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An Energy Storage Application Suite

PRESENTED BY

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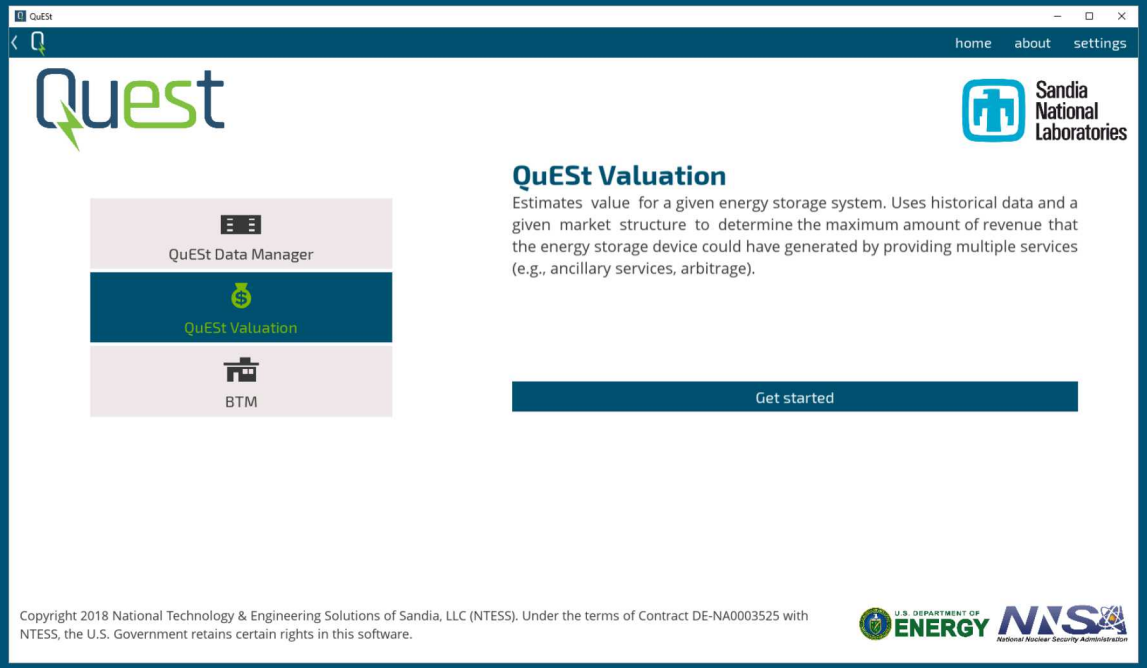
What is it?



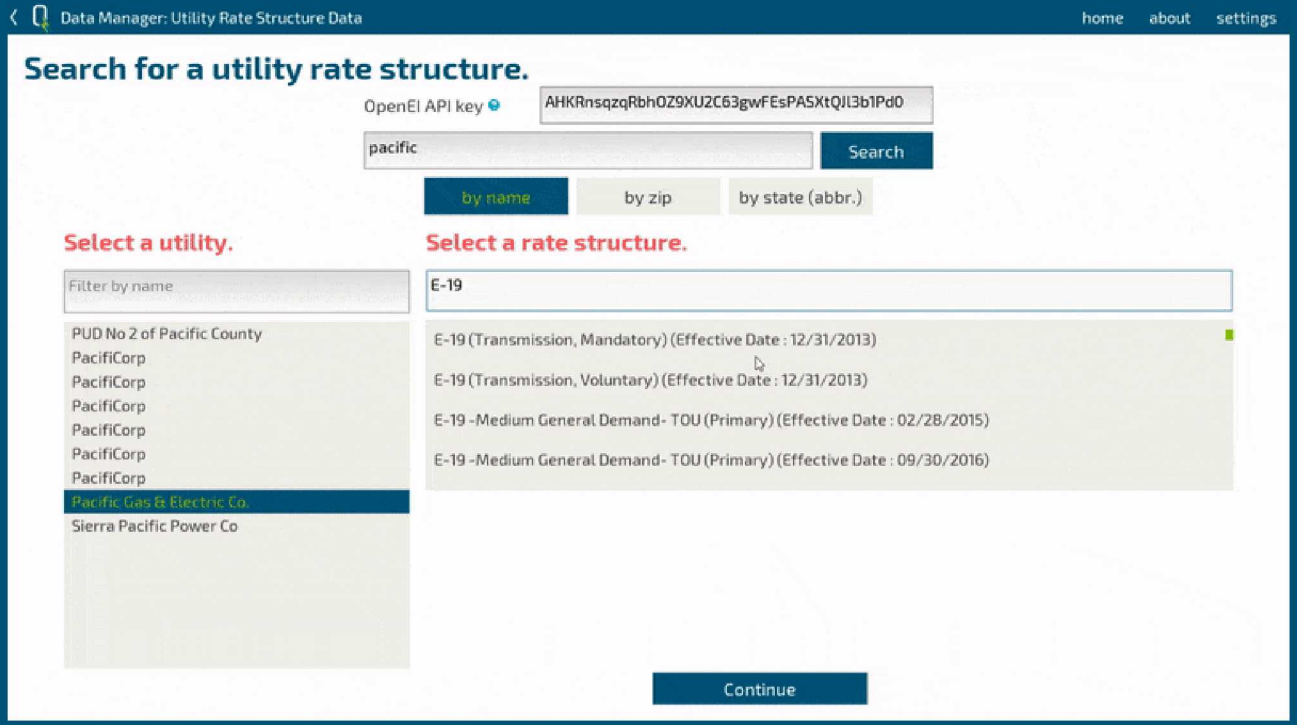
- Open source, Python-based energy storage analysis software application suite
- Developed as a graphical user interface (GUI) for the optimization modeling capabilities of Sandia's energy storage analytics group
- Initial development driven by optimization models for energy storage valuation
- Version 1.0 publicly released in September 2018
- Version 1.1 publicly available on GitHub
  - github.com/rconcep/snl-quest
  - Or on sandia.gov/ess

