Energy Storage System (ESS) for Building Energy Management

FUNDAMENTAL OF RENEWABLE ENERGY
29 – 30 JANUARI 2019

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

17% of Renewable Energy in 2030

Energy scenario

Power quality

Increase share of RE

Intermittent

Sustainability

Balance in supply

Energy Security

Cost effective

Reliability

Power outage

Stability in power distribution & transmission

Energy Storage System (ESS)

Supportive source of power

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

Consumer

Boost the supply at peak periods (peak shaving)

Backup in case of emergencies

Utility

Smoothing intermittent Renewable Energy power flow

Regulate frequency

Voltage control

Charge & Discharge

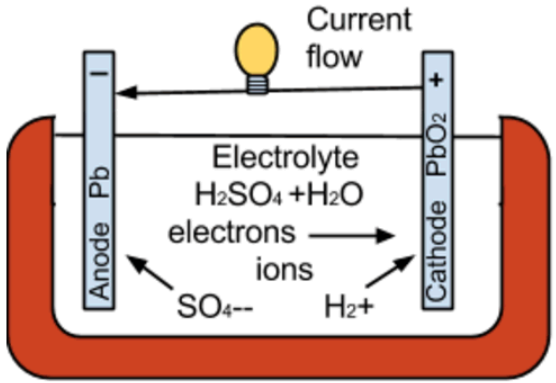
Lead Acid Battery

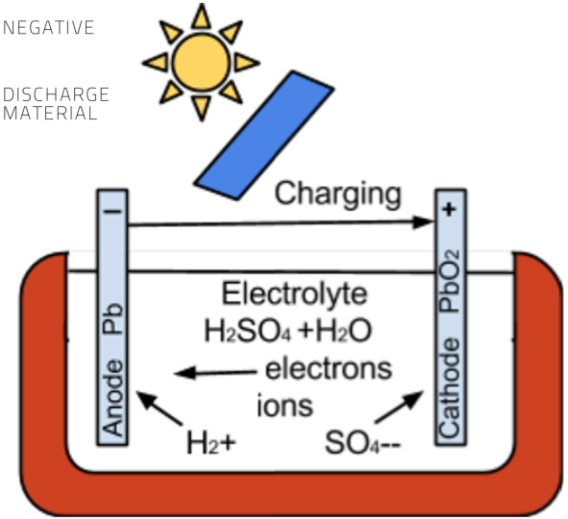
DISCHARGE

$PbO_2 + 2H_2SO_4 + Pb \rightleftarrows PbSO_4 + H_2O + PbSO_4$

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





LITHIUM BATTERY AS AN ENERGY STORAGE SYSTEM

SOME PRODUCTS WORLDWIDE…

TESVOLT
THE ENERGY STORAGE EXPERTS

PYLONTECH

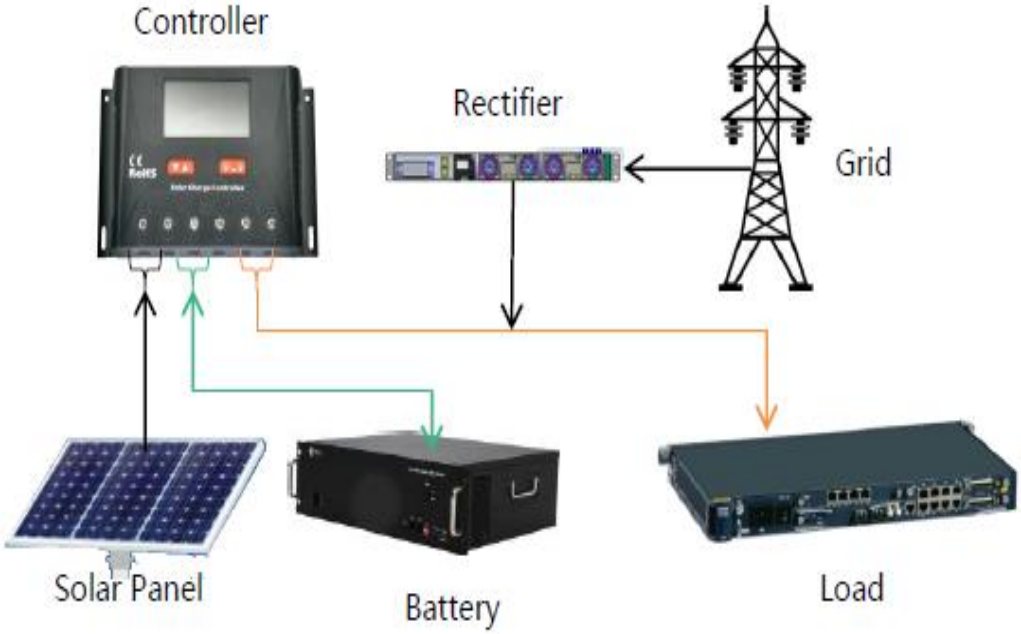
Product ranges from low to high voltages & can be connected to all power generators

