



Energy Storage System (ESS) for Building Energy Management

FUNDAMENTAL OF RENEWABLE ENERGY
2 – 3 Febuari 2021

Cawangan Kejuruteraan Elektrik



Energy scenario



Renewable Energy



Increase in power generation capacity

Reduces dependencies fossil-fuel based power plant

Clean energy, reduces **Green House Gasses**

20% of Renewable Energy in 2025

Energy scenario



Power quality

Increase share of RE

Sustainability

Intermittent

Balance in supply

Energy Security

Cost effective

Reliability

Power outage

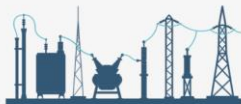
Stability in power distribution
& transmission

Energy Storage System (ESS)



CAPACITY FIRMING

Variable, intermittent power from wind & solar, can be maintained at a committed (firm) level for a period of time.



FREQUENCY REGULATION

Regulate grid frequency in specified band.

LOAD LEVELING

Storing power & delivering during high demands.



RESIDENTIAL STORAGE

Backup power & reduce or eliminate diesel consumption.



Batteries, hydro, thermal, capacitor, flywheel, hydrogen & etc.



SMART GRID

Enable energy producers to be integrated into the grid on a large scale



PEAK SHAVING

Avoid highly variable load to commercial and industrial customer, which reduces operational cost during peak.



POWER QUALITY

Improves quality of power.



SPINNING RESERVE

Eliminates the need to have back-up generators running idle.

Utility

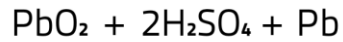
Smoothing intermittent Renewable Energy power flow

Regulate frequency

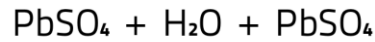
Voltage control

Charge & Discharge

Lead Acid Battery



DISCHARGE



CHARGE

LEAD DIOXIDE + DILUTE SULPHURIC ACID + LEAD

LEAD SULPHATE + WATER + LEAD SULPHATE

POSITIVE PLATE

COMPOSITE

NEGATIVE PLATE

POSITIVE

WATER

NEGATIVE

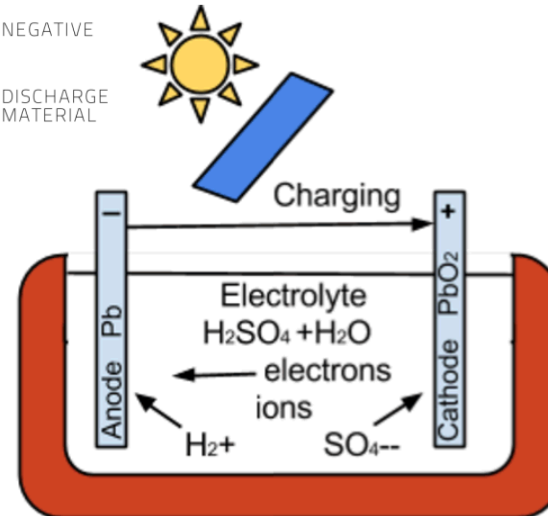
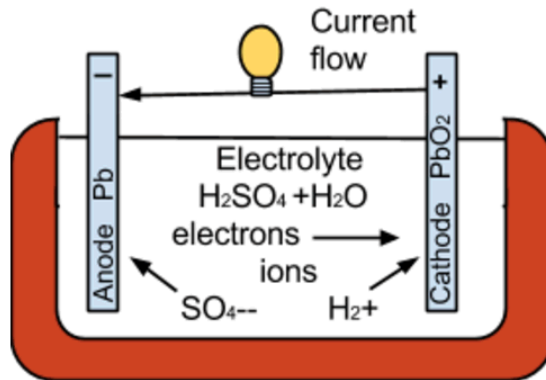
ACTIVE MATERIAL

