



Model Selection Platform for Energy Storage

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Project Overview

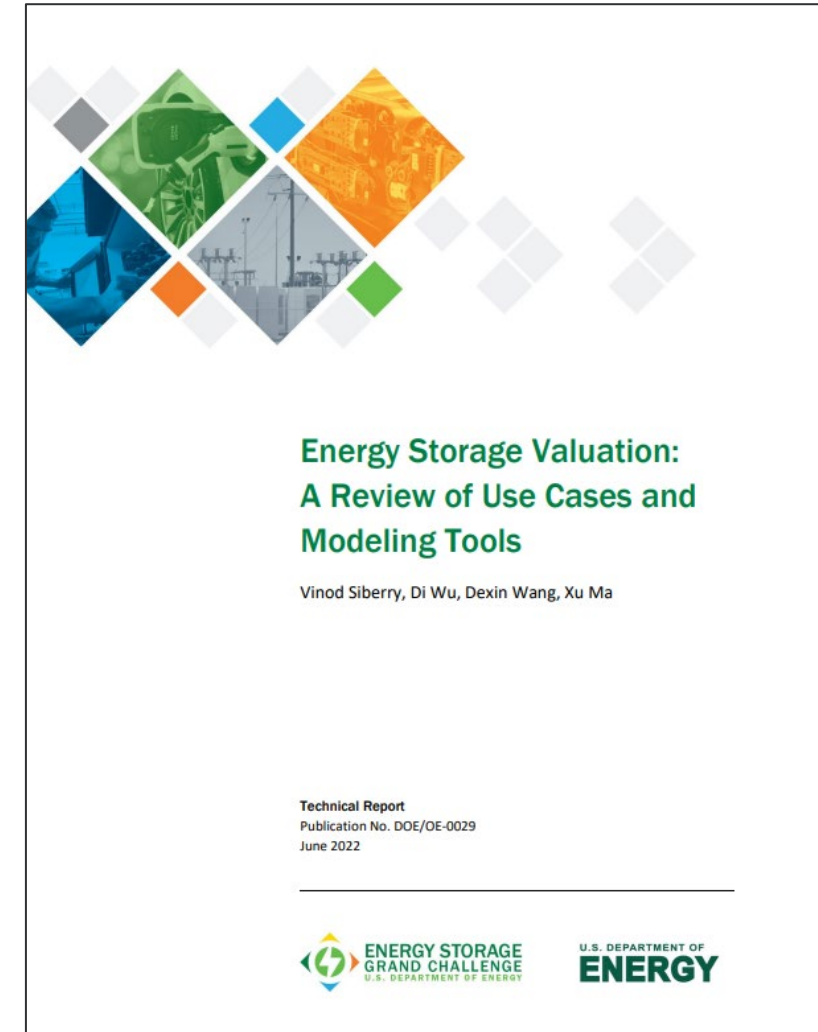
- **Project Goal:** One-stop and user-friendly portal that guides users to the most suitable tools for energy storage technology R&D, economic valuation, and grid integration studies.
- **Current Practice:** Stakeholders lacked visibility into available tools and had to sift through informal channels, disconnected websites, and inconsistent documentation, leading to delays, redundant efforts, and missed opportunities.
- **Why PNNL:** PNNL combines unique storage modeling capabilities, broad expertise across technologies and use cases, extensive experience in tool development, and a proven record of turning analytics into decision support for various stakeholders.
- **Innovation:** A publicly accessible platform that provides a comprehensive overview, detailed tool comparisons, an interactive wizard, and an AI assistant to map users' needs with storage tools and capabilities developed across DOE labs.
- **Impact:** Reduce missed opportunities, strengthen planning efforts, accelerate informed decision-making, and support broader use of cost-effective energy storage solutions.
- **Alignment:** MSP helps stakeholders identify the right tools to support storage development, assessment, deployment, and validation for a more reliable, affordable, and resilient grid.

Background and Motivation

- Rich Landscape of Energy Storage Tools
 - Diversified scopes, data needs, functionalities and capabilities, platforms, and license terms
 - Provide stakeholders with many options—but make the selection challenging and time-consuming
- Why Static Comparison Tables Are Insufficient
 - Tools must be organized by purpose to reveal their strengths
 - Each category needs tailored attributes (e.g., temporal resolution for production-cost vs. degradation modeling for R&D)
 - Generic matrices still leave stakeholders unsure which tool best fits their specific objectives, skills, and data
- MSP Objectives
 - Create a centralized library that organizes this rich ecosystem of DOE's capabilities
 - Offer configurable, category-specific comparisons that reveal differences at a glance
 - Provide ranked recommendations aligned with individual stakeholders' needs