Why QuESt?

- For energy storage project stakeholders
  - Accessible and easy-to-use software tool for energy storage valuation and related applications
- For engineers/developers
  - Open source software project
  - Pyomo models and other code can be tweaked to fit specific needs
- It's free
  - Written in Python; no software licenses required
- Current application list
  - QuESt Data Manager – Manages acquisition of ISO market data, US utility rate data, commercial and residential load profiles, etc.
  - QuESt Valuation – Estimates potential revenue generated by energy storage systems providing multiple services in the electricity markets of ISOs/RTOs
  - QuESt BTM* - Estimates the cost savings for time-of-use/net energy metering customers using behind-the-meter energy storage systems

* For v1.2 release

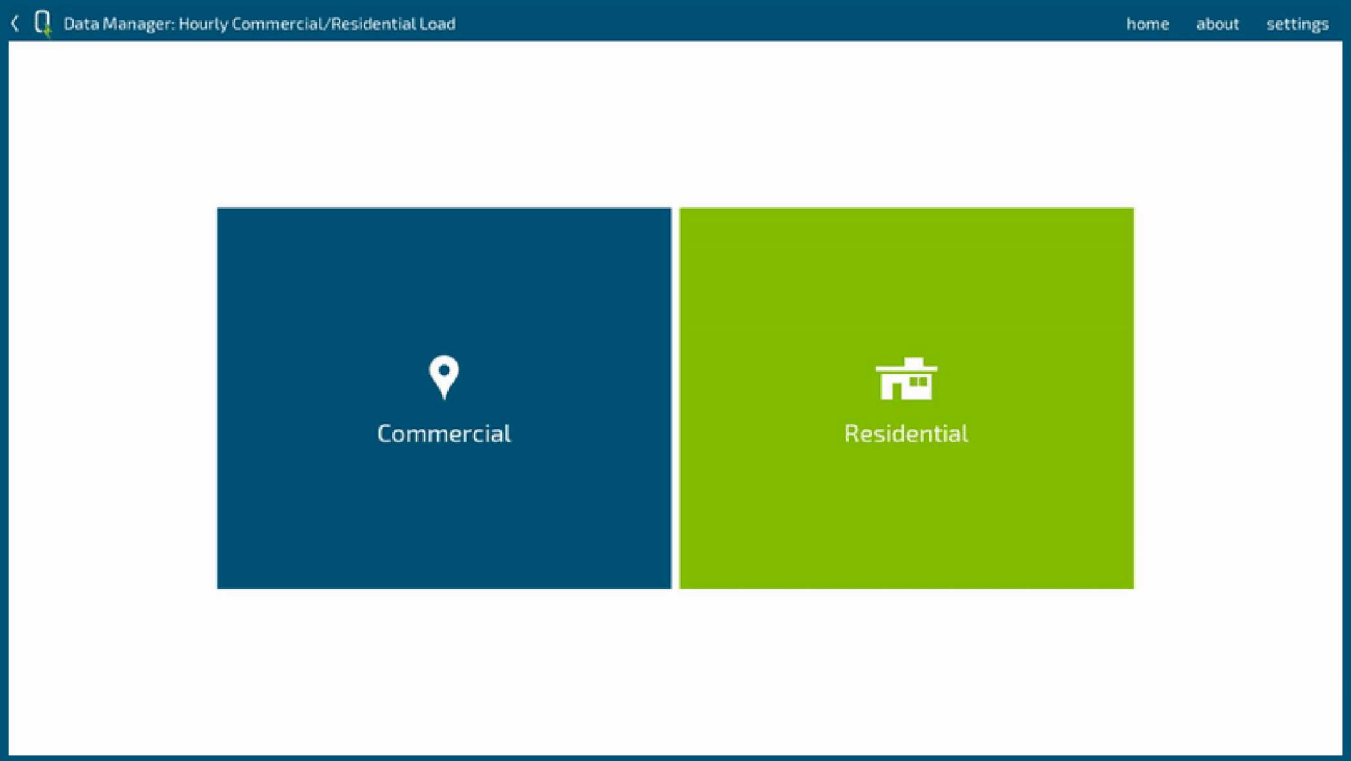
QuESt Data Manager



We use publicly available APIs, posted market data, and crowd-sourced data.