ELECTROLYTE

ACTIVE MATERIAL

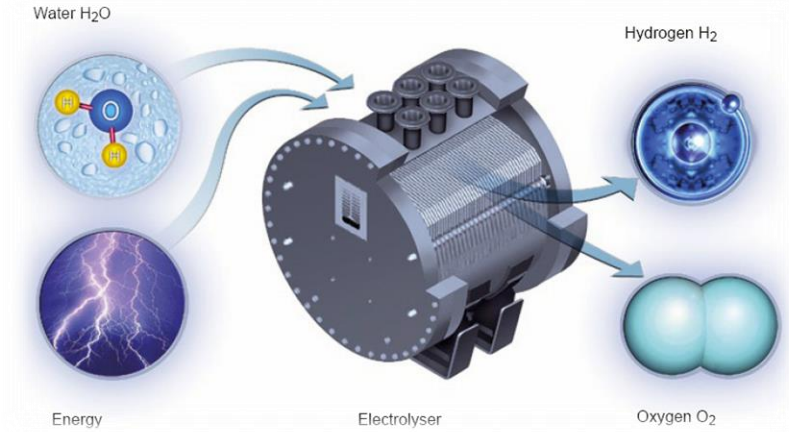
DISCHARGE MATERIAL

DISCHARGE MATERIAL



Hydrogen (H₂) as an ESS

- Hydrogen
 - Main source:
 - Water
 - Crude oil
 - Biomass
 - Expected to be the main primary energy in the future



LITHIUM BATTERY AS AN ENERGY STORAGE SYSTEM

SOME PRODUCTS WORLDWIDE...

TESVOLT
THE ENERGY STORAGE EXPERTS

 **PYLONTECH**



Product ranges from low to high voltages & can be connected to all power generators

APPLICATIONS

INCREASED SELF-CONSUMPTION

Consume more of your self-generated electricity

PEAK LOAD SHAVING

Cut your consumption peaks and save money due to lower power consumption

BACKUP POWER

In case of an outage, your storage system takes over the electricity supply within a split of a second

DIESEL-HYBRID OPTIMIZATION

Improved system utilization, lower fuel consumption

OFF-GRID ELECTRICITY SUPPLY

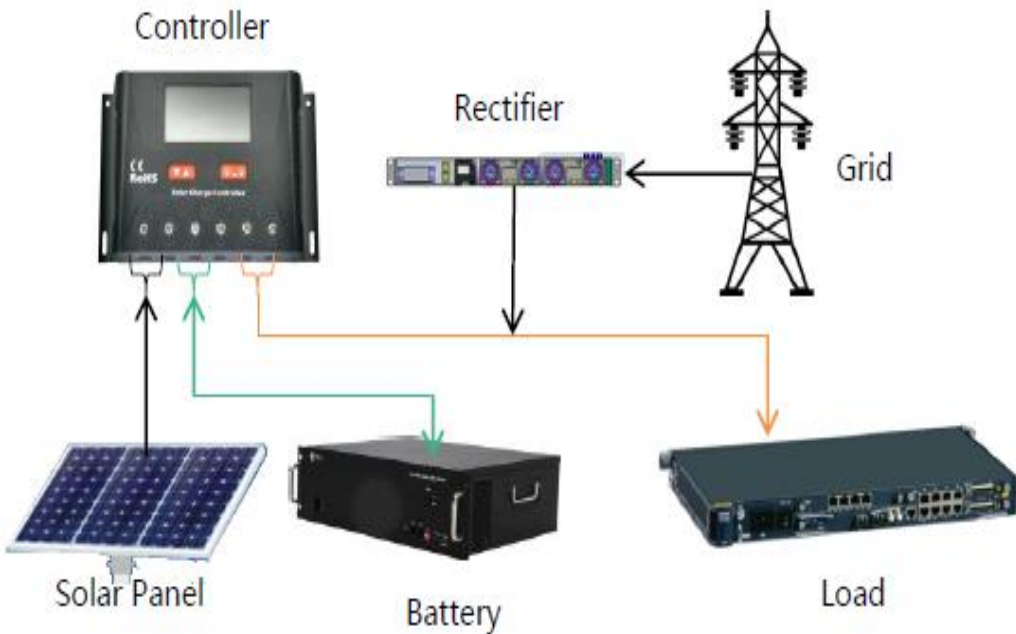
Create your own electricity grid, e.g. with a photovoltaic system

FREQUENCY RESERVE (PRL)

Contribute to main grid stabilization and charge the battery when there is too much energy in the grid, or discharge your battery when there is too little energy in the grid.