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

EAIF
ARE Awards Winner 2019

THE smarter award
2018
WINNER

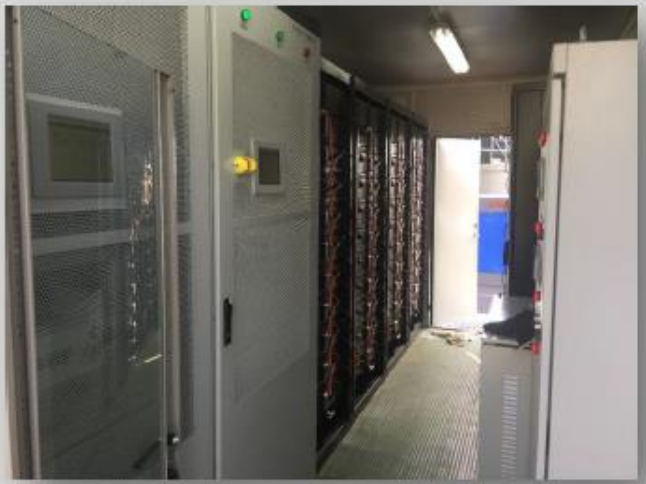
Location: Dubai

- 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

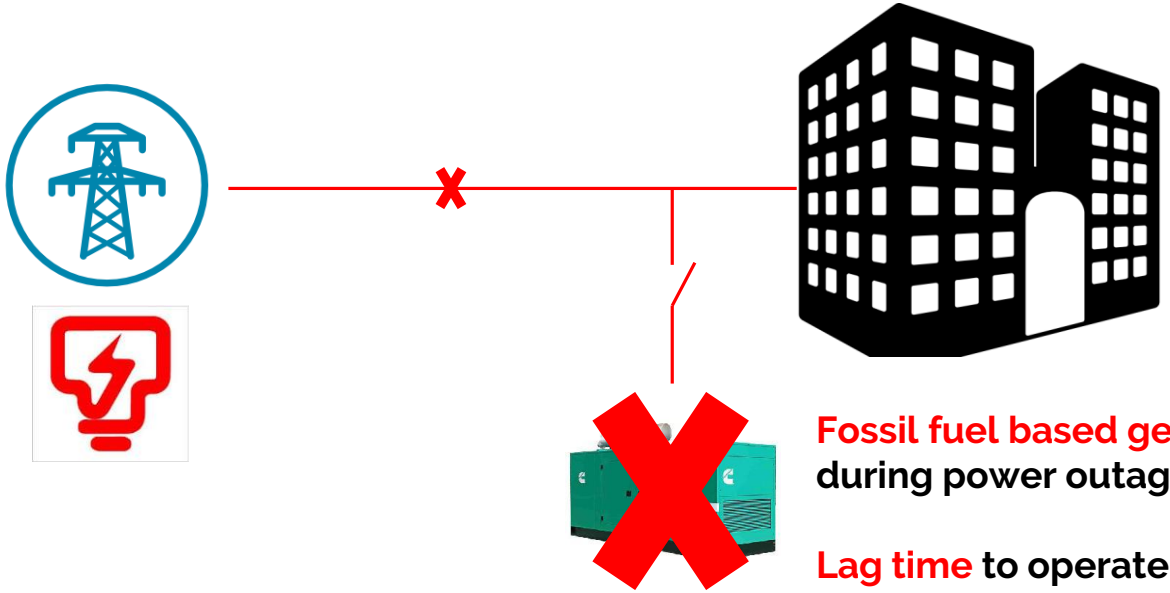


- Smart Mirco Grid ESS
- 100kva Diesel Generator,
- 150kw PV Power Plant,
- 500kwh Pylontech Battery ESS

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

