy. For example, agencies could purchase electricity produced by small modular nuclear reactors or a fossil generating facility that includes carbon capture and storage.

## Strategic Planning for Renewable Energy Deployment: REopt Overview



Now, let me turn over the presentation to Kate Anderson, who will provide an overview of REopt.

REopt Website

[http://www.nrel.gov/tech\\_deployment/tools\\_REopt.html](http://www.nrel.gov/tech_deployment/tools_REopt.html)

Renewable Energy Optimization (REopt) Fact Sheet

<http://www.nrel.gov/docs/fy14osti/62320.pdf>

REopt: A Platform for Energy System Integration and Optimization

<http://www.nrel.gov/docs/fy14osti/61783.pdf>

## REopt: Decision Support throughout Energy Planning Process

### REopt - an energy planning platform

- offers concurrent, multiple technology integration
- optimizes capabilities to help clients meet cost savings/energy performance goals



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Thanks Brad.

Next, we'd like to spend some time talking about the REopt energy planning platform, and how it can help agencies develop a strategy to meet energy goals, like those Brad described.

REopt is a techno-economic decision support tool developed at the National Renewable Energy Laboratory. It is used to inform energy decisions throughout the energy planning process.

There are two key elements that set REopt apart from other tools.

First, it evaluates multiple energy technologies at the same time, rather than evaluating each individually. This allows us to develop integrated solutions and examine how combinations of technologies can work together toward an energy goal.

Second, REopt's optimization capabilities allow us to identify the lowest cost approach to meeting energy performance goals. We do not need to know up front which technology to focus on, or the size of that technology. Instead, REopt optimizes to find the most cost-effective type and size of technology for a given site.

We use REopt throughout the energy planning process, starting with high level master planning or portfolio-level analysis on the left, and moving to more detailed analysis supporting project development and microgrid operation on the right. By using one platform, analysis cost and time is reduced, because the data collected for initial planning can be continually refined throughout the process and used for more detailed analysis.

I'll describe each of these stages in more detail on the following slides.

### Master Planning

- Develop an agency-level strategy to meet energy goals
- Screen opportunities across a wide portfolio
- Prioritize options for further study
- Estimate cost to meet goals



Cost-effective PV at Army bases

At the master planning stage, we help clients develop an agency-level strategy to meeting their energy goals. This could include achieving 30% renewable electricity, getting to carbon neutral, or simply reducing lifecycle costs of energy.

RE feasibility depends on a number of factors— current and future utility energy costs, RE costs, incentives, utility policies around net metering and interconnection, site energy consumption, site land availability and constraints, renewable energy resources— and all of these vary across an agency's portfolio of sites

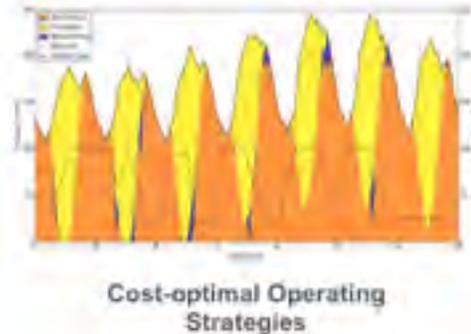
For agencies with many sites, often geographically distributed sites across the nation or the world, it can be quite challenging to figure out where to start.

REopt combines all these factors to screen RE opportunities across the agency's portfolio of sites, and then prioritizes the top options for further study.

REopt also estimates the cost of meeting energy goals. For example- does this require a \$1 million dollar investment or a \$1 billion dollar investment? Over the lifecycle of the projects, am I going to pay more or less than I would for utility energy?

## Project Development

- Technology types & sizes
- Installation & operating cost
- Optimal operating strategies



Once we have a prioritized list of opportunities and know where to focus additional time and resources, we move on to the project development phase.

At this stage, we refine the data for each site, for example collecting 15-minute load data and complex utility rate tariffs.

Based on this more detailed data, we refine the recommendations for technology type and size, and estimate installation and operating costs for the project.

If the project involves a dispatchable technology, like a battery, we recommend operating strategies to maximize economic returns.

This could be by shaving demand during peak periods or shifting energy consumption to lower time-of-use periods.

## Resiliency Analysis

- Resiliency benefit of RE
- Generation & storage sizing
- Operating strategies for microgrids



CORE Microgrid Design Process

For sites that have an energy security or resiliency goal, we can also go a level deeper, evaluating how the RE assets can help extend the amount of time a site can survive and outage.

We can also size generation and storage to meet a resiliency goal- such as supporting a critical load for a specified period of time—while also providing economic benefit during grid-connected operation.

## Technologies Evaluated in REopt

- **RE Generation**

- PV
- Solar hot water
- Solar vent preheat
- Wind
- Biomass (electric, thermal, CHP)
- Waste to energy (electric, thermal, CHP)
- Landfill gas (electric, thermal, CHP)
- Ground source heat pumps

- **Diesel and natural gas generators**

- **Electric and thermal storage**

- **Utility Grid**



REopt evaluates both thermal and electric renewable energy technologies.