Over the Past Years

- MSP Report
 - Review and compare tools for different use cases
- MSP Web App
 - Initially focused on price-taker valuation tools
 - Expanded to include 60+ DOE tools related to storage
 - ✓ Energy Storage Technology
 - ✓ Price-Taker Valuation
 - ✓ Production Cost Modeling
 - ✓ Supporting Tool
 - Landing Page
 - ✓ Systematic taxonomy
 - ✓ Filters & Search
 - Comparison Tables
 - ✓ Quick and customizable comparisons across multiple tools
 - ✓ Tailored list of capabilities and features for each category
 - Selection Wizard



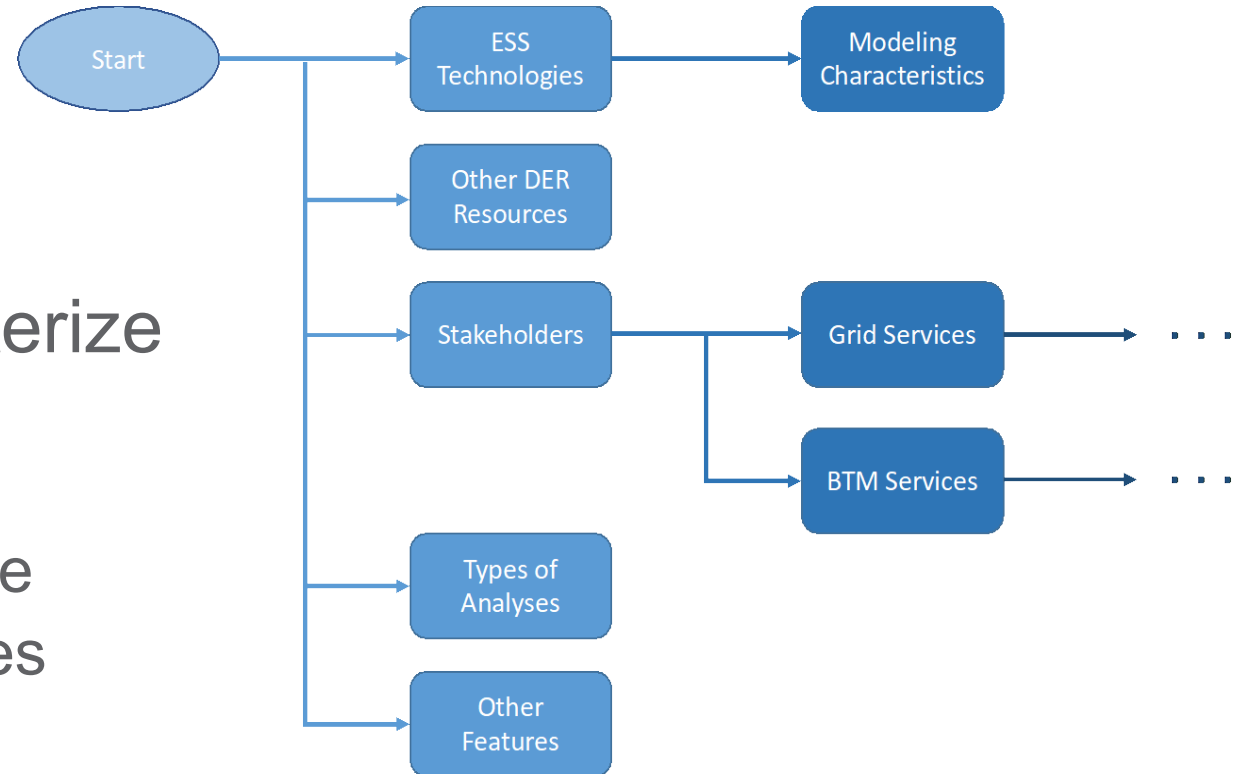
Selection Wizard

Core of the Select Wizard

- Specification discovery procedure
- Dynamic scoring engine

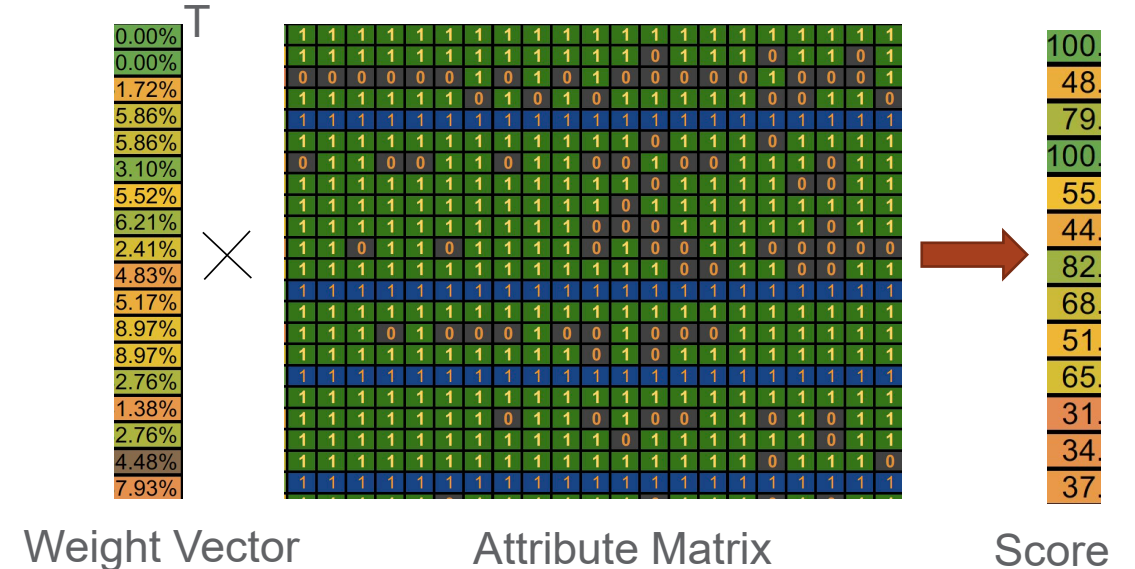
Key Attributes Used to Characterize Valuation and Planning Tools

- Available storage technologies
- Other resources paired with storage
- Available grid and end-user services
- Types of analyses
- Software distribution and other features/capabilities