Source: Energy Malaysia,Vol. 14, 2018

Energy Storage System (ESS) for Building Energy Management



Fossil fuel based generator as backup during power outage

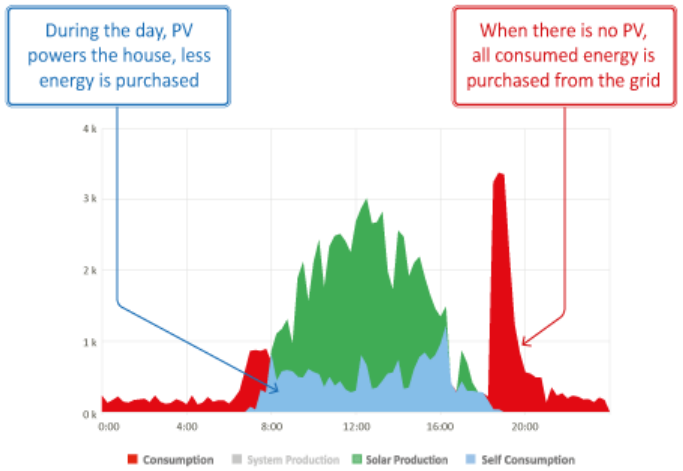
Lag time to operate

Environmental issue – **Carbon gasses**

Energy Storage System (ESS) for Building Energy Management

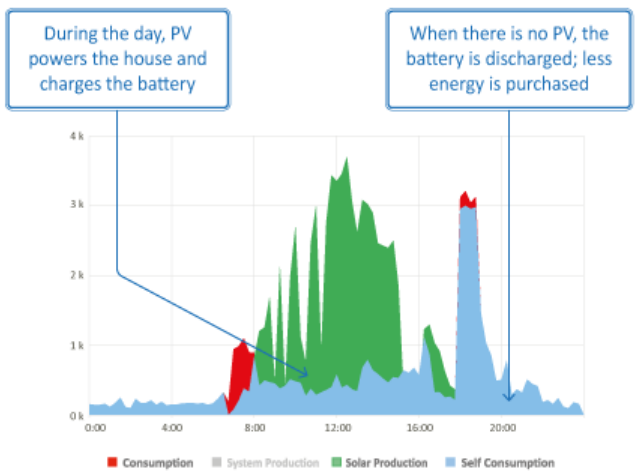
Typical 4KW System Before Battery Installation

