U.S. DEPARTMENT of ENERGY | Federal Energy Management Program

REopt Federal User Support Session Two

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This presentation was produced when the laboratory operated as the National Renewable Energy Laboratory (NREL). The laboratory is now the National Laboratory of the Rockies (NLR).

Session 2 Overview

Agenda

I.	Welcome and Discussion
II.	Capability Overview & Demo: Evaluating Heat Pumps in REopt
III.	Federal Success Story: GHP at Denver Federal Center
IV.	Next Steps, Discussion, Q&A

Learning Objectives

- Understand **REopt capabilities and resources**.
- **Learn from federal colleagues** about how they're using REopt.
- **Discuss priorities for future REopt user support sessions**.

Presenters

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Welcome to Our Second REopt Federal User Support Session!

These sessions include:

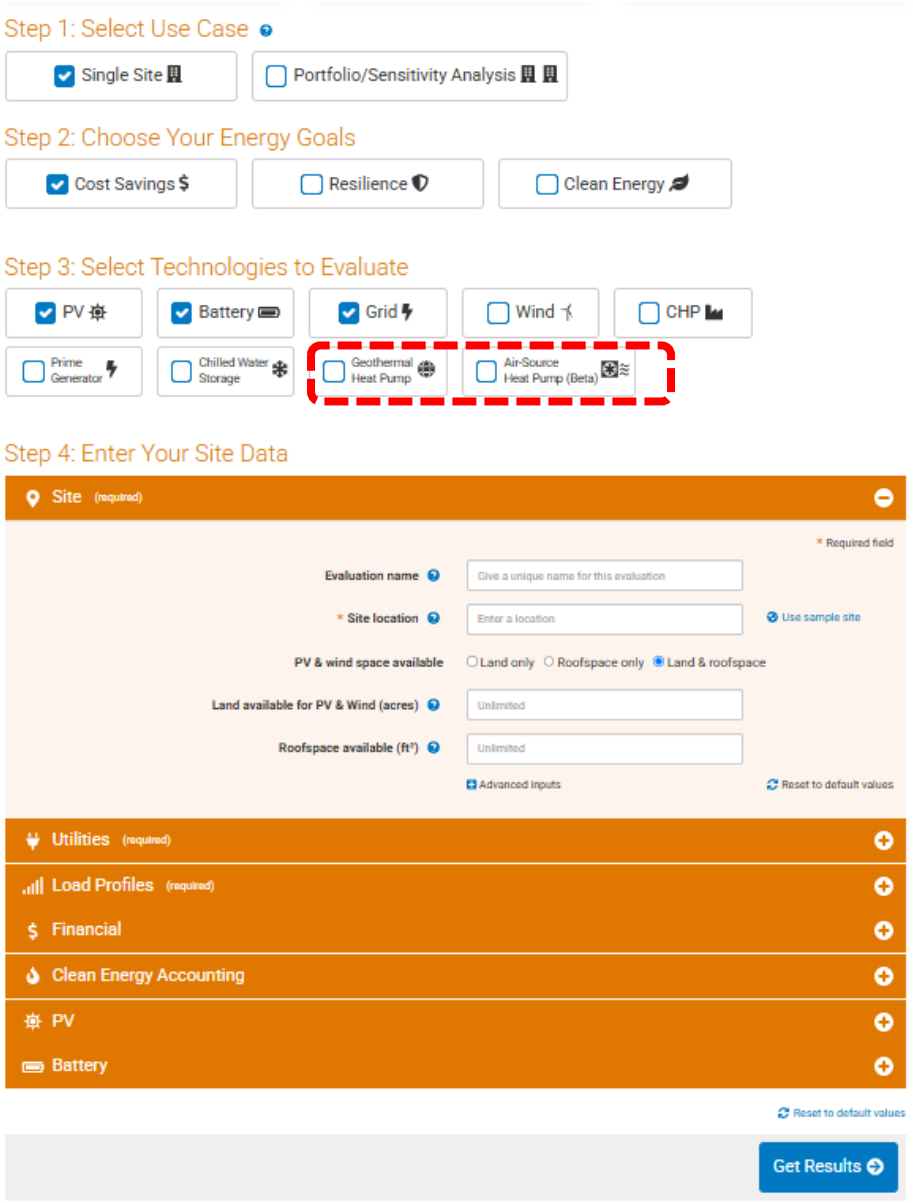
- Overviews of REopt capabilities
- Hands-on REopt trainings
- Discussion and feedback about the tool and user support
- Federal REopt case studies / success stories
- Open Q&A

We want these sessions to be helpful and engaging,
and we look forward to your input on the tool and sessions!