A Two-Stage Scoring Method

- Offline Setup
 - A static binary matrix is generated to describe the capabilities of individual tools with respect to the identified key attributes
 - Weights are assigned to different groups of attributes based on our experience in various storage assessment projects
- Online Calculation
 - Distribute the weights at the group level to individual discovered specifications as they are collected from users
 - Scores are calculated dynamically by multiplying the weight vector by the attribute matrix

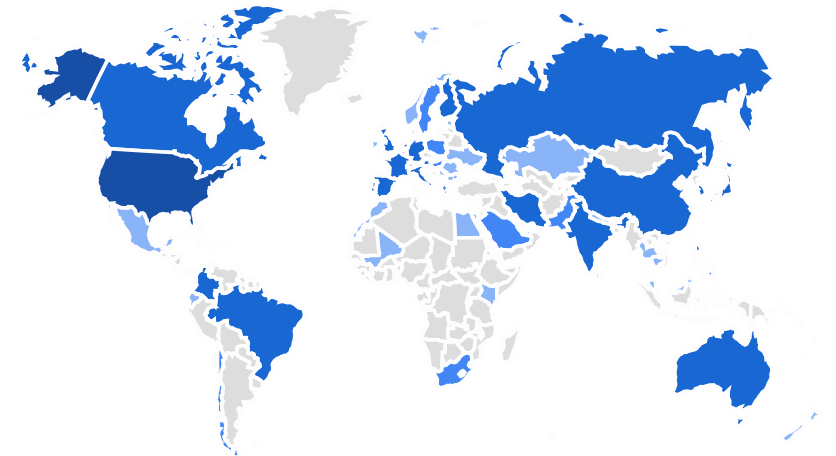


FY25 Progress & Updates

- Updated Existing Tools
- Integrated additional DOE and non-DOE Tools
 - 12 additional tools (76 tools in total)
 - Examples: PSHVT, A-LEAF, ICE, DER-VET, XENDEE
- User Survey for Feedback on Content and Functionality
 - Overall Experience: 6.2 of 7
 - Useful feedback on desired features
- Comprehensive Mobile-Friendly Design Update
- Retrieval Augmented Generation (RAG) based AI Assistant