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%

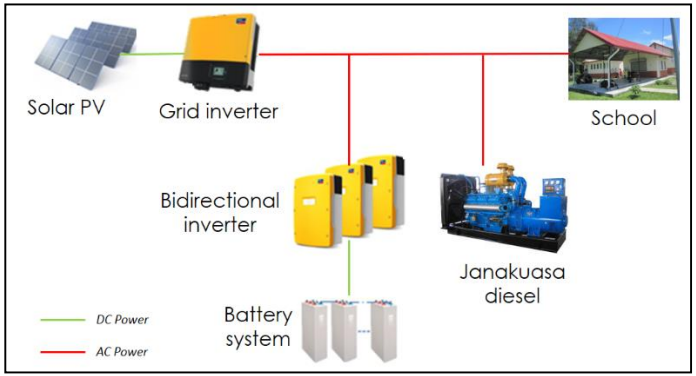


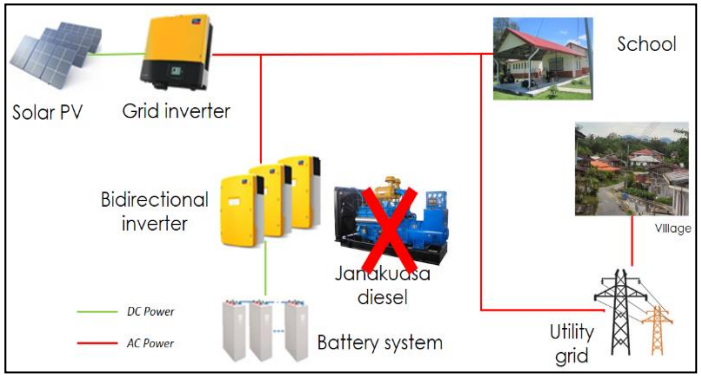
Source: empowerenergy.co.uk/battery-storage/

A case study on ESS

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

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

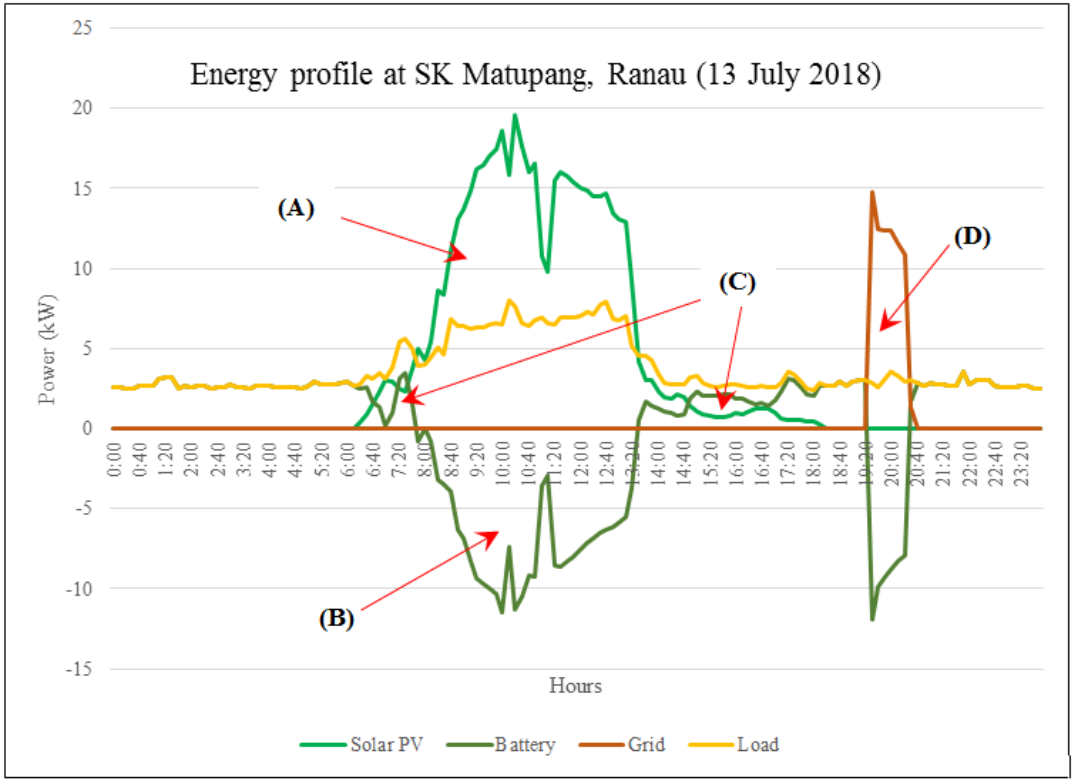




Before: Off-grid solar PV with diesel generator

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