- Locational marginal prices (LMPs), (frequency) regulation performance/capacity clearing prices, etc. posted by ISOs/RTOs
- U.S. utility rate structures sourced and validated by OpenEI.org (NREL)
- Commercial and residential hourly load profiles for all TMY3 (typical meteorological year) locations in the U.S. by OpenEI.org
  - 16 DOE commercial reference building models

QuESt Data Manager

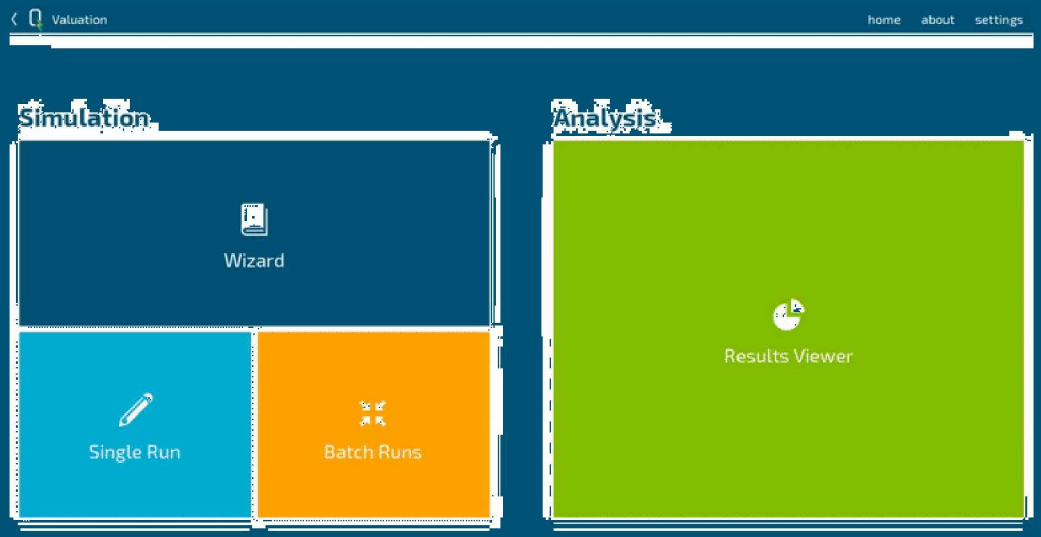


QuESt Valuation

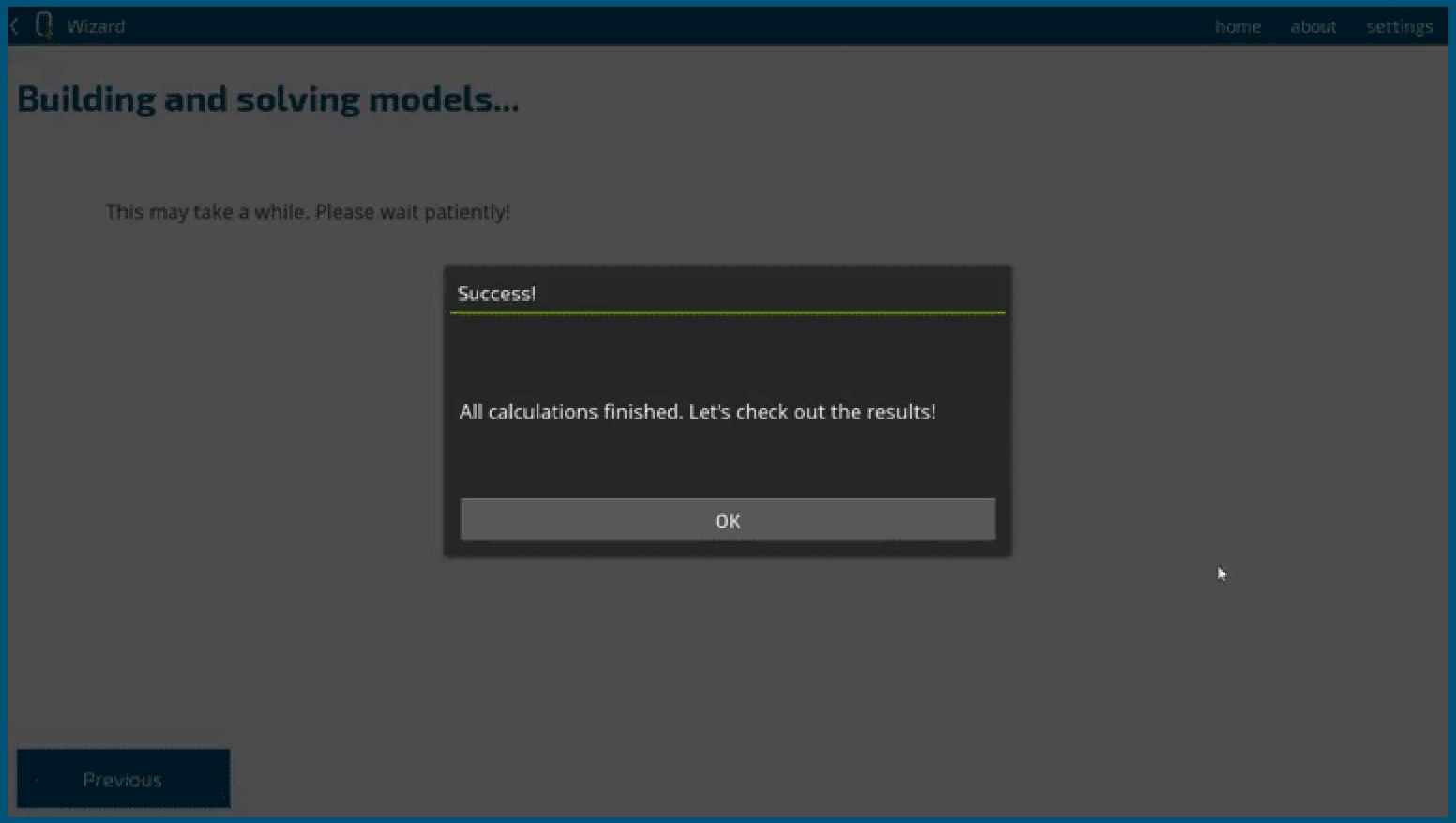
Given an energy storage device, an electricity market with a certain payment structure, and market data, how would the device maximize the revenue generated and provide value?