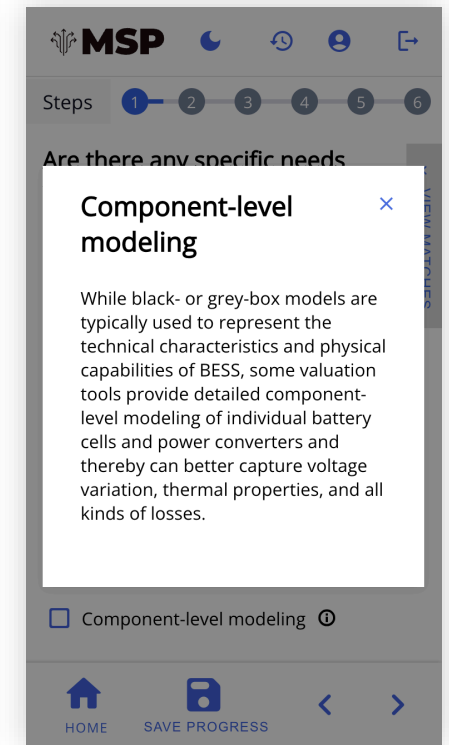
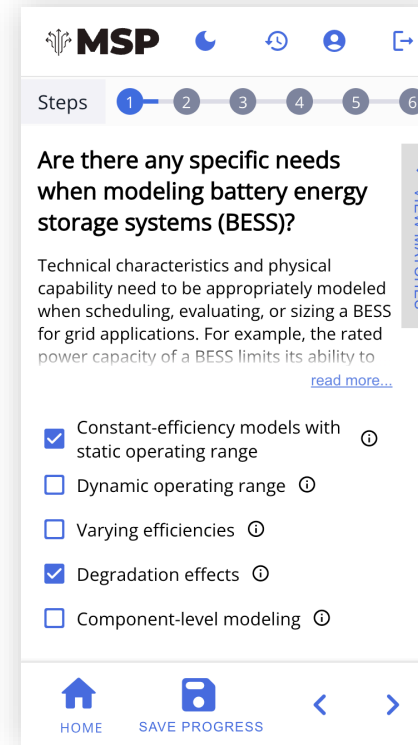
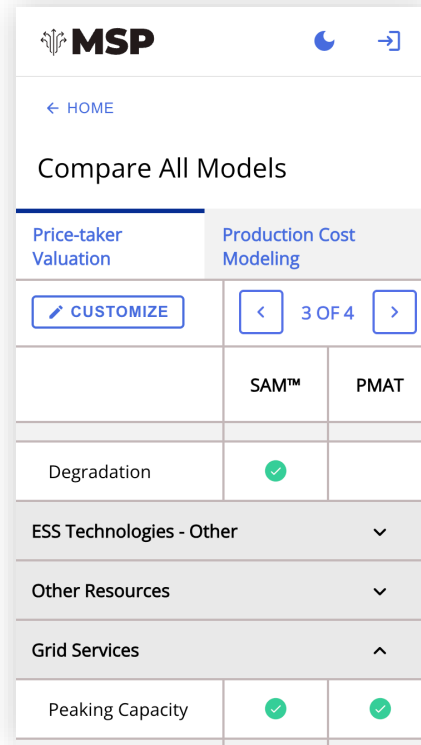
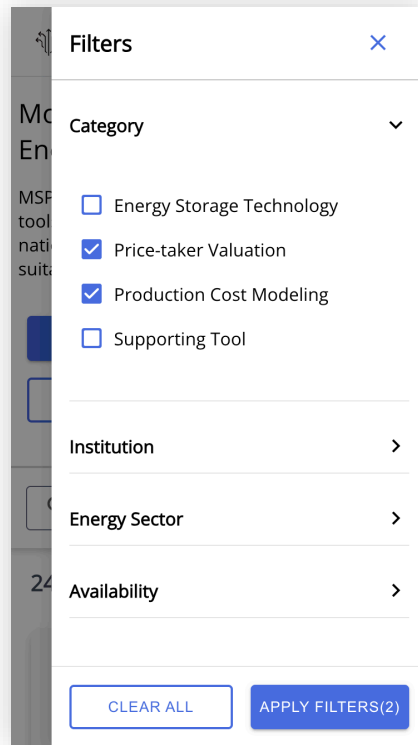
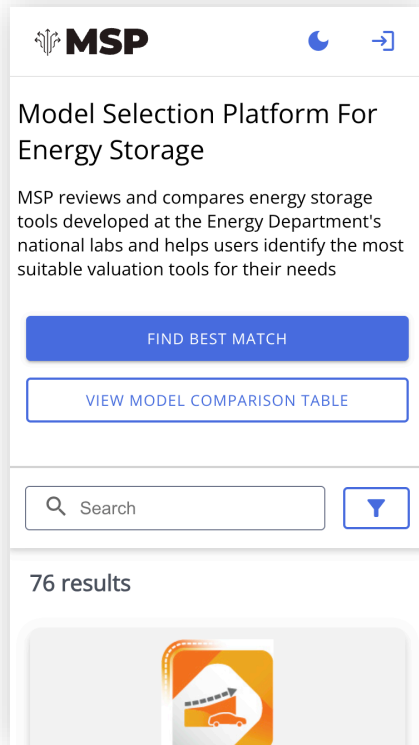
2.7K Users