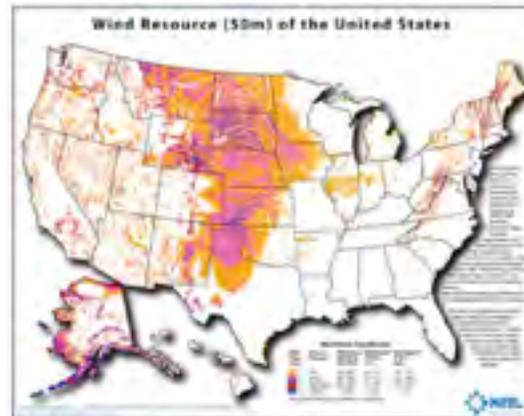
This includes 3 solar technologies— photovoltaics, solar hot water, and solar ventilation preheating— as well as wind, biomass, waste to energy, landfill gas, and ground source heat pumps.

REopt also includes diesel and natural gas generators for energy security analysis, as well as electric and thermal storage.

Utility electricity and thermal fuel options like natural gas and propane are modeled, as well.

## REopt - INPUTS

- **Site data**
  - Location
  - Electric and thermal loads
  - Utility costs
  - Space available for RE
- **NREL GIS resource data**
- **RE technology costs**
- **Incentives data**
- **Site energy goals**



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The inputs to REopt are a combination of data about each site provided by the agency, as well as data drawn from NREL and other databases.

Typically, at the master planning stage, the agency provides a list of sites, along with the location of each site; annual electric and thermal energy consumption and cost; and estimates of space available for RE, such as land or roof area.

For more detailed analyses, sites provide refined data including 15-minute load data and complex utility rate tariff structures.

NREL then pulls renewable energy resource data, including the amount of solar, wind, and biomass available at each site, from its GIS database.

Cost data comes from NREL research and cost models, as well as databases of installed project costs, which are continually updated to stay current with market conditions. Costs typically vary with system size, with larger systems experiencing economies of scale.

Incentives data comes from the Database of State Incentives for Renewable and Efficiency, or DSIRE, funded by the Department of Energy and operated by the North Carolina Clean Energy Technology Center.

Depending on the ownership scenario we are evaluating—agency-owned or third party owned—we apply the appropriate federal, state, and local incentives.

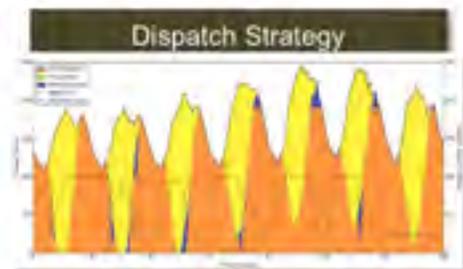
In coordination with the client, we select appropriate analysis goals, such as achieving 30% renewable electricity.

Incentives data comes from the Database of State Incentives for Renewable and Efficiency (DSIRE):  
<http://www.dsireusa.org/>

## REopt - OUTPUTS

- **Optimized Minimum Cost Solution**
- **Recommended Technologies**
  - Size
  - Cost
  - Production
- **Dispatch Strategies**
  - What to do
  - When to do it
- **Prioritized list of sites**
- **Estimate of cost to meet goals**

Ranked List of Projects			
	Site	Technology	Size
1	C	PV	100 kW
2	G	Wind	1 MW
3	A	LFG	2 MW



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Based on this data, REopt then evaluates the optimum energy mix at each site and provides the minimum cost solution that meets the energy goals.

REopt recommends a technology or set of technologies for each site, including the size (for example 100 kW), the initial cost, the lifecycle cost, and the net present value.

For dispatchable technologies, like storage, REopt also recommends a dispatch strategy for when to operate the technology, such as when to charge or discharge the battery.

Based on the recommendations at each site, opportunities are then prioritized across the whole portfolio. The prioritization depends on the agency's goals, but is often based on net present value.

Those sites with the highest net present value are prioritized first because they represent the largest potential cost savings.

REopt also provides an estimate of the cost to meet the agency's energy goals.

## Who Uses REopt - Federal Agencies

NREL performs REopt analysis as a service for federal agencies, private companies, universities, and communities.

REopt has been used to assess opportunities at over 8,000 sites

- **US Forest Service**
- **National Park Service**
- **Fish and Wildlife Service**
- **Department of Defense**
- **Department of Energy**
- **Department of Commerce**
- **General Services Administration**
- **US Department of Veterans Affairs**
- **Department of Homeland Security**
- **US Department of Agriculture**
- **US Bureau of Reclamation**
- **Bureau of Land Management**

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REopt is not available for use outside NREL. Instead, it is run by NREL as an analysis service for clients.

