



Optimization of conceptual design and operational strategy of battery energy storage systems in combination with other innovative technologies for utility-scale PV powerplants.

Proposition master's thesis

1 Background

Stationary energy storage systems are generally regarded as one of the key technologies for the energy transition. The total installed capacity of stationary battery energy storage systems (BESS), especially based on lithium-ion batteries, has steadily increased in recent years. However, high investment costs paired with complex calculations required to estimate the lifetime cost and benefit of battery storage systems for a specific location are a considerable barrier to BESS deployment. Due to numerous interdependencies between the BESS and the grid, market, powerplant as well as other innovative elements and operation strategies the full potential of BESS is not yet fully understood, and project developers struggle with this task when developing a new project.

2 PVRADAR

[PVRADAR](#) is a software platform that allows project developers to quickly estimate the lifetime value of innovative technologies in the context of specific photovoltaic projects. Being able to accurately evaluate the effect of innovative technologies such as bifacial panels, albedo enhancers, smart cleaning technologies ("cleaning robots") and more allows project developers to find the right technologies for their project, reduces cost and ultimately makes photovoltaic power generation more efficient: [PVRADAR's mission is to facilitate the integration of innovative technologies in large-scale PV and making research available for business.](#)

PVRADAR is currently developed by a highly motivated, dynamic, and very international team: consisting of 5 members from 4 different countries and 3 different continents. CEO Thore Müller is a former student of Prof. Hamacher and TUM-alumni. Together with head of product management Franco Clandestino he has worked several years in the applied research department of French energy giant ENGIE. CTO Konstantin Pogorelov is a software architect with 20+ years of experience.

Thesis

Acting as a project manager you will support the implementation of PVRADAR's battery model. Based on your specifications, the development team will implement functions to estimate cost and benefit of battery storage in utility-scale PV powerplants and integrate them into the PVRADAR software environment.

During your master's thesis you will learn key principles in software development and product management and gain experience that will help you take a real-world approach to optimization in the PV sector. At the interface of research, technology, and economics you will get an in-depth look into the very questions the industry is currently struggling with, preparing you for your later work in the field... ideally at PVRADAR.

Contents of Thesis:

1. Literature research on total cost of ownership of large-scale BESS: installation, replacement, predictive- and corrective maintenance.
2. Literature research on behind-the-meter revenue streams for large-scale battery systems, such as spot market trading ("arbitrage") and frequency control.
3. Translation of results into simplified models that will be implemented into the PVRADAR simulation framework based on your guidance.
4. Testing and validation if models have been implemented correctly.
5. Definition of several use-cases (example projects) in different locations and with typical configurations.
6. Using PVRADAR simulation framework, simulation of different scenarios, combining BESS with different other innovative technologies (bifacial panels, intelligent cleaning systems, etc.) and operation strategies.
7. Discussion of results: Which combination of BESS with innovative technologies, revenue streams and operation strategies yield the most profitable project?

3 Requirements

We are looking for a generalist that loves to solve real-world problems and loves to work in a team. Besides a high level of motivation, ideally, you would bring:

- Good technical understanding of BESS
- Good understanding of economic principles
- Basic understanding of general programming principles
- Good proficiency in English language (team language)

4 Interested?

Please send us an email to info@virtuous-re.com stating your experience and motivation!