ES-Select™: A Decision Support Tool

Selecting best-fit energy storage technologies

U.S. DEPARTMENT OF ENERGY | Electricity Delivery & Energy Reliability

Energy Storage Program

DNV KEMA

The best storage device is the one that best fits the application's needs at the lowest total cost. However, finding that best-fit device is not easy. Comparing energy storage devices is complicated by a wide variety of operational and business-related factors including differences in deliverable power, efficiency, discharge time, and cycle life and decisions about the actual installed cost of the device, the number of applications the device can be applied to, and the ability to monetize the intended benefits of the application. These factors ultimately impact the return on investment of these systems.

DNV KEMA developed the Energy Storage Select (ES-Select™) decision-support tool to help users identify feasible energy storage technology options as well as provide the probability of reaching a payback point and the statistical distribution of the payback year. ES-Select™ is a sophisticated, highly interactive model that offers a means to conduct careful analysis of the many interrelated factors that influence energy storage performance. It compares feasible energy storage applications; handles uncertainties in application value, storage cost, cycle life, efficiency, and discharge duration; and chooses a storage technology for multiple simultaneous applications. It provides a graphical comparison of statistical distributions for feasible energy storage options and allows users to change default values and add new storage technologies to the model database.

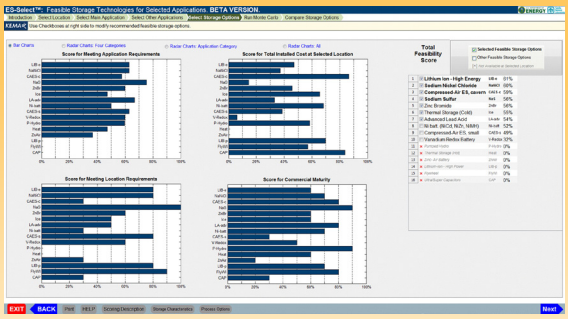
Overview

The Office of Electricity Delivery and Energy Reliability's (OE's) Energy Storage Program is funding research to improve understanding and identification of available energy storage options. U.S. Department of Energy (DOE) stimulus grants have accelerated the development of emerging storage projects, and now commercialization is key in providing feasible and cost-effective solutions while providing quality and reliable electricity.

DOE funded the $178 million Pacific Northwest Smart Grid Demonstration Project to test and measure new smart grid technologies and analytical tools. DNV KEMA was among the funding recipients, and it formed a partnership with NorthWestern Energy to construct a smart grid among 200 Montana utility customers. DNV KEMA will provide smart grid consulting, oversee the installation, work with customers on equipment use and benefits, and manage the educational components of the campaign.

Interface Example

ES-Select™ offers end users and developers a means to conduct careful analysis of the many interrelated factors that influence energy storage performance and the total cost of owning an energy storage system for any desired application or set of combined applications.



Model Inputs

The ES-Select™ decision-support model helps users select feasible energy storage options for their specific grid applications.

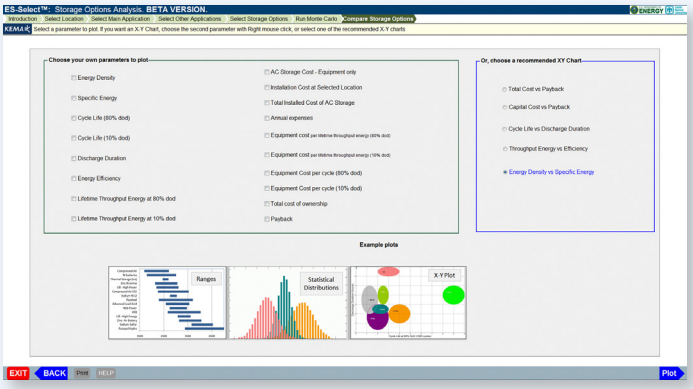
- All required inputs have "recommended default values" to be modified by the user, if needed
- Treats all input data uncertainties or ranges as "statistical distributions"
- Offers a database of grid applications and allows the user to modify values
- Allows multiple grid storage applications to be combined for a higher value
- Allows users to introduce new energy storage technologies to the database
- Uses Monte Carlo analysis to handle uncertainties in cost, benefit, cycle life, efficiency, discharge duration, and other parameters
- Allows users to change energy storage and application data