REopt Web Tool

REopt identifies the cost-optimal **system mix, sizing, and dispatch** for a building, campus, or microgrid to achieve site energy **cost savings** and **resilience** goals.

- Only **requires 3–4 user inputs** while offering hundreds of customizable inputs with default values
  - **Required:** Site location, energy consumption, and energy costs
  - **Optional:** Technology costs and performance, financial parameters
- Users specify their site's unique **energy goals** and **technologies of interest**
- Users can evaluate a **single site** or screen a **portfolio** of sites for distributed energy resource (DER) opportunities



REopt Web Tool: reopt.nrel.gov/tool

Recap Session 1:

Agenda	Session 1 topics
Poll and discussion	• What are you hoping to get out of these REopt federal user support sessions?
Federal REopt success story	• Lynn Chan, National Parks Service: REopt national-scale screening and detailed site analyses
Capability overview, demo, and resources	• REopt overview • Web tool demo: Basic PV and battery analysis • REopt resources and training materials
Optional homework	• Spend 15 minutes trying REopt on your own!

Discussion: On-Site Energy

1. **What types of on-site energy projects are you considering or actively working on? (e.g., technologies, goals)**

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2. **What are your biggest challenges/hurdles for these projects?**

Discussion: On-Site Energy

1. What types of on-site energy projects are you considering or actively working on? (e.g., technologies, goals)

2. What are your biggest challenges/hurdles for these projects?

3. **How familiar are you with REopt?**

Discussion: Experience using REopt

For those that have used the REopt web tool, either for last session's optional homework or for other purposes:

- What went well?
- What questions came up about how to use REopt?
- Feedback: I wish REopt could ____.

Capability Overview: Evaluating Heat Pumps in REopt

Bill Becker

What Is a Heat Pump?

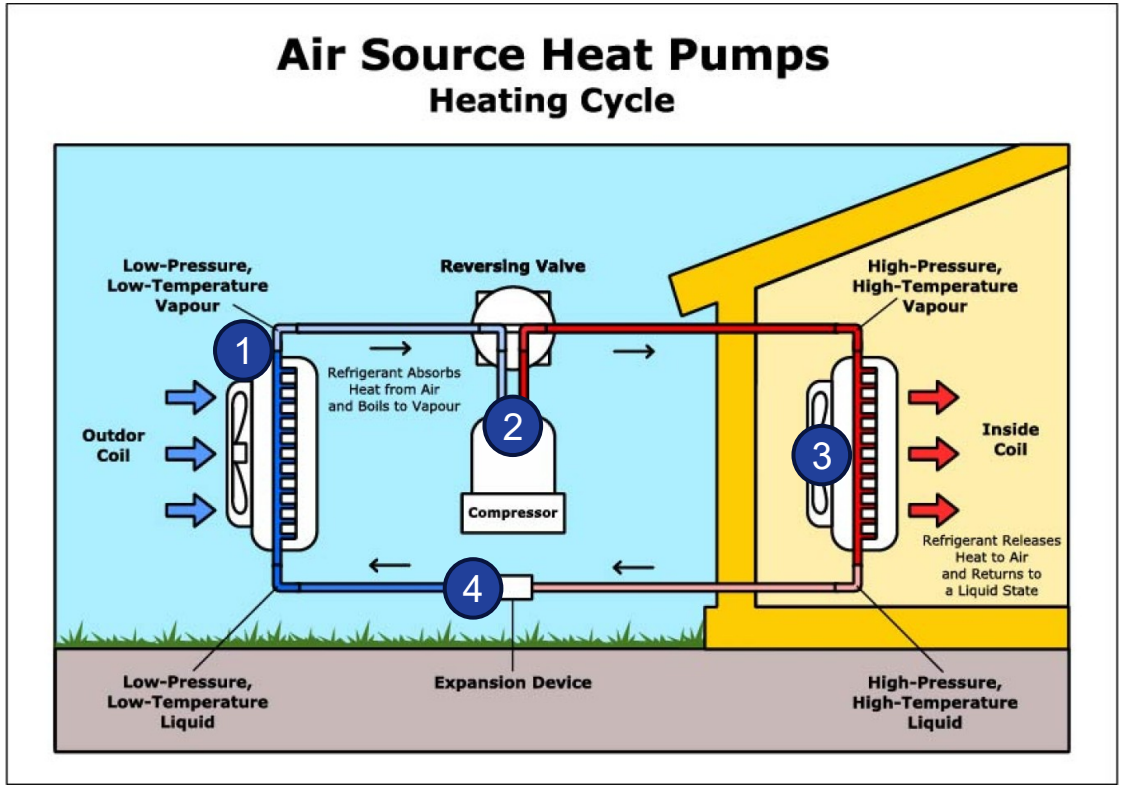
- A heat pump is a set of equipment used for **heating, ventilation, and air-conditioning (HVAC)** for space heating or cooling
- A heat pump operates as a refrigeration cycle which **transfers heat** from a **source** (e.g., outside air for **air-source heat pumps (ASHP)** or ground for **geothermal heat pumps (GHP)**) to a **sink** (e.g., inside space), and is **powered by electricity**
    - **Heating:** A heat pump extracts heat from the outside air or ground and delivers it to a conditioned space
    - **Cooling:** A heat pump extracts heat from the conditioned space and delivers it to the outside air or ground
- Heat pumps can be used to **replace or supplement** conventional HVAC equipment such as:
    - Natural gas boilers and furnaces, and resistive heaters for heating
    - Chillers and air-conditioning systems for cooling (which are also types of heat pumps)