REopt has been used to assess opportunities at over 8,000 sites to date.

Some of the agencies that have used REopt are listed on the screen, including federal agencies, private companies, universities, and communities.

## Who Uses REopt - And Others . . .

NREL performs REopt analysis as a service for federal agencies, private companies, universities, and communities

REopt has been used to assess opportunities at over 8,000 sites

- Indian Health Service
- Western Area Power Administration
- The National Zoo
- Town of Greensburg, KS
- Frito Lay
- Anheuser Busch
- E&J Gallo
- Arizona State University
- Miami University of Ohio

## Value of REopt

- Achieving carbon and energy reduction goals requires large investment
- Many different technology options
  - Choosing wrong technologies could cost millions

### REopt saves time and money by:

- Evaluating different scenarios quickly
- Modeling how different technologies work together
- Modeling how technologies interact with utility markets
- Incorporating constraints
- Prioritizing options
- Identifying the most cost-effective path to meeting goal

So why do agencies use REopt?

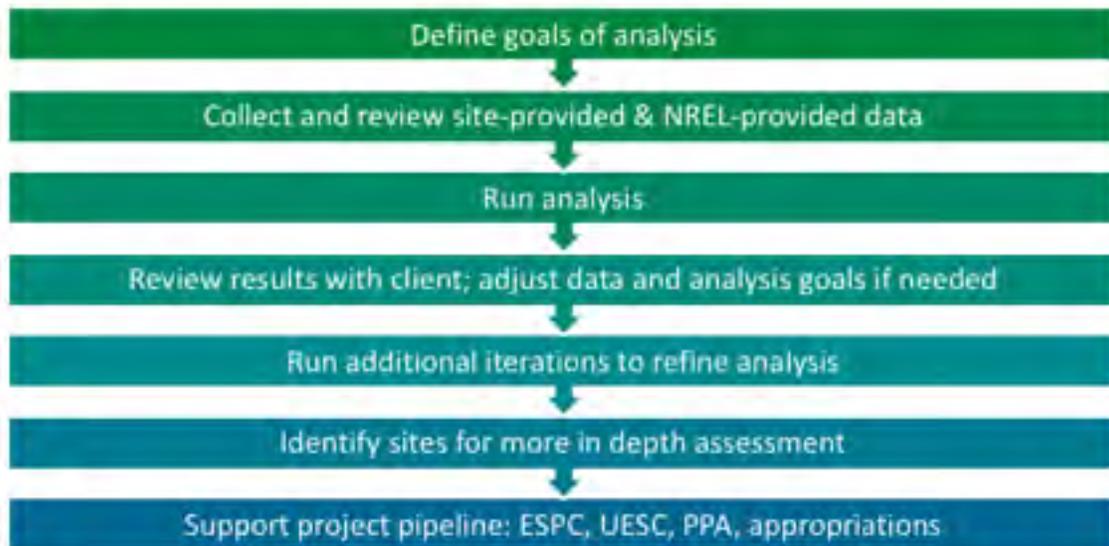
Achieving carbon and energy reduction goals often requires a large investment, and there are many different technology options and potential project locations. Choosing the wrong options could be quite costly.

REopt helps agencies save time and money by quickly evaluating different scenarios, modeling how different technologies work together, modeling how technologies interact with utility markets, and incorporating constraints such as limits on technology types or system size.

REopt helps agencies to prioritize options for future study, identifying fatal flaws early on so agencies do not sink additional time and money into pursuing technically or economically infeasible projects.

For agencies with energy goals, REopt identifies the most cost-effective path to meeting a goal, and provides a preliminary strategy for agencies to follow.

