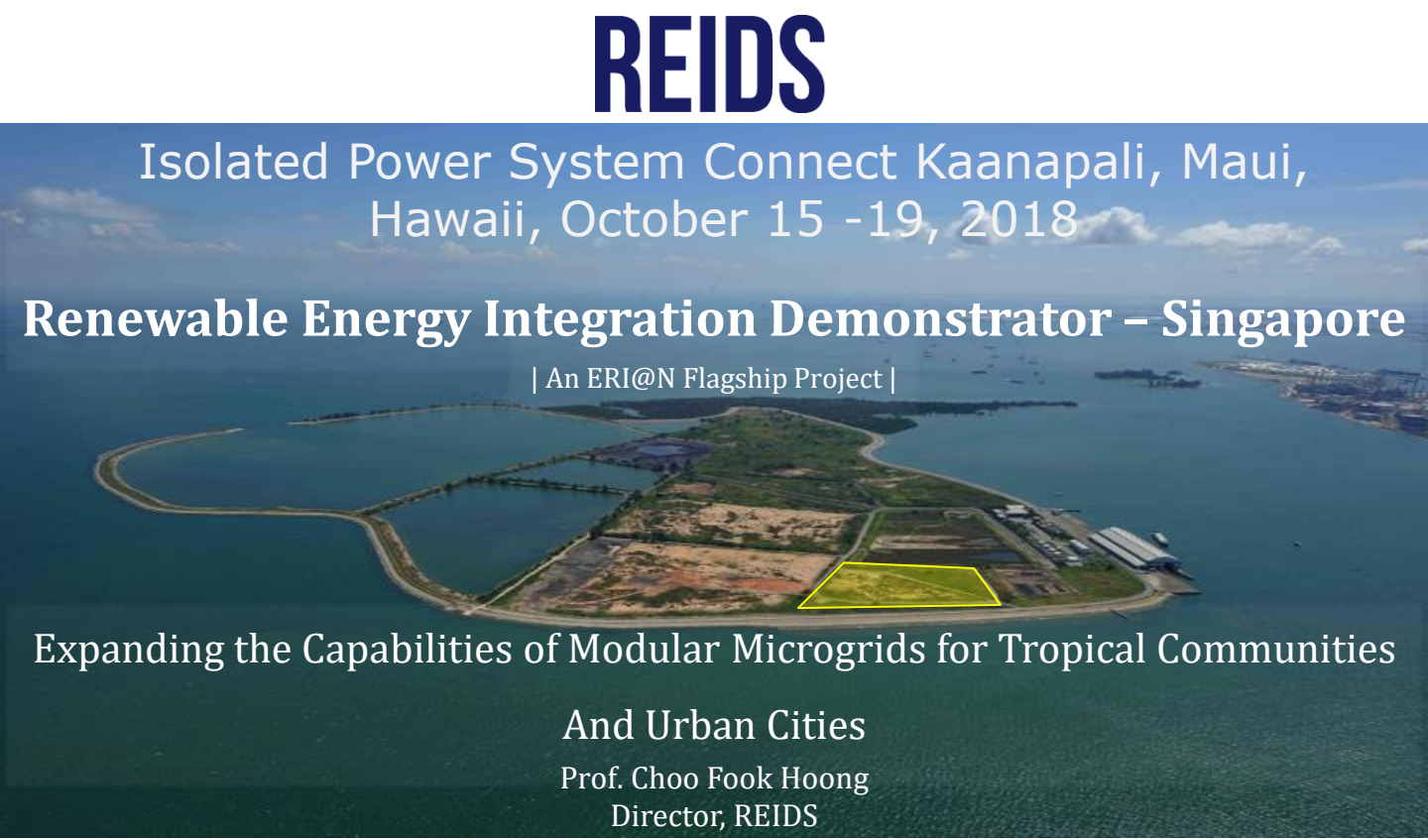
REIDS

Isolated Power System Connect Kaanapali, Maui, Hawaii, October 15 -19, 2018

Renewable Energy Integration Demonstrator – Singapore

| An ERI@N Flagship Project |



Expanding the Capabilities of Modular Microgrids for Tropical Communities And Urban Cities

Prof. Choo Fook Hoong
Director, REIDS

Research Leader