How Do Air-Source Heat Pumps Work?

Heating mode, shown to the right:

1. **Outdoor air provides the heat (air-source)** for the evaporation of the refrigerant.
   - Refrigerant evaporates at very low temperatures, allowing it to absorb heat from cold outdoor air.
2. The compressor pressurizes the refrigerant while driving the flow of the cycle.
3. The pressurized vapor refrigerant is condensed by transferring heat to the indoor air, **heating the space.**
4. The condensed liquid is expanded to lower pressure and returns to the evaporator (outdoor unit) to repeat the cycle.

For cooling mode, the cycle is reversed and acts like an air-conditioning system.



https://www.energy.gov/energysaver/air-source-heat-pumps

How Do Geothermal Heat Pumps Work?

A GHP provides space heating and cooling from a **geothermal heat exchange (GHX) loop** that is placed in the ground and facilitates **heat exchange between the ground and the building**.

As with ASHPs, a **refrigeration cycle** facilitates energy transfer between the GHX loop and the building.

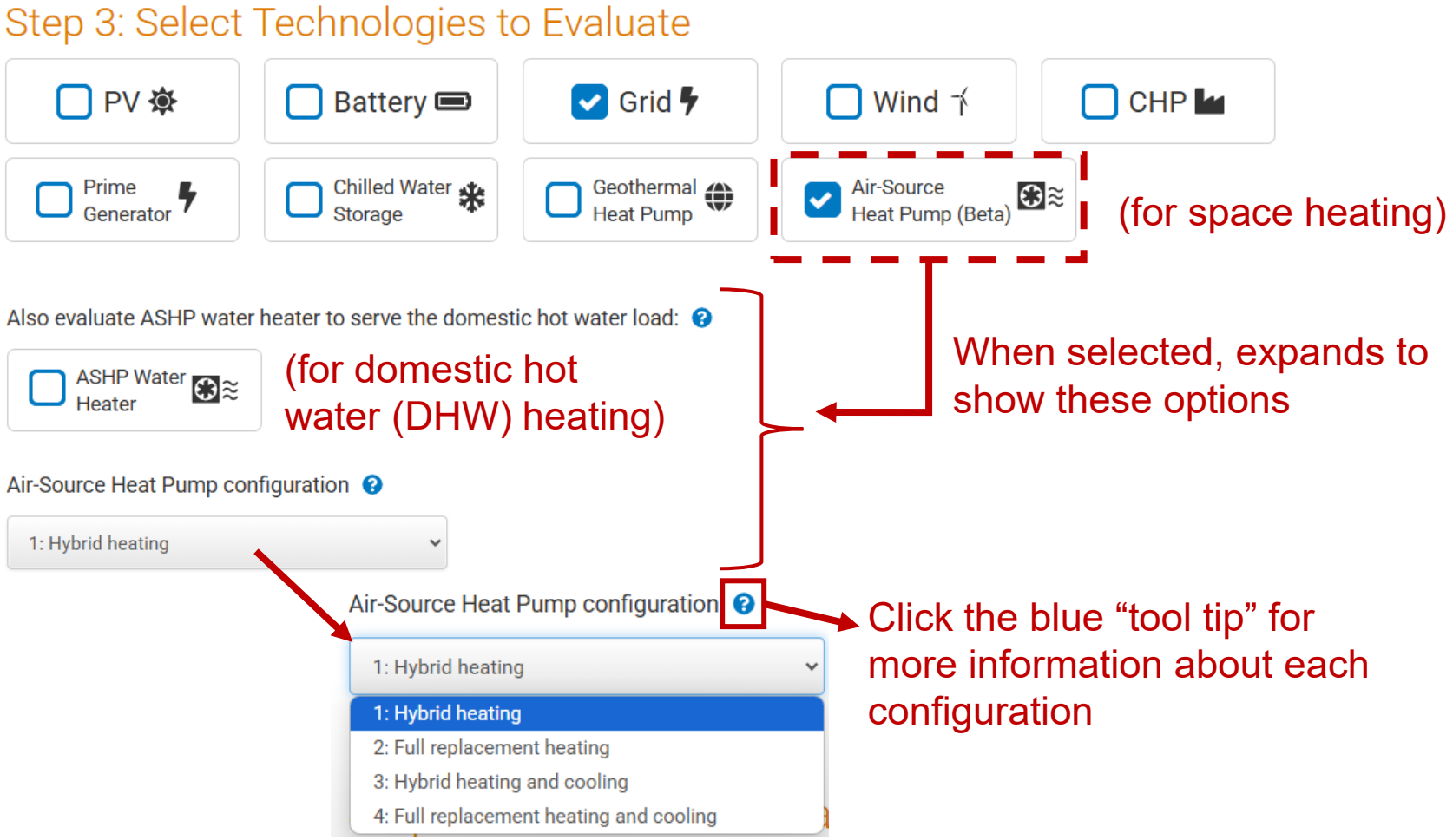
GHPs are sometimes called ground-source heat pumps, geo-exchange, earth-sourced, ground-coupled, etc.

A GHP **is not:**

- Direct use from a hot reservoir
- Power generation

Image Credit-NREL

ASHP Technology Selection in REopt Web Tool



GHP Technology Selection in REopt Web Tool

Require GHP in the solution?:

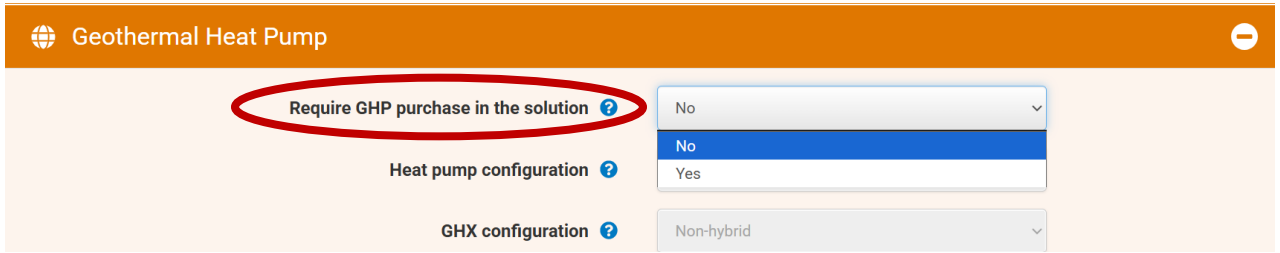
- Yes or no
- *Note: GHPs cannot currently be evaluated as supplementary to the existing system due to REopt's modeling framework*