## REopt Screening Process

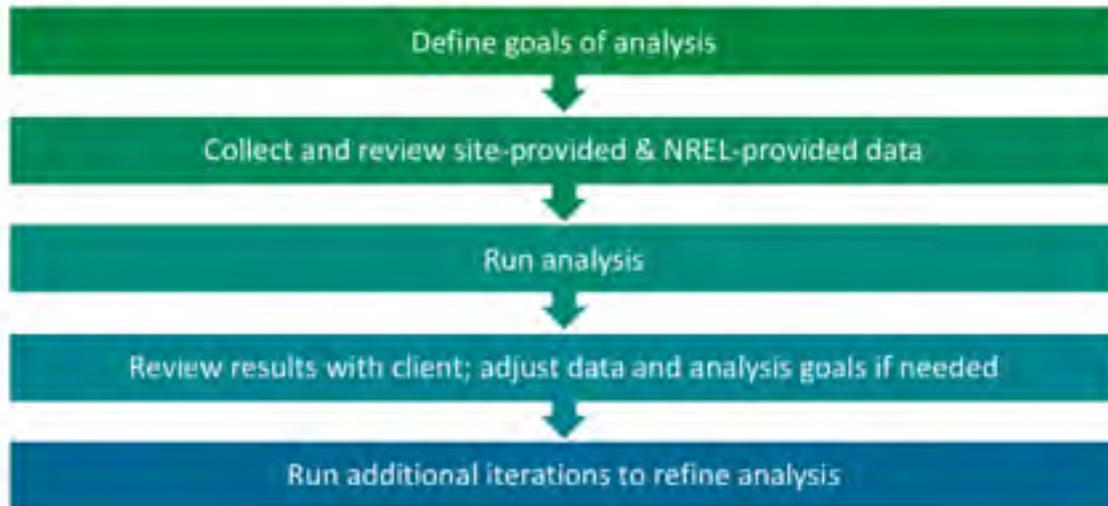


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So, what does the REopt screening process look like?

## REopt Screening Process – Part 1: Analysis



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First, we work with the agency to define the goals of the analysis.

This could be Net Zero energy, carbon neutrality, or simply minimizing energy costs.

Second, we collect and review data on each site, including energy consumption and cost, land availability, and incentives data.

Next, we run a first iteration of the analysis, and then review these results with the client. Often at this point, we update the data for some of the sites.

For example, the client might realize that only part of the land initially submitted is actually available for development, or that a nearby air field restricts development of wind turbines above a certain height.

After we've revised the data, we run additional iterations to refine the analysis and develop a prioritized list of opportunities.

## REopt Screening Process – Part 2: Implementation

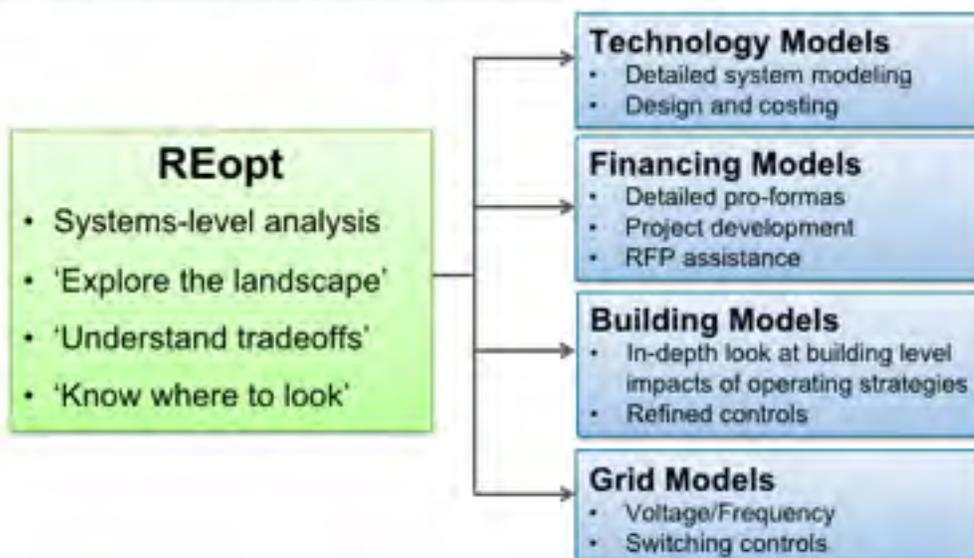
Identify sites for more in depth assessment



Support project pipeline: ESPC, UESC, PPA, Appropriations

Once we have this list, we move on to implementation, selecting sites for more in depth assessment, and then supporting project development through energy savings performance contracts, utility energy service contracts, power purchase agreements, or appropriations.

## REopt: Directing Resources to Follow-on In-Depth Analysis



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REopt provides the systems-level analysis, allowing agencies to explore the landscape, understand tradeoffs, and know where to look for the best opportunities.

REopt is not, however, a final answer.

Instead, REopt is meant to direct follow on in-depth analysis to those sites with the best chance of success.

Before implementing a project, an agency will typically conduct a more detailed study, for example using technology-specific models to develop detailed system designs, financing models to develop detailed pro-formas, building models to look at the impact of operating strategies, and grid models to evaluate the impact of the project on system stability.

## Strategic Planning for Renewable Energy Deployment: REopt Case Studies



Now that you have some background on the REopt model itself, I'd like to show you some case studies of how REopt has been used.

## Portfolio Optimization for National Park Service (NPS)

- REopt screened **320** National Parks for RE opportunities
- Results were used to select **3 sites** for site assessments
- FEMP/NREL continue to work with NPS to prioritize sites and support project development

The mission of the National Park Service is to protect our natural and cultural resources for future generations. The use of renewable energy at our facilities is a key strategy to meet this mission. NREL's REopt Tool has allowed us... for the first time in our history to better understand the opportunities that exist at NPS facilities to deploy renewable energy.

*Shawn Norton  
Branch Chief, Sustainable Operations and Climate  
Change, National Park Service*

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The National Park Service used REopt to screen 320 parks for renewable energy opportunities.