Application

Application-Telecom



Some facts on Lithium battery

- **Product lifetime** up to 30 years
- **Depth of Discharge (DoD)** > 90%
- **Numbers of full cycle** up to 8,000 (double than Lead Acid batteries)
- **Efficiency (Battery)** > 98%
- **High energy density** requires shorter time to fully charge
- **Very safe technology**
- **Battery Monitoring at cell level with Battery Management System (BMS)**
- **Flexible, modular and expandable capacity for future**
- **Ability to combine with renewable energy system such as solar Photovoltaic (PV)**



Municipality without subsidy, England

4 MWh / 4 MW

On-Grid. Power grid stabilization,
Income from electricity trading



Shipping Company, Germany

48 kWh / 18 kW

On-Grid. PV charging current for electric fork-lift trucks



Avocado Farm
Australia

48 kWh / 18 kW

Off-Grid. Self-sufficient power supply

Partner: Unlimited Energy Australia



© TESVOLT GmbH

Location: Dubai

- Date: 6. 2019
- Purpose: Household Consumption
- Config.: 18*US2000,38.4kWh
- Inverter: Steca
- Energy Source: PV



Location: Czech Republic

- Date: 11. 2017
- Purpose: Peak Shaving
- Config.: 1*Powercube M1, 108.9kWh
- Energy Source: PV



Location: North Asia



- Smart Micro Grid ESS
- 100kva Diesel Generator,
- 150kw PV Power Plant,
- 500kwh Pylontech Battery ESS





The 100 MW lithium-ion energy storage system by TESLA. The largest ESS in the world

Source: Energy Malaysia, Vol. 14, 2018

FZSoNick Batteries

Sodium Metal Chloride batteries are the latest generation of the secondary batteries developed specifically to the constraints of the energy storage applications. They use metal-based cathode and molten Sodium anode to provide exceptionally safe and reliable power that is enclosed in the industrial-grade steel case and equipped with integrated Battery Monitoring. Stable chemical reaction, zero maintenance and insensitivity to temperature and storage aging makes them one of the best choices for Telecom BTS and Core Sites, Energy Storage, Residential and other industrial applications.



Sodium Battery



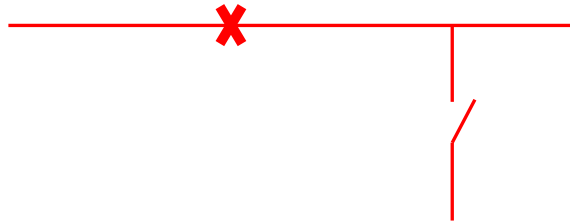
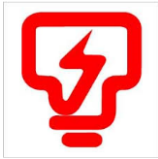
The world's safest and eco friendly battery.

No flammable materials. Free of toxic material and 100% recyclable.

No gas emissions. No fire/water flood reaction.



Energy Storage System (ESS) for Building Energy Management



Fossil fuel based generator as backup during power outage

Lag time to operate

Environmental issue – **Carbon gasses**



POWER QUALITY
Improves quality of power.