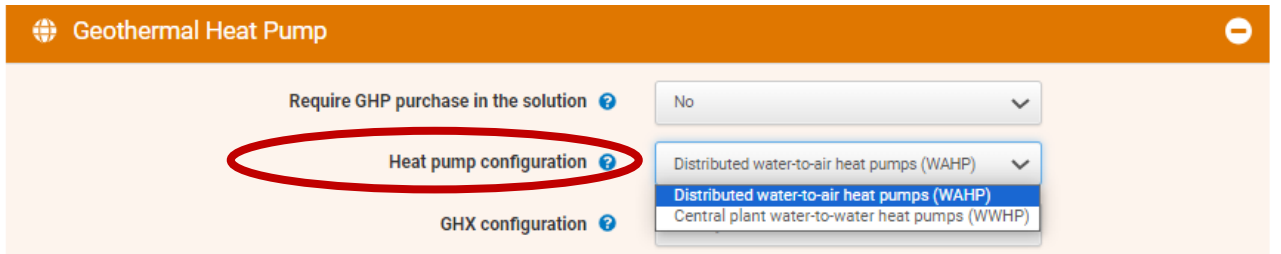
Heat pump configuration options:

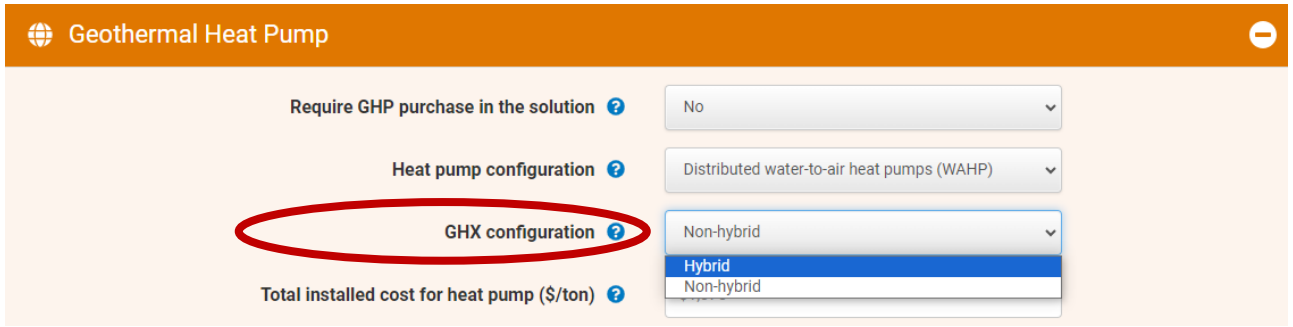
- **Distributed water-to-air heat pumps** (WAHP), sometimes called water-source heat pumps
- **Central plant water-to-water heat pumps** (WWHP)

Heat exchanger (GHX) configuration:

- **Closed loop, vertical bores** most common in commercial applications
- **Optional Hybrid GHX:**
  - Supplement heat sink/source with boiler or cooling unit
  - Can be used with WWHPs or distributed WAHPs
  - Not an option for sites with large-asymmetric heating and cooling loads