Examples:

- How much revenue could a flywheel plant located at the Houston pricing node in the ERCOT market have generated in the month of July 2016 by participating in energy arbitrage? What if it also provided frequency regulation services?
- What are the effects of increased size or power rating on revenue potential?



QuESt Valuation



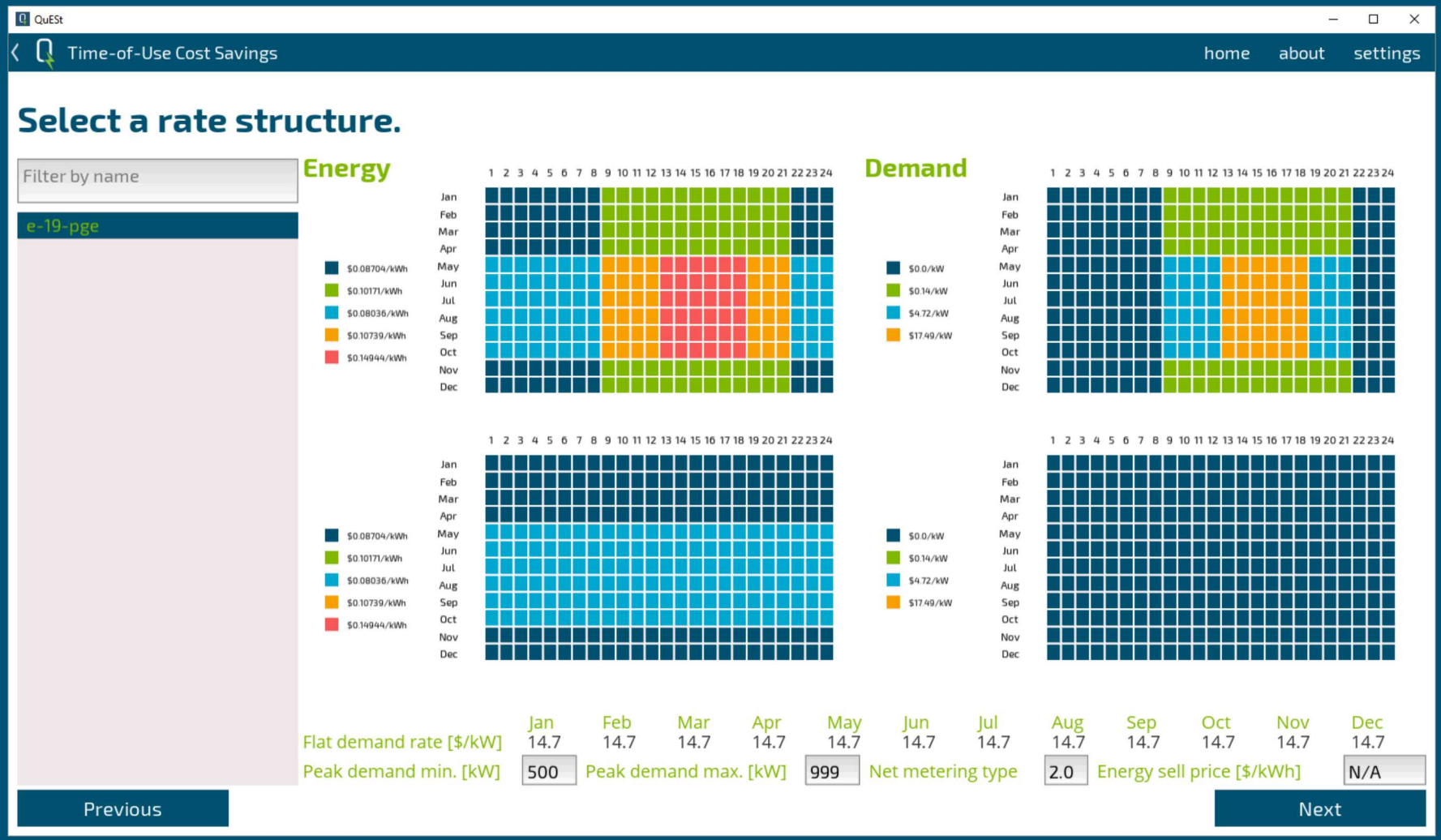
QuESt BTM*

A collection of applications for behind-the-meter energy storage. The first application will be estimating cost savings for time-of-use and net energy metering customers.