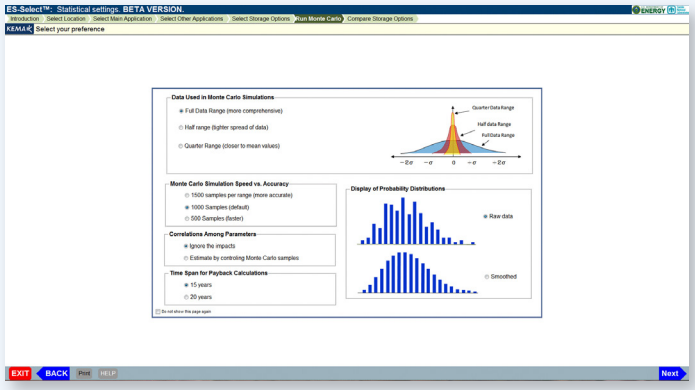
Model Outputs

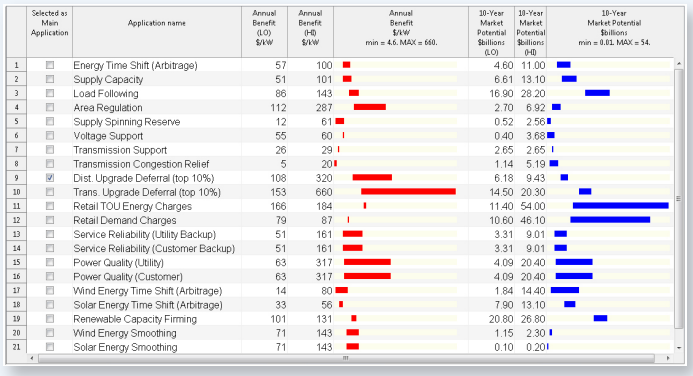
The ES-Select™ report offers presentation-ready comparison charts and tables of financial and technical characteristics for use in the business case development process:

- Discounts the value of combined energy storage applications based on their compatibility
- Identifies and ranks feasible energy storage options and allows users to overwrite the findings
- Maps feasible energy storage options against each other
- Plots distribution of "payback" time
- Gives probability of reaching a payback point as a function of cost or benefit
- Provides a sensitivity analysis to determine the required cost adjustment to improve payback
- Considers incompatibility between multiple applications to assess total value
- Scores the feasibility of different energy storage technologies and ranks them for the selected application(s)
- Offers graphical comparison of cost, payback, and other key parameters

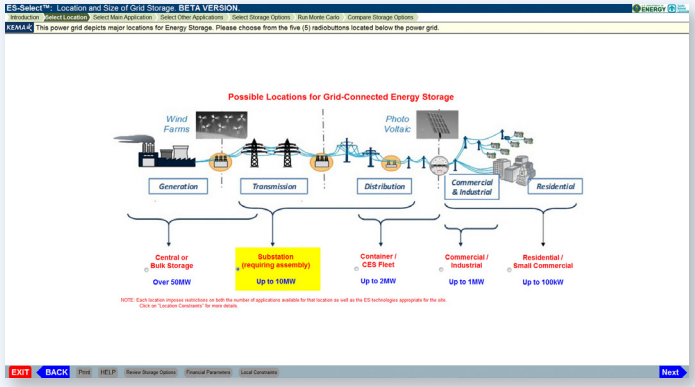
Additional Interface Examples







	Selected as Main Application	Application name	Annual Benefit (LO) $/kW	Annual Benefit (HI) $/kW	Annual Benefit $/kW min = 4.6, MAX = 660.	10-Year Market Potential $billions (LO)	10-Year Market Potential $billions (HI)	10-Year Market Potential $billions min = 0.01, MAX = 54.
1	☐	Energy Time Shift (Arbitrage)	57	100		4.60	11.00	
2	☐	Supply Capacity	51	101		6.61	13.10	
3	☐	Load Following	86	143		16.90	28.20	
4	☐	Area Regulation	112	287		2.70	6.92	
5	☐	Supply Spinning Reserve	12	61		0.52	2.56	
6	☐	Voltage Support	55	60		0.40	3.68	
7	☐	Transmission Support	26	29		2.65	2.65	
8	☐	Transmission Congestion Relief	5	20		1.14	5.19	
9	☑	Dist. Upgrade Deferral (top 10%)	108	320		6.18	9.43	
10	☐	Trans. Upgrade Deferral (top 10%)	153	660		14.50	20.30	
11	☐	Retail TOU Energy Charges	166	184		11.40	54.00	
12	☐	Retail Demand Charges	79	87		10.60	46.10	
13	☐	Service Reliability (Utility Backup)	51	161		3.31	9.01	
14	☐	Service Reliability (Customer Backup)	51	161		3.31	9.01	
15	☐	Power Quality (Utility)	63	317		4.09	20.40	
16	☐	Power Quality (Customer)	63	317		4.09	20.40	
17	☐	Wind Energy Time Shift (Arbitrage)	14	80		1.84	14.40	
18	☐	Solar Energy Time Shift (Arbitrage)	33	56		7.90	13.10	
19	☐	Renewable Capacity Firming	101	131		20.80	26.80	
20	☐	Wind Energy Smoothing	71	143		1.15	2.30	
21	☐	Solar Energy Smoothing	71	143		0.10	0.20	



Technical Challenges

- High cost of components
- Uncertain application values and the values of combined applications of different compatibilities
- Difficult to compare feasible technologies
- Uncertain total cost and value complicates determining the payback

Project Partners

- Sandia National Laboratories
  http://www.sandia.gov
- DNV KEMA
  http://www.dnvkema.com

For More Information

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Related Reading

DNV KEMA, "ES-Select™ Tool," *http://www.sandia.gov/ess/esselect.html.*

Sandia National Laboratories, "Energy Storage Systems Program (ESS)," *http://www.sandia.gov/ess/.*

Importance of Energy Storage

Large-scale, low-cost energy storage is needed to improve the reliability, resiliency, and efficiency of next-generation power grids. Energy storage can reduce power fluctuations, enhance system flexibility, and enable the storage and dispatch of electricity generated by variable renewable energy sources such as wind, solar, and water power. The Office of Electricity Delivery and Energy Reliability Energy Storage Program funds applied research, device development, bench and field testing, and analysis to help improve the performance and reduce the cost of energy storage technologies.

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