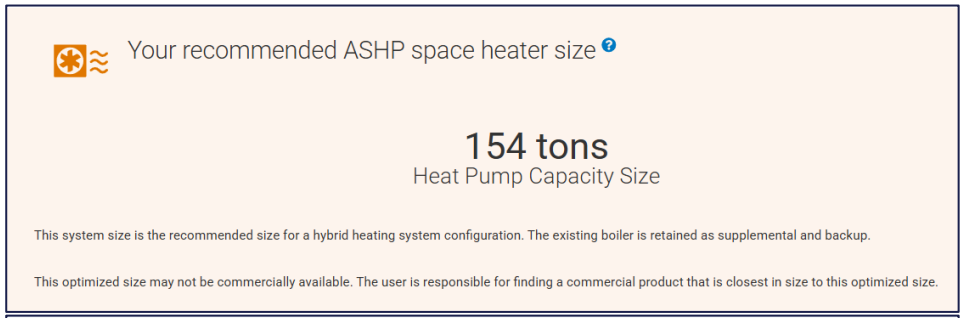
Heat Pump Results

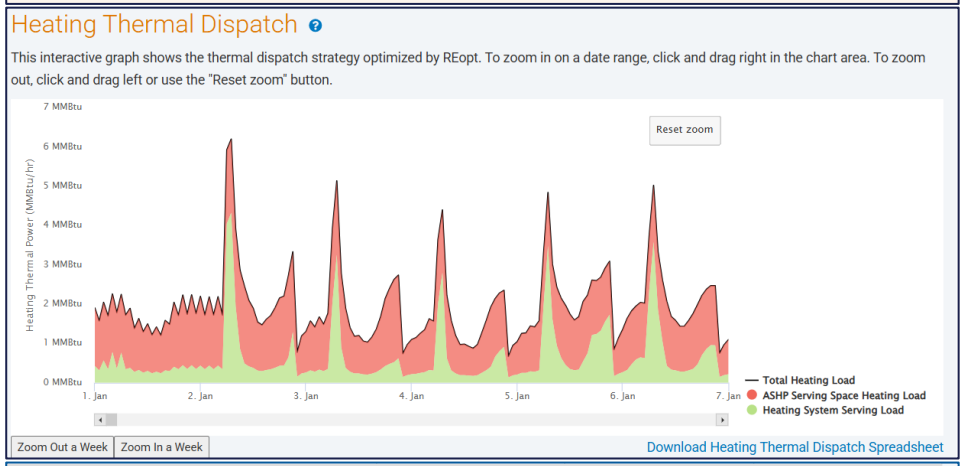
- Heat pump **size** (ton)
- **Operations** data for how the load is served, with or without the existing heating system
- Annual **energy** production
- Annual average **performance**
- And all the other outputs that REopt provides for any technology, such as investment costs, energy costs, and **financial metrics**

Size

Operations