- Incorporate specific utility rate structures (energy TOU schedule and rates, etc.)
- Use location-specific simulated load and photovoltaic power data
- Future BTM applications
  - Optimal sizing for power balancing
  - Control applications

*For v1.2 release; content is under development and subject to change.

QuESt BTM*



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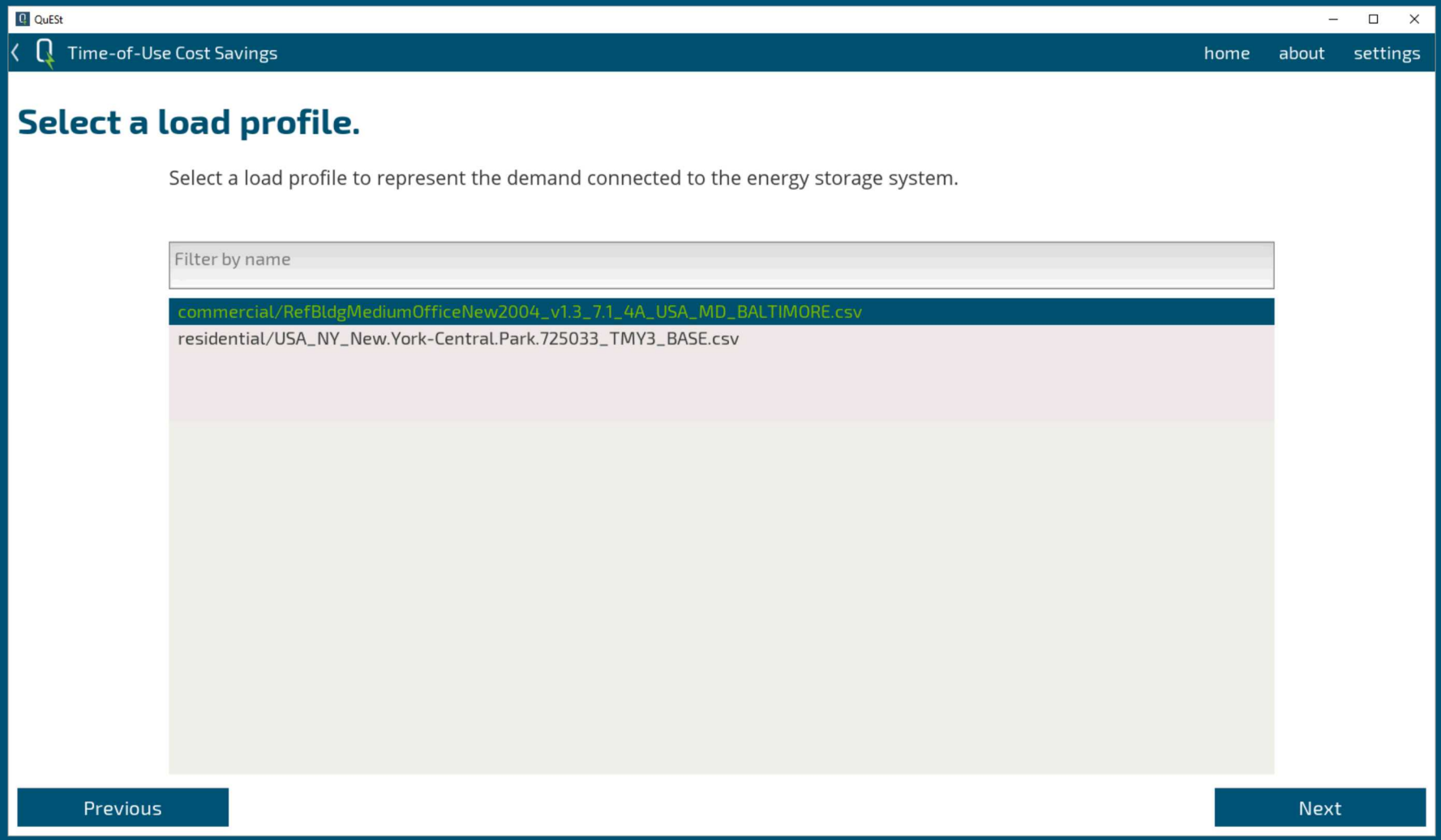