The results were used to select 3 sites for more detailed site assessments.

FEMP and NREL continue to work with NPS to prioritize opportunities and support project development.

Here's what Shawn Norton, the Branch Chief for Sustainable Operations and Climate Change at the National Park Service, had to say about the REopt analysis.

## Portfolio Optimization for Army and Navy

- **Army and Navy Goals**

- Minimize lifecycle cost of energy
- Achieve **Net Zero** at installations

- **Use REopt to:**

- *Identify* and *prioritize* cost-effective projects to meet goals
- Estimate cost of meeting goals

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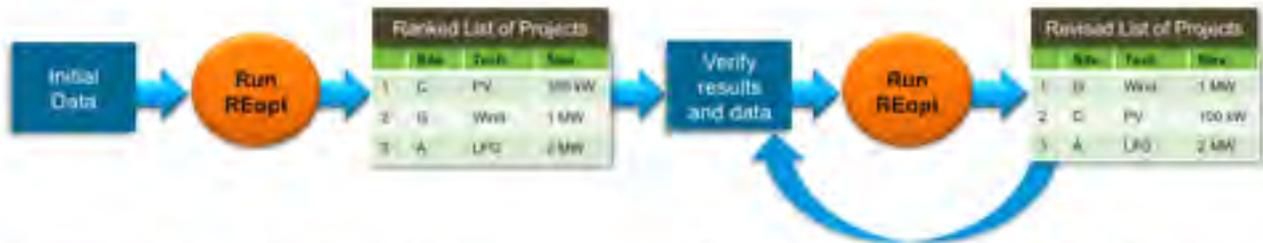
FEMP

Next, I'd like to talk about how we used REopt to help the Army and Navy meet their renewable energy goals.

When we started working with them, they were interested in both minimizing their lifecycle cost of energy, as well as achieving net zero at their installations. They later each developed goals to install 1 gigawatt of renewable energy.

They used REopt to identify and prioritize cost-effective projects to meet these goals, as well as to estimate the cost of meeting these goals.

## Portfolio Optimization for Army and Navy



REopt is an *iterative planning process*. It provides a *prioritized list of projects* based on initial data, which is then refined in subsequent iterations based on updated data.

- REopt screenings catalyzed development of **over 260 MW** of RE on Army and Navy installations

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We helped the Army and Navy by collecting initial data and running REopt to develop a ranked list of projects.

We then worked with specific sites to verify the data and results, adjust inputs where needed, and re-run the analysis to develop a revised list of projects.

We often don't have perfect data upfront, so the REopt analysis is typically an iterative planning process, where we continue to refine the results as more accurate data becomes available.

For the Army and Navy, the REopt screenings catalyzed development of over 260 MW of renewable energy on Army and Navy installations.

## Navy Marine Corps - Camp Lejeune

- NREL worked with the Navy and U.S. Marine Corps to conduct an RE screening of **91** bases
- Camp Lejeune was identified as a top opportunity in the screening and, following a more detailed site assessment and feasibility study, the Navy and Marine Corps are developing a **13 MW solar facility**
- The facility will be owned and operated by Duke Energy and broke ground in July 2015



Camp Lejeune  
Solar Groundbreaking

One example is at Marine Corps base Camp Lejeune.

NREL worked with the Navy and U.S. Marine Corps to conduct an renewable energy screening of ninety-one Navy and Marine Corps bases.

Marine Corps Base Camp Lejeune was identified as a top opportunity in this screening. Following a more detailed site assessment and feasibility study, the Navy and Marine Corps are developing a 13 MW (AC) solar facility at Camp Lejeune in partnership with the utility Duke Energy. The facility will be owned and operated by Duke Energy.

The project will help Duke Energy further its commitment to RE, diversify its energy mix, and meet the North Carolina Renewable Energy and Energy Efficiency Standard. The project will provide greater resource availability and diversity to Camp Lejeune while helping the Navy meet its 1 GW RE goal.

## Army - Fort Huachuca

- REopt screening identified Fort Huachuca, AZ as a top candidate for PV
- After conducting more detailed evaluation, U.S. Army awarded contract to Tucson Electric Power to build an **18 MW** PV system in 2014
- At time of construction, this was largest DoD solar array on a military installation
- Representing about **25%** of the annual installation electricity requirement of Fort Huachuca



18MW solar array at Fort Huachuca

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Another example is the Army's Fort Huachuca.

NREL's REopt screening for the Army Office of Energy initiatives identified Fort Huachuca as a top candidate for photovoltaics.

After conducting a more detailed evaluation of the site, the U.S. Army awarded a contract to Tucson Electric Power (TEP) to build an 18 MW PV system in 2014.

At the time of construction, this was the largest U.S. Department of Defense solar array on a military installation, representing about 25% of the annual installation electricity requirement of Fort Huachuca.

The project promotes the Army's energy security and sustainability strategy to position the Army to enhance its current and future capabilities, readiness, and performance.

