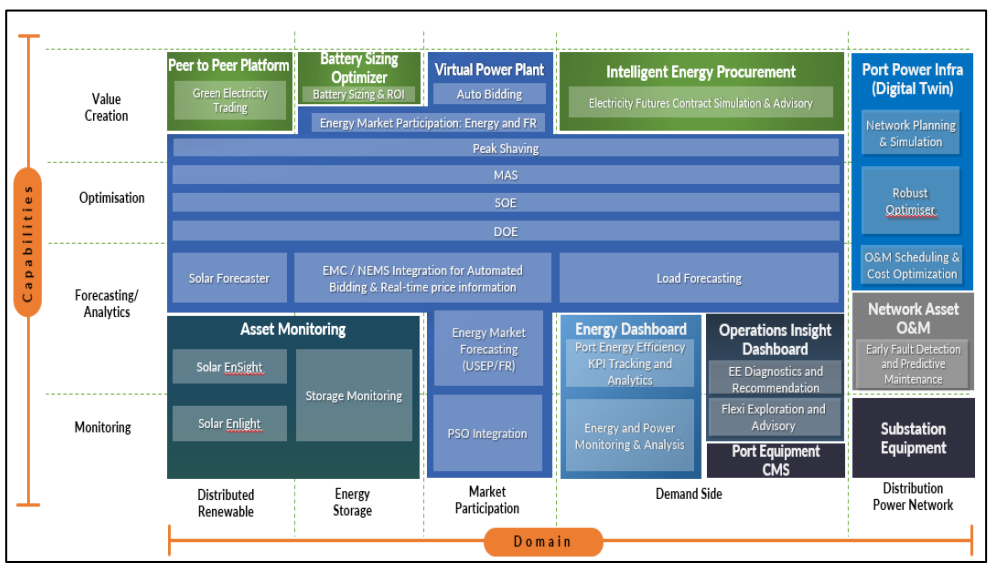
AIOT-ENABLED SMART GRID APPLICATIONS FOR SUSTAINABLE AND RESILIENT DIGITAL PORTS IN SINGAPORE (ASGARD PROJECT)

PROJECT SUMMARY

The ongoing transformation in the energy sector has ushered in a wave of variable and distributed energy resources on electrical grids across their impressive growth. The overall power industry is facing challenges in its transition into increasingly distributed generations and the two-way power flows and communications that these require. Smart Grid entails technology applications to allow easier integration and higher penetration of new energy technologies and ensure efficient delivery of sustainable, economic, and secure electricity supplies.

The ASGARD project aims to design, implement, and validate cutting edge smart grid technologies and solutions using PSA's Pasir Panjang Terminal as a living lab. The 2MW/2MWh Battery Energy Storage System (BESS) deployed for this project will showcase the capability of BESS to provide additional revenue stream for PSA by providing frequency regulation services to the National Electricity Market of Singapore (NEMS) and, level out peak loads by carrying out peak shaving. Thereby, ensuring energy efficiency and system resiliency.

The Smart Grid Management System (SGMS) will provide a complete suite of scheduling processes for an end-to-end solution to cover the operation needs of PSA – long-term asset planning, short-term operation scheduling and real-time energy management of Distributed Energy Resource (DERs) and demand-side management. SGMS is an energy management system with automated real-time optimization to determine optimal controls based on forecasts. Its purpose-built UI/UX provides operators with timely monitoring and insights, ensuring speedy actions.



Overall Application Landscape that shows the role and capabilities of each applications in its corresponding domain

The containerized ESS will include four key subsystems, namely the Battery System, Power Conditioning System (PCS), Container and Energy Management System (EMS).

PROJECT OUTCOMES

The solution consists of the EnOS™ AIoT platform, which is deployed on-premises in PSA. This platform enables the synergy between cloud and edge computing, facilitating the integration between the OT and IT systems. Data ingestion and analytics processes are streamlined to provide further insights to the Distributed Energy Resources (DERs) deployed on site.

SGMS is the main interface between the energy market and PSA's internal system. The solution takes real-time energy market and PSA load information as inputs to the Deterministic Optimization Engine (DOE), which outputs an optimised Battery Energy Storage System (BESS) operating schedule for maximum revenue generation. At the field device level, Model Predictive Control (MPC) is deployed on an edge device to carry out real-time optimization and controls based on the operational status of the DERs. In addition, when participating in Frequency Regulation (FR) market, MPC translates the Automated Generation Control (AGC) signals from Power System Operator (PSO) to provide responsive support to the grid.

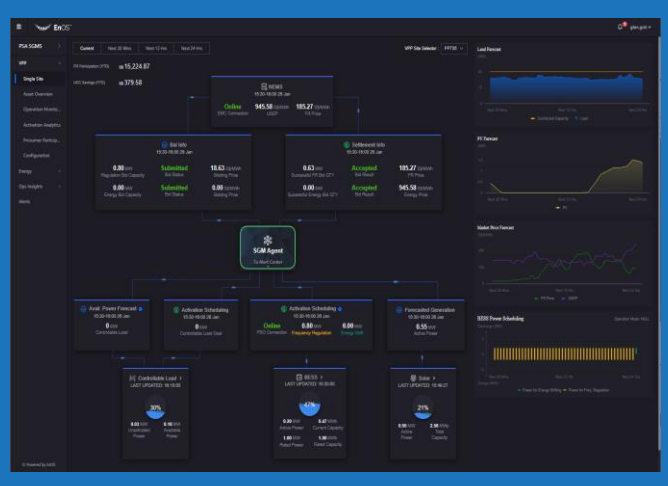
The BESS is equipped with an advanced active module balancing solution which allows for mixed-chemistry BESS configuration – Lithium Iron Phosphate (LFP) and Nickel Manganese Cobalt (NMC), on top of maximising the overall BESS capacity utilisation.

Based on the current regulation, the solution is expected to demonstrate to other industry players in Singapore the capability of BESS as an additional revenue stream, encouraging them to adopt BESS and provide services to the Singapore Grid.

The solution complements Singapore's Energy Transition journey towards a more sustainable future through renewable energy.

The BESS is slated to be commissioned and operationalised in 2022. After which, the overall PSA solution will participate in the National Electricity Market of Singapore (NEMS) to provide energy and frequency regulation services to the Singapore Grid. This will be the first behind-the-meter BESS to participate in the NEMS market.

Energy Dashboard to show the energy asset consumption and breakdown



Virtual Power Plant (VPP) Site View to show the overall PSA DER and participation status

Virtual Power Plant (VPP) virtual monitoring to show energy market related information

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