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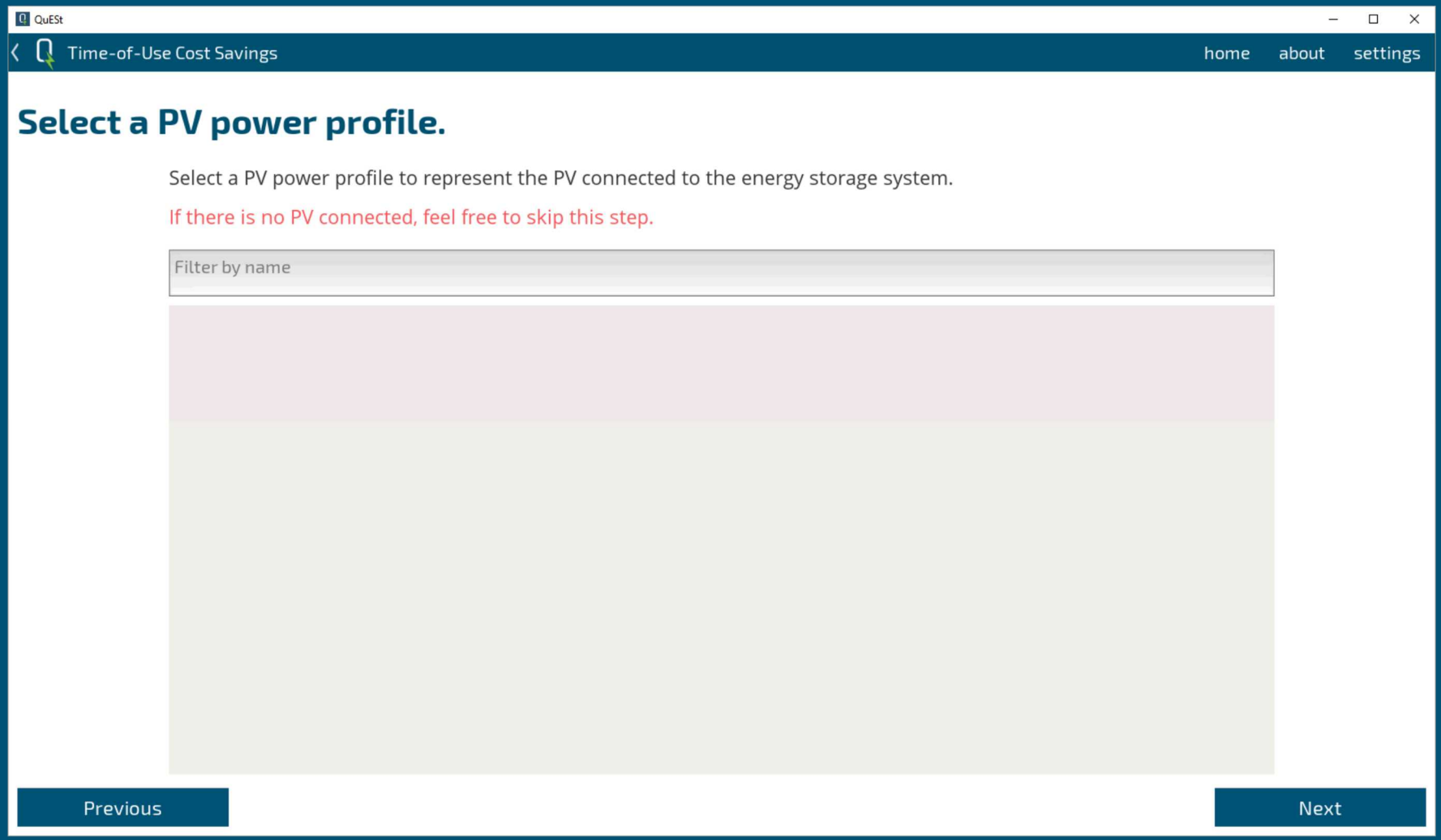