## Army Perspective

**“The Army sees high value from REopt findings when it came to deactivating projects. It used the results as an authoritative source to lay down a project and move on. The Army views walking away from bad deals to be just as valuable – if not more so – than signing a good deal.”**

*- Katy Christiansen  
Army Office of Energy Initiatives*

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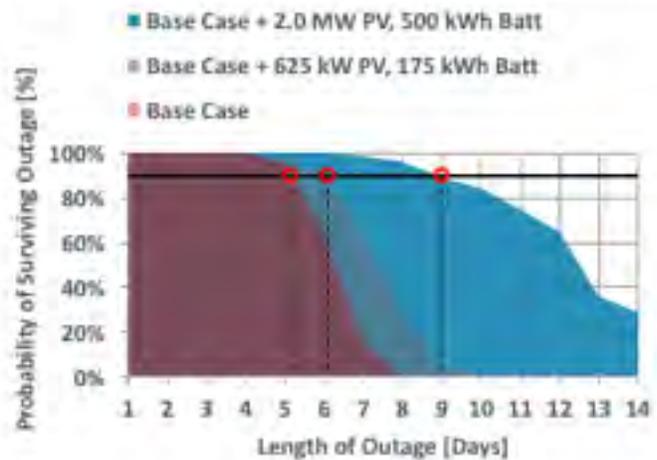
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While the previous slides highlight successful projects, those projects that REopt screened out are just as important as the feasible projects identified.

This quote from a staff member supporting Army Office of Energy Initiatives highlights that identifying fatal flaws and excluding nonviable projects early on allows agencies to focus limited resources on pursuing and deploying the projects with the highest chance of success.

## Army – Energy Security Impact of RE

- Analyzed how adding RE alongside conventional generation in a microgrid can extend survivability of Army base
- Looked at random outage start dates and durations throughout year
- Found that *augmenting diesel generators with PV and battery* extended length of time site could survive outage by 1 to 4 days



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In addition to supporting development of projects toward the Army's renewable energy goals, we also helped the Army to evaluate the impact of RE projects on the resiliency of their bases. For example, at one base we looked at how adding renewable energy alongside conventional generation in a microgrid can extend the amount of time the base could survive a grid outage.

The length of outage you can survive varies depending on when the outage starts, because the load and the solar resource are different at different times of the year.

We looked at random outage start dates and durations throughout the year, and found that augmenting the diesel generators with PV and batteries extended the length of time the site could survive an outage.

This graph shows the probability of surviving an outage of a given number of days, with the probability on the Y-axis and the length of outage on the X-axis. We found that adding PV and batteries extended the time the base could survive the outage by 1-4 days.

## Campus Planning: Arizona State University (ASU)



- ASU goal: **100% mitigation** of energy emissions by 2025
- REopt analysis used to **evaluate carbon reduction pathways**
  - Preference for projects, not RECS or purchasing carbon offsets
  - Least-cost solution for 25%, 50%, 75%, 100% reduction in equivalent carbon emissions
  - What-if scenarios around load, RE costs, utility costs, incentives

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We've looked at a couple of federal examples, but REopt analysis services are available for any organization, federal or non-federal.

Here is an example of how the private sector is also using REopt.

Arizona State University used REopt to evaluate carbon reduction pathways towards meeting its goal of 100% mitigation of energy emissions by 2025.

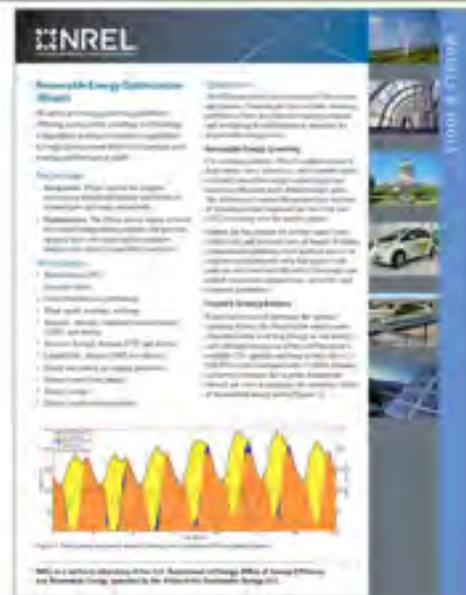
We looked at least-cost solutions for a range of carbon reductions, from 25% to 100%, and conducted what-if scenarios around different load growth projections, RE costs, utility costs and incentives.

The analysis is helping ASU develop a strategy toward their 100% mitigation goal.

## REopt Summary

### For additional information about REopt:

- Contact FEMP/NREL
- Access the links on your screen



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That concludes my portion of the webinar. For more information on REopt, please feel free to contact me or visit the links you see on your screen for additional information.