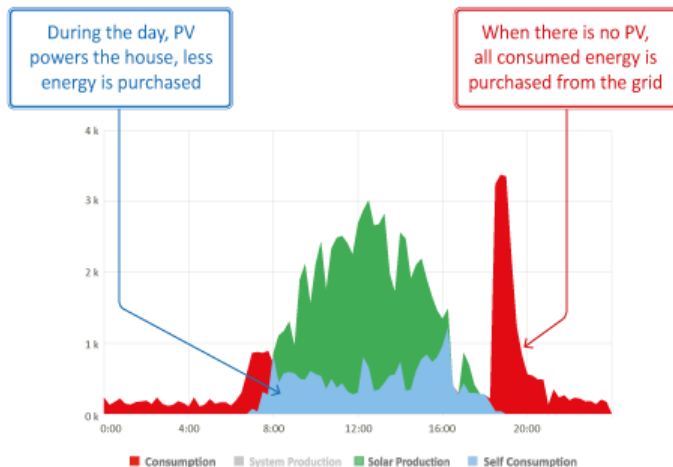
SPINNING RESERVE
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Energy Storage System (ESS) for Building Energy Management



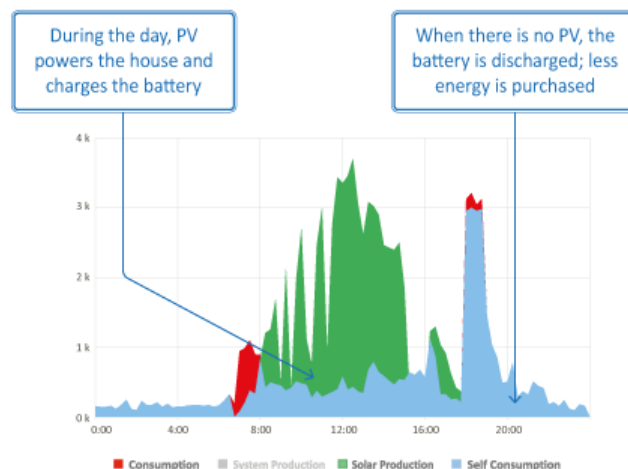
Typical 4KW System Before Battery Installation

Total produced energy	Total consumed energy	Self-consumed energy	Total purchased energy	Electricity bill saving
18.19 kWh	12.15 kWh	5.63kWh	6.52 kWh	46%



Typical 4KW System After Battery Installation

Total produced energy	Total consumed energy	Self-consumed energy	Total purchased energy	Electricity bill saving
18.26 kWh	12.40 kWh	11.41kWh	0.99 kWh	92%

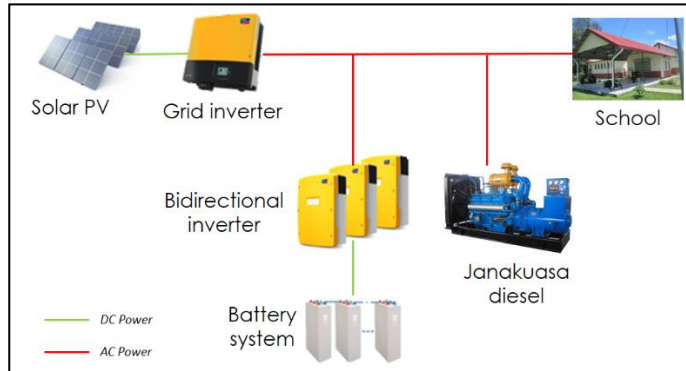


A case study on ESS

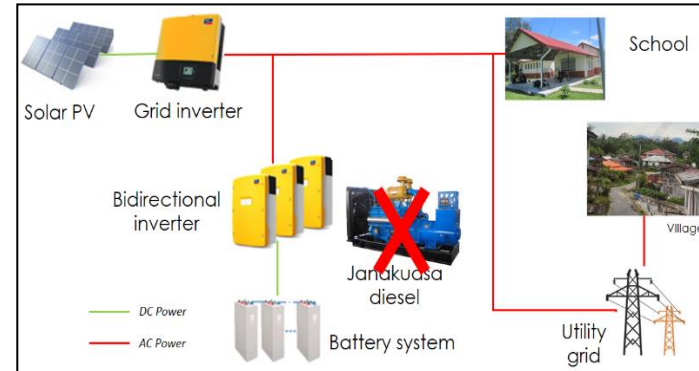


JKR has taken **proactive action in realizing the potential of ESS** to ensure uninterrupted power supply for the government building.