Financials





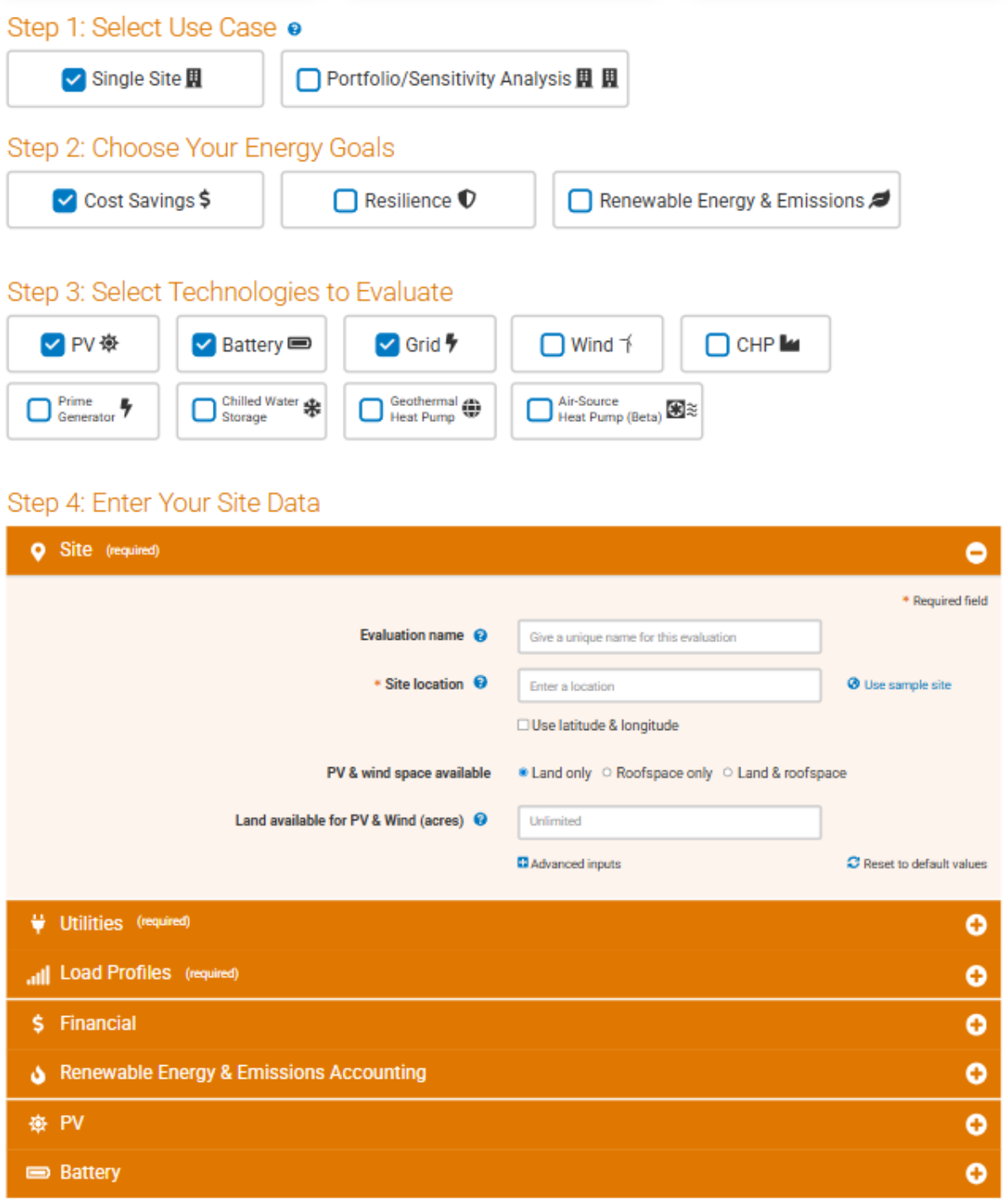
Year 1 Utility Electricity Cost — Before Tax			
Utility Export Benefit	$0	$0	$0
Utility Energy Cost	$478,529	$484,719	$6,190
Utility Demand Cost	$200,080	$209,195	$9,115
Utility Fixed Cost	$0	$0	$0
Utility Minimum Cost Adder	$0	$0	$0
Total Year 1 Utility Cost - Before Tax	$678,609	$693,914	$15,305
Year 1 Utility Fuel Cost — Before Tax			
Heating System Fuel Cost	$47,943	$2,314	-$45,629