If there are attendees that have had a REopt screen performed for their agency already, we'd like to hear from you about whether you've implemented any of the projects identified in the REopt screen, and how we can further assist you in developing projects.

Now I'd like to turn it back over to Brad for additional information on requesting FEMP's assistance.

Cost-Optimal Pathways to 75% Fuel Reduction in Remote Alaskan Villages

<http://www.nrel.gov/docs/fy16osti/64491.pdf>

NREL Helps Federal Agencies Reach New Efficiency Targets

<http://www.nrel.gov/news/features/2015/19546>

How Solar PV Can Support Disaster Resiliency

[https://www.nrel.gov/tech\\_deployment/state\\_local\\_governments/blog/how-solar-pv-can-support-disaster-resiliency](https://www.nrel.gov/tech_deployment/state_local_governments/blog/how-solar-pv-can-support-disaster-resiliency)

## Strategic Planning for Renewable Energy Deployment: REopt Requesting FEMP Assistance



And now, to tell you about some additional FEMP's services, here is FEMP's Renewable Energy Program Manager, Rachel Shepherd.

## FEMP Assistance

Start implementing renewable energy projects to meet the **30% by 2025 target**:

- Project planning and implementation
- Project assistance
- Project financing mechanisms
- RE technologies
- Resource maps and screening tools
- Purchasing renewable power

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FEMP provides many tools and resources that federal agencies can use to leverage their results from REopt and deploy renewable energy projects and technologies. Today we will be discussing FEMP's guidance for project planning and implementation, as well as requesting project assistance.

The FEMP website is a great resource for learning about project financing mechanisms, renewable energy technologies, resource maps, screening tools, and purchasing renewable power.

FEMP's Renewable Energy Projects and Technologies

<http://energy.gov/eere/femp/federal-renewable-energy-projects-and-technologies>

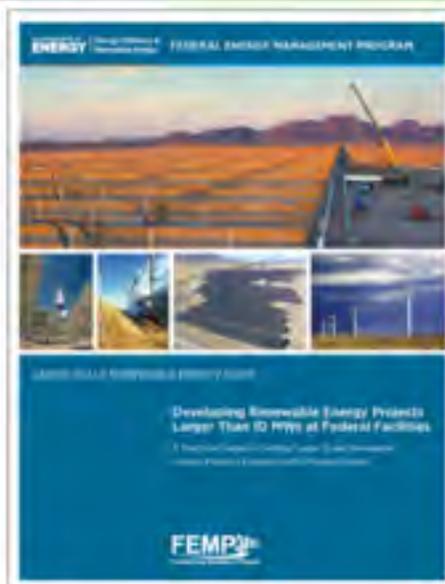
Renewable Energy Project Assistance from FEMP

<http://www.energy.gov/eere/femp/federal-energy-management-program-renewable-energy-project-assistance>

## Project Planning and Implementation

**FEMP has guides for successfully planning and implementing renewable energy projects**

- *Guide to Integrating Renewable Energy in Federal Construction*
- *Small- to Medium-Scale Federal Renewable Energy Projects*
- *Developing Renewable Energy Projects Larger than 10 MWs at Federal Facilities*



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FEMP has developed three guides to help federal agencies successfully plan and implement renewable energy projects.

The first is a “Guide to Integrating Renewable Energy in Federal Construction”. This document helps federal agencies understand renewable energy options, select appropriate types of renewable energy technologies, and integrate these technologies into all phases of new construction or major renovation projects.

FEMP also provides guidance for “Small- to Medium-Scale Federal Renewable Energy Projects”. This guidance is for projects that are less than 10 megawatts, and includes nine steps of instruction for planning and implementing projects. By utilizing the REopt tool you will have already completed the planning phase of the guide, which are the first two of the nine steps.

The guide to “Developing Renewable Energy Projects Larger than 10 MWs at Federal Facilities” provides a project development framework to allow the federal government, private developers, and investors to work in a coordinated fashion on large-scale renewable projects. The purpose of this guide is to define key elements that compose a successful, financially attractive, large-scale renewable energy project.

Guide to Integrating Renewable Energy in Federal Construction  
[http://www.energy.gov/sites/prod/files/2013/10/f3/re\\_construction\\_guide.pdf](http://www.energy.gov/sites/prod/files/2013/10/f3/re_construction_guide.pdf)

Small- to Medium-Scale Federal Renewable Energy Projects  
<http://www.energy.gov/eere/femp/small-medium-scale-federal-renewable-energy-projects>

Developing Renewable Energy Projects Larger than 10 MWs at Federal Facilities  
<http://www.energy.gov/sites/prod/files/2013/10/f3/large-scalereguide.pdf>

## Project Assistance

### Planning Phase:

- Strategic investment planning
- Policy and program support
- Screening
- Feasibility study
- Interconnection and grid integration assistance
- High-performance green building construction or renovation assistance
- Acquisition strategy

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FEMP offers several services for planning and implementing renewable energy projects. During the planning phase, FEMP can help develop and support your overall agency, sub-agency, or regional strategic investment plan.