An existing off-grid solar PV system was selected – SK Matupang, Ranau to **demonstrate & evaluate ESS performance**

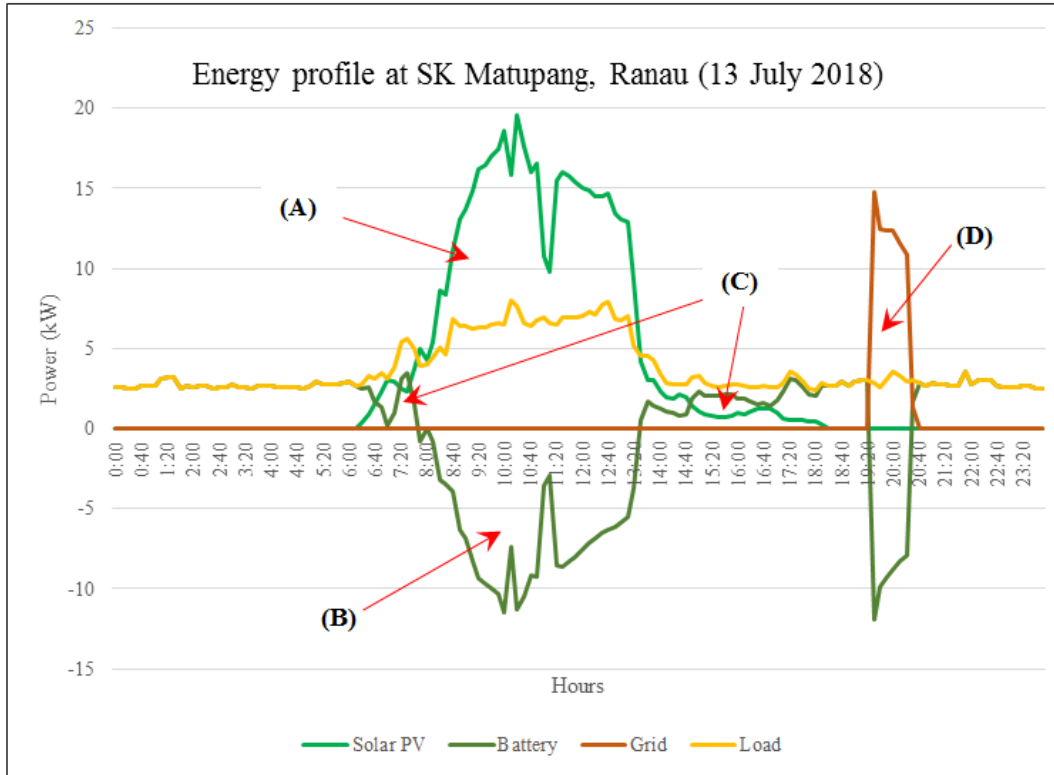


Before: Off-grid solar PV with diesel generator



After: Grid connected solar PV with ESS

A case study on ESS



(A) Electrical power generated from the solar PV panels. The power was generated based on the requirement from the load of the school buildings.

(B) Excess energy from the solar PV panels was stored into the ESS (battery)

(C) In the event of low power generated from the solar PV panel that not sufficient to meet the load demand, the ESS discharged its energy to compensate the deficit.

(D) The power from the grid provided stability and balance to the system for several hours when required.

Conclusion & Recommendation



The **Energy Storage System (ESS)** shall be looked as a potential method and solution in mitigating the **instability of power supply** from the grid



Useful for any **Building Energy Management**



JKR can play their role in ensuring that the building electricity service is highly **reliable, low interruptible power supply** and **cost-effective**

Thank You