REopt Demo

https://reopt.nrel.gov/tool

Notes:

- When evaluating multiple heat pump technologies concurrently, REopt will only pick one heat pump technology in the solution (or none).
- For faster solve times and to compare heat pump technology cost-effectiveness, consider running REopt multiple times.
- REopt offers high-fidelity screening for DER potential, but is not a design tool. Consultation with heat pump engineering companies is strongly recommended before making investment decisions.



Federal Success Story: Geothermal Heat Pumps at Denver Federal Center

Geothermal Heat Pump REopt Analysis at Denver Federal Center

GSA's Denver Federal Center has **distributed water-source heat pumps** connected to a building-interior water loop.

REopt was used to evaluate the integration of a **geothermal heat exchanger** into the heat pump system to replace (**non-hybrid**) or supplement (**hybrid**) the boiler and cooling tower used to maintain the water loop temperature within specified temperature limits.

The analysis suggested hybrid GHX could provide cost savings while the non-hybrid GHX may increase energy costs at this site.

https://www.energy.gov/femp/denver-federal-center-geothermal-heat-pump-reopt-analysis

Discussion, Q&A, Next Steps

What's New and What's Coming Soon in REopt

Recent Updates

- **Solar photovoltaics (PV) and battery cost scaling:** PV and battery cost assumptions adjust based on the likely system size (e.g., residential vs. commercial vs. industrial)
- **Portfolio and sensitivity analysis enhancements:** Screen multiple sites for DER opportunities or explore how key assumptions impact results.

Coming Soon (~1 month)

- **Federal default values:** Financial assumptions prescribed by statute for the federal sector
- **Simulate electric vehicle charging loads** to be considered in DER sizing
- **Concentrated solar thermal** as a technology option

Next Steps

- **Please help spread the word!** Who else do you know who might benefit from REopt?

- **Optional homework:** Spend 15 minutes using REopt to evaluate ASHP or GHP at your site! Jot down the following (and optionally email reopt@nrel.gov):
  - Questions about how to use REopt
  - Feedback: I wish REopt could _____.

- **Success stories? Feedback?** Please reach out to Valerie (valerie.michel@hq.doe.gov) and/or Kathleen (kathleen.krah@nrel.gov) to share how REopt is supporting energy decisions at your agency!

Additional REopt Resources

- **FEMP REopt training webinars:**
  - Evaluating Your Utility Rate Options
  - Additional recent REopt training webinars to be posted for on-demand access in the coming months.

- **General REopt Resources:**
  - YouTube Tutorial Series: youtube.com/watch?v=DEeCdVfU0VU&feature=emb_logo
  - User Manual: reopt.nrel.gov/tool/reopt-user-manual.pdf
  - User Forum: github.com/NREL/REopt-Analysis-Scripts/discussions
  - Project Examples: nrel.gov/reopt/projects/

Request Project Assistance!

Review FEMP's Distributed Energy Technical Assistance services.

Ready to start? Request Technical Assistance.

Q&A

Thank you!

Valerie Michel (FEMP), valerie.michel@hq.doe.gov
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