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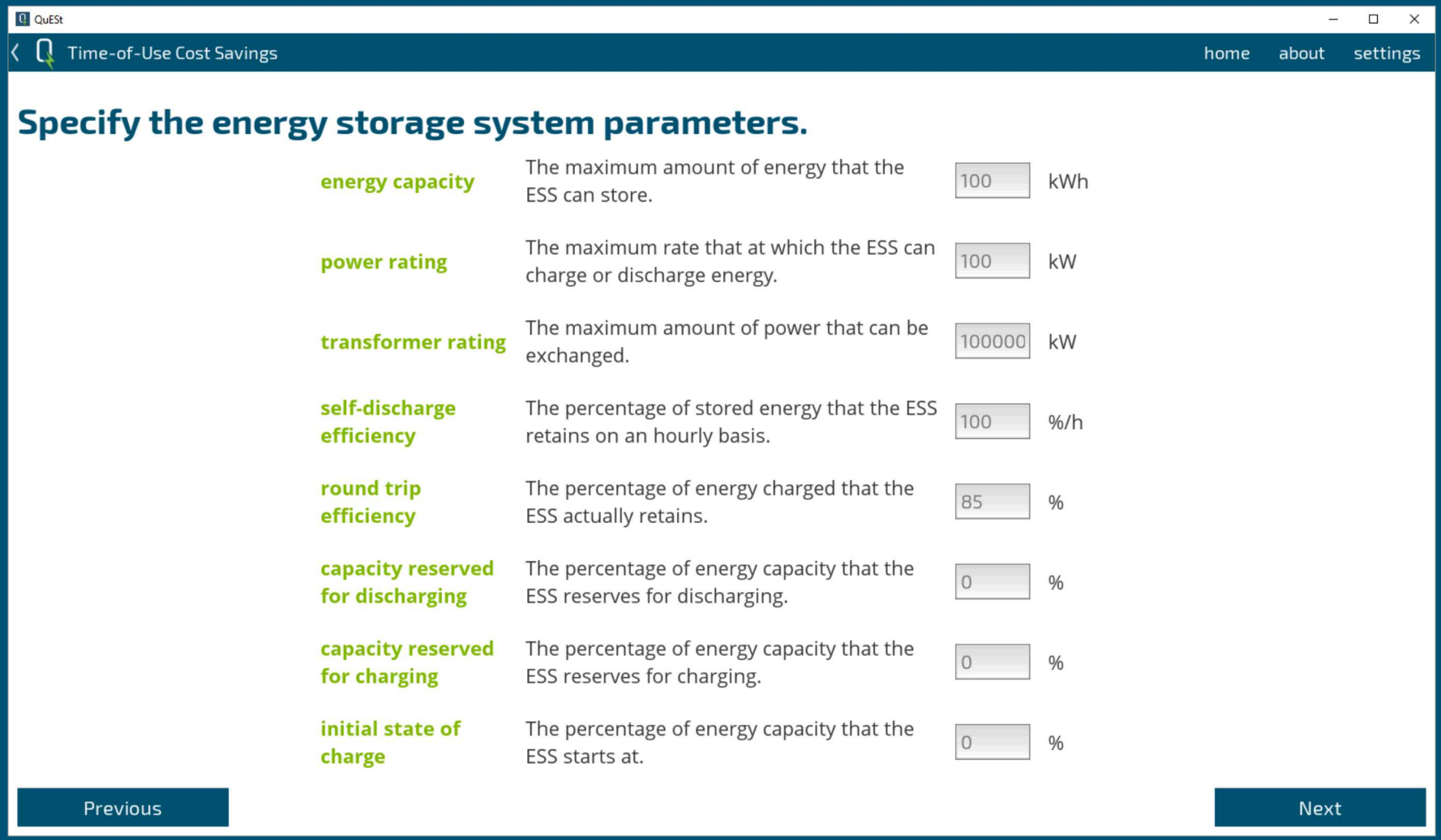

