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QuESt Update: Energy Storage Technology Selection Tool

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Abstract

Many factors must be taken into consideration when designing an energy storage (ES) system, so that it is cost-effective, profitable, and meets the minimum technical requirements. QuESt is a suite of applications for ES simulation and analysis; however, its previous version did not include a planning functionality. In this work, we propose an ES technology selection tool that has been integrated into the latest QuESt version. This tool requires the user to input the deployment location of the ES system and the desired grid applications. Then, based on pre-loaded databases, ES technologies are ranked to indicate the best fit to the user selections.

Motivation:

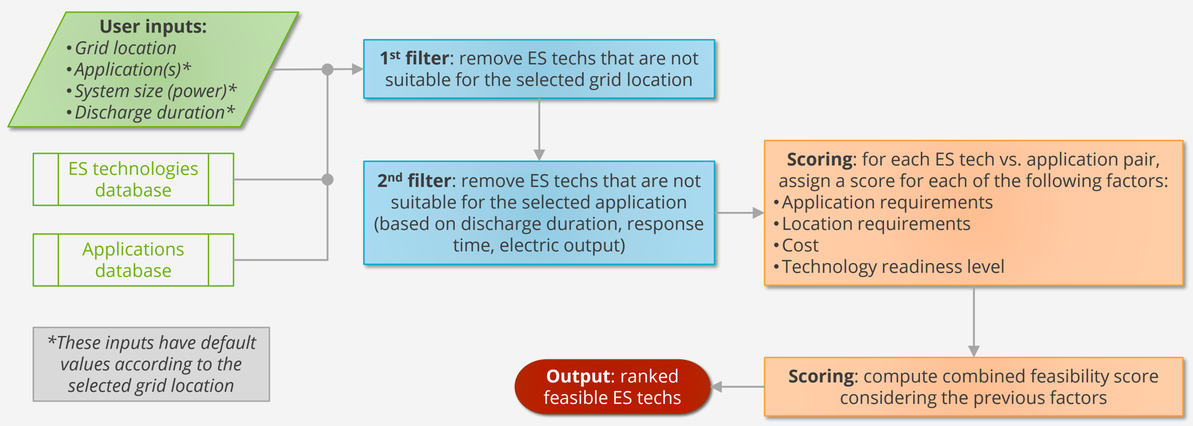
- ES technologies offer a wide range of capabilities, such as:
  - Small (few kW) to very large (GW) systems;
  - Short (few minutes) to long (10+ hours) discharge duration;
  - Low (50-60%) to high (>90%) round-trip efficiency;
  - Short (<5 years) to long (40+ years) calendar life.

- Grid applications have diverse minimum requirements:
  - Power vs. energy applications;
  - Short vs. long discharge duration;
  - Fast vs. slow response time.

Goal:

- Develop a decision support tool to perform initial screening to help users identify feasible ES technologies for a given project.

Tool Overview:



Inputs:

- Databases containing parameters to characterize each ES technology and application.
  - Rated discharge duration, round-trip efficiency, cycle life, response time to full power, cost, maturity level, deployment location restrictions, and so on.
- User inputs:
  - Grid location: transmission/central, distribution, commercial/industrial, residential;
  - Application: black start, upgrade deferral, energy arbitrage, operating reserves, peak shaving, and so on;
  - System size: 10 kW, 100 kW, 1 MW, 10 MW, 100 MW;
  - Discharge duration: from 0.5 hour to 10 hours.

Computation Approach:

1. Feasibility Criteria

- Some technologies are not feasible to be deployed at all grid locations.
- Some technologies do not meet the minimum application requirements.
- Technologies that do not meet **both** the grid location **and** application feasibility criteria are not considered for further analysis.

2. Scoring of Feasible Technologies

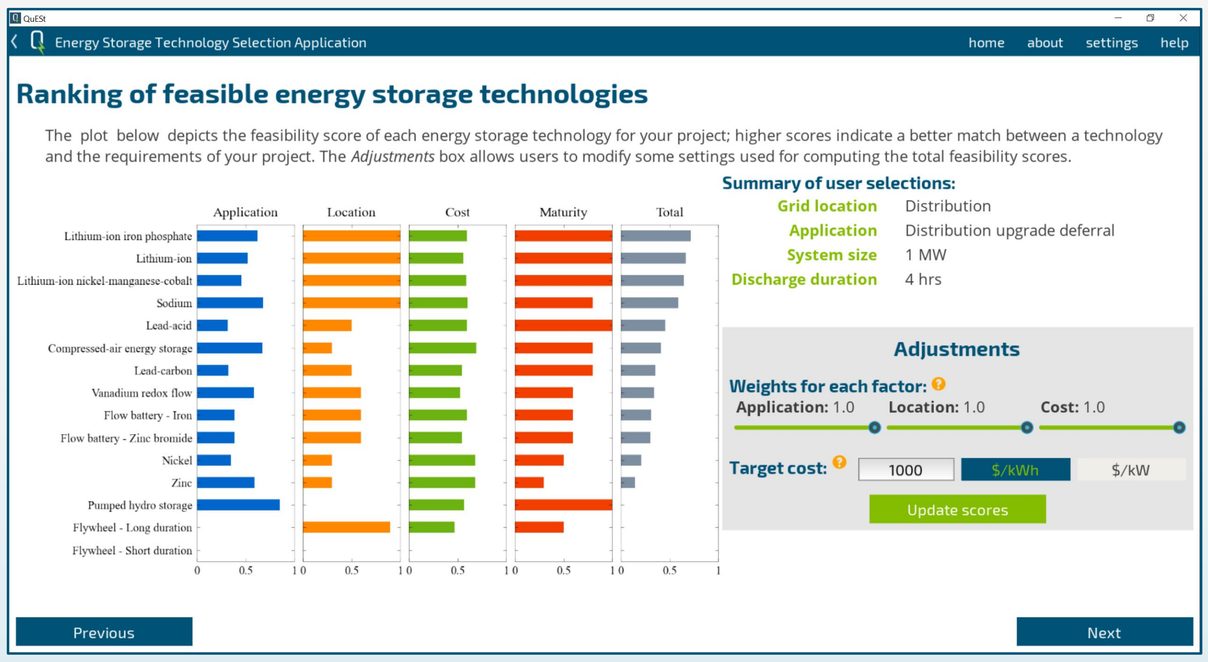
- The feasible technologies are scored with respect to:
  - Application requirements
  - Location requirements
  - Cost
  - Maturity
- By default, all four factors have the same weight in the final computation, but users can alter those weights.

3. Output:

- Ranking of all feasible energy storage technologies.

Example:

- User selections:
  - Grid location: distribution
  - Application: distribution upgrade deferral
  - System size: 1 MW
  - Discharge duration: 4 hours



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