Around the World
since July 2022



Comprehensive Mobile-Friendly Design Update

- Filter layout and interaction on the landing page
- Comparison table navigation and customization
- Progress and help info presentation in the selection wizard



MSP AI Assistant

- An AI-powered assistant that helps users find useful information about energy storage tools included in MSP
- How It Works – Retrieval augmented generation (RAG)
 - We organize the knowledge about energy storage tools into a “knowledge base”
 - ✓ Carefully maintained content in MSP
 - ✓ Official webpages of tools
 - When users ask questions, the assistant
 - ✓ Searches through the knowledge base for most relevant information
 - ✓ Uses the large language model (LLM) to understand the question and provide clear and helpful answers
- Why RAG?
 - More Accurate: The AI assistant gives answers based on our curated documentation, instead of general knowledge the LLM was trained with
 - Always Up-to-date: Easy to update with new information about tools and features

MSP AI Assistant Examples

Example Q&As – General/specific, different stakeholders and use cases

MSP AI Assistant beta

I'm a large retailer business. How can energy storage help me?

As a large retail business, energy storage systems can provide several key benefits:

1. Cost Management:
 - Reduce electricity bills by storing energy when rates are low and using it during high-rate periods
 - Lower demand charges by decreasing power consumption during peak hours
2. Operational Benefits:
 - Provide backup power capability to maintain critical operations during outages
 - Help maintain consistent power quality for your facilities
3. Financial Advantages:
 - Potential to participate in utility programs that offer incentives for power management
 - Ability to defer costly electrical infrastructure upgrades

Which type of energy storage is best for me?

For retail businesses, battery energy storage systems are typically the most practical choice due to:

1. Proven Technology:
 - Mature and reliable technology with high energy density
 - Multiple proven options including lithium ion and flow batteries

Ask AI Assistant a question

MSP AI Assistant beta

As a utility, how do I compare the economic value of different energy storage systems?

To compare the economic value of different energy storage systems, utilities should consider these key approaches:

1. Choose the appropriate valuation method:
 - For small-scale storage systems: Use price-taker valuation tools
 - For large-scale storage systems: Use production cost modeling (PCM) tools that account for market price impacts
2. Evaluate multiple value streams:
 - Peaking capacity benefits
 - Energy arbitrage opportunities
 - Frequency regulation services
 - Transmission and Distribution (T&D) investment deferral
 - System resilience benefits
3. Consider technical characteristics:
 - Cost and efficiency
 - System lifetime and degradation
 - Duration and power output capabilities
 - Response time and ramp rates

Important note: While most benefits can be monetized, some values like resilience improvements should be evaluated separately using specific

Ask AI Assistant a question

MSP AI Assistant beta

Is there a tool that can estimate the value resilience improvement using energy storage?

Yes, there are several tools that can help estimate resilience improvement using energy storage. Two notable tools are:

1. Energy Storage Evaluation Tool (ESET™) - Developed by Pacific Northwest National Laboratory, this tool can evaluate various types of energy storage systems including batteries, hydrogen, microgrids, and thermal storage. It can examine multiple use cases and grid applications to maximize benefits from stacked value streams.
2. REopt - Developed by NREL, this tool can specifically evaluate resilience improvements by:
 - Calculating the value of resilience based on avoided power interruption costs
 - Optimizing energy storage system size and duration for resilience
 - Determining the cost-optimal backup power system design when considering resilience value

It's important to note that resilience benefits are typically measured through metrics such as:

- Survivability against random outages
- Total unserved energy
- Duration and magnitude of affected load during outages
- Financial losses from unserved energy

Ask AI Assistant a question

Look Forward

- Library Expansion
 - Standards
 - Additional non-DOE tools
- Enhanced Presentation of Relationships
 - Interactive visualization based on a force-directed graph
 - Link tools, institutions, sectors, and categories, etc.
- Self-Service Portal for Developers
 - Add new tools that haven't been included yet
 - Update descriptions, screenshots, and other information as needed
- AI-Assisted Modeling Workflow
 - Natural-language model builder to lower the user barrier
 - Automated result interpretation to accelerate scenario exploration

Acknowledgment

This material is based upon work supported by the U.S. Department of Energy, Office of Electricity, Energy Storage Division.

The Office of Electricity leads the U.S. Department of Energy's research and development to strengthen and modernize our nation's power grid to maintain a reliable, affordable, secure, and resilient electricity delivery infrastructure.

<https://www.energy.gov/oe/energy-storage>



Thank You

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