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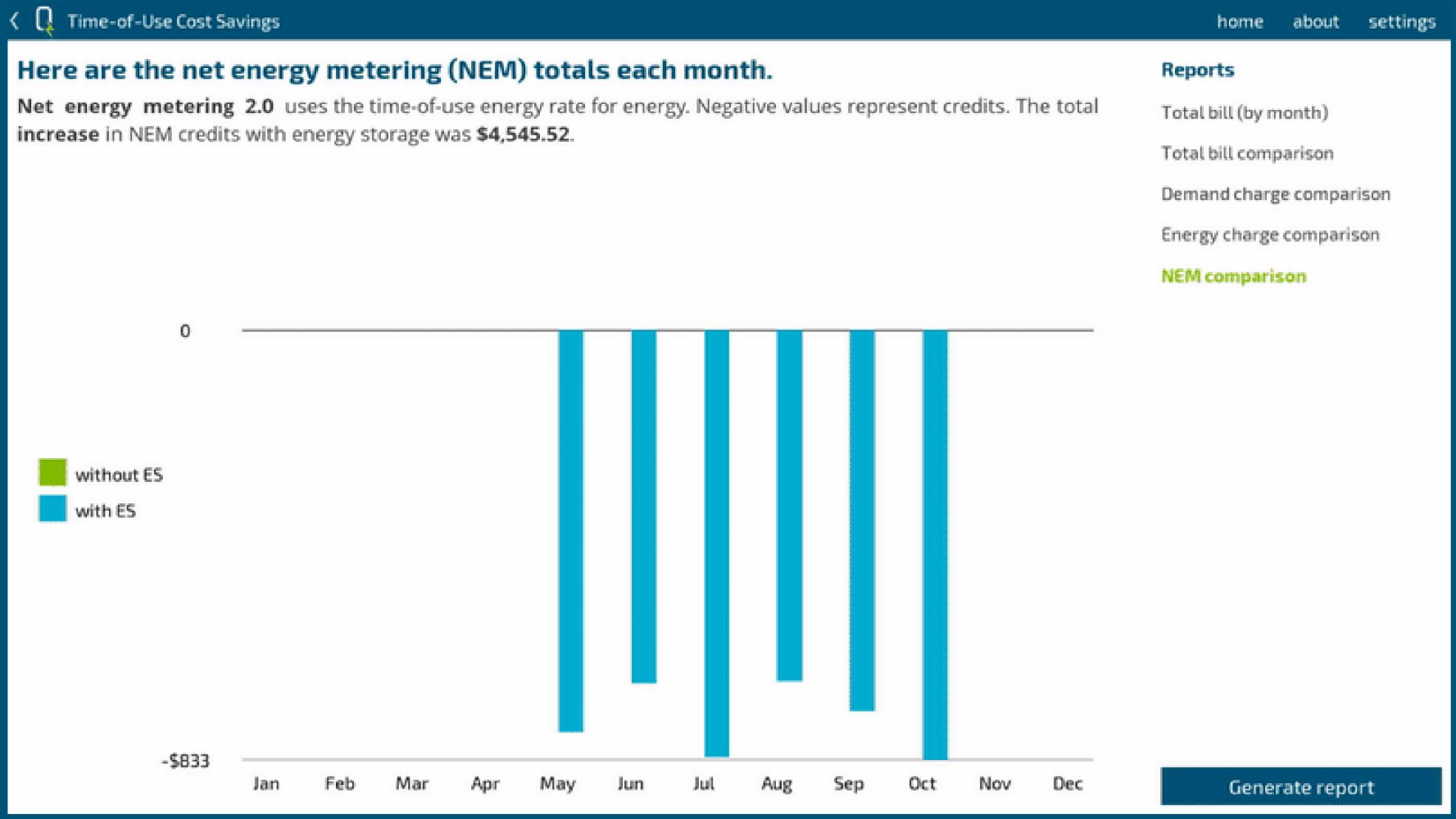

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The Future

Mission: Continue adding applications and new capabilities to the suite, building upon the software architecture and GUI foundation that we have established.

- Consider more complex valuation models, such as modeling degradation
- New applications
  - Technology selection assistant
  - Explorer for energy storage cost data (collected by Mustang Prairie)
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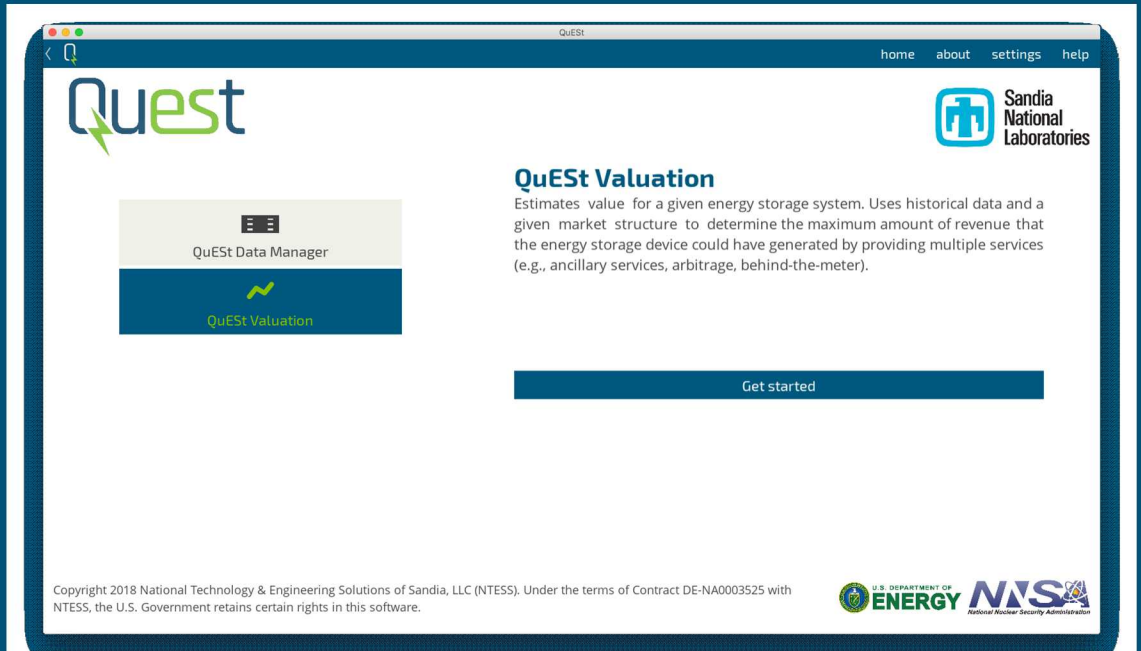

Acknowledgements

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Follow us on GitHub:

github.com/rconcep/snl-quest