FEMP also provides assistance for site specific projects such as a feasibility study or interconnection and grid integration assistance.

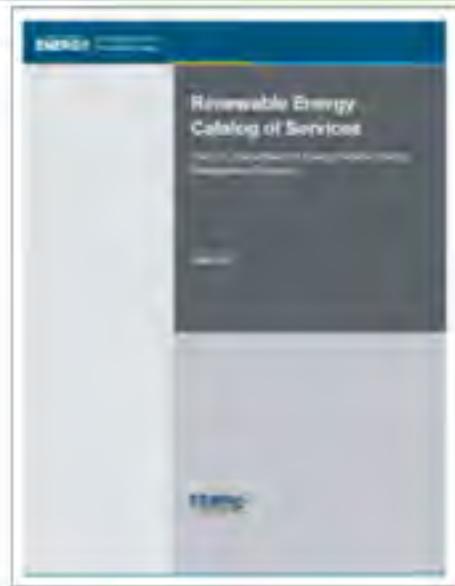
Renewable Energy Project Assistance from FEMP

<http://www.energy.gov/eere/femp/federal-energy-management-program-renewable-energy-project-assistance>

## Project Assistance

### Implementation Phase:

- Request for proposal or proposal review assistance
- Contract assistance
- Design review assistance
- Performance period (operations and maintenance, measurement and verification) assistance



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FEMP assists with project implementation, as well. We can support you from the initial step, which is a request for proposal, through the final step, which is the performance period.

To find out all of FEMP's project assistance services, please go to FEMP's Renewable Energy Catalog of Services. The link can be found in the box below.

FEMP's Renewable Energy Catalog of Services

[http://www.energy.gov/sites/prod/files/2015/03/f20/re\\_catalog\\_of\\_services.pdf](http://www.energy.gov/sites/prod/files/2015/03/f20/re_catalog_of_services.pdf)

## Strategic Partnership Agreements

### Does your agency have a Strategic Partnership Agreement?

- Formally known as Work-for-Others Agreement
- An agreement between a federal agency and U.S. Department of Energy
- Provides access to project assistance from NREL
- REopt screenings can be completed through this agreement

**Contact Kate Anderson or Rachel Shepherd for further assistance**

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You may already have access to technical services and project assistance through a Strategic Partnership Agreement, formally known as Work-for-Others Agreement.

This is an agreement between a federal agency and the Department of Energy to work directly with each other. The agreement allows an agency access to NREL's technical services and project assistance team, which includes REopt screenings.

If your agency has a Strategic Partnership Agreement in place, a REopt screening may have already been completed. Please contact Kate Anderson or myself if you would like to find out if a REopt screening has been completed that is applicable to you, if you are interested in learning more about Strategic Partnership Agreements, or if you have any other questions about FEMP assistance.

Both our contact information will be provided at the end of this presentation or you can request to be contacted by someone from FEMP when you take the course evaluation.

Learn more about a Strategic Partnership Agreements  
<http://www.nrel.gov/technologytransfer/wfo.html>

## First Thursday Update - Summary

### In conclusion

- Thanks to our Instructors, **Kate Anderson** and **Rachel Shepherd**
- Click the link to complete an **evaluation** and **quiz**
- Receive a ***Certificate of Completion***
- Thank you for joining us!
- Register for the upcoming FEMP Training!

### Questions? Please contact:

Brad Gustafson: [Brad.Gustafson@ee.doe.gov](mailto:Brad.Gustafson@ee.doe.gov)

Rachel Shepherd: [Rachel.Shepherd@ee.doe.gov](mailto:Rachel.Shepherd@ee.doe.gov)

Kate Anderson: [Kate.Anderson@nrel.gov](mailto:Kate.Anderson@nrel.gov)

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FEMP would like to thank our instructors Kate Anderson and Rachel Shepherd. Thanks also to Beverly Dyer, FEMP's Training Director, and our production team.

Now, please click on the link in the lower right box which will take you to a brief quiz and short course evaluation. Completing these will provide *FEMP* with information to continue to improve its training offerings, and provide *you* with a Certificate of Completion.

We look forward to seeing you at our next First Thursday, on February 4th, when we will cover the Federal Energy and Water Management Awards. Thanks for joining us.

Learn more about upcoming FEMP Training opportunities:  
<https://www4.eere.energy.gov/femp/training>

### Questions? Please contact:

Brad Gustafson: [Brad.Gustafson@ee.doe.gov](mailto:Brad.Gustafson@ee.doe.gov)

Rachel Shepherd: [Rachel.Shepherd@ee.doe.gov](mailto:Rachel.Shepherd@ee.doe.gov)

Kate Anderson: [Kate.Anderson@nrel.gov](mailto:Kate.Anderson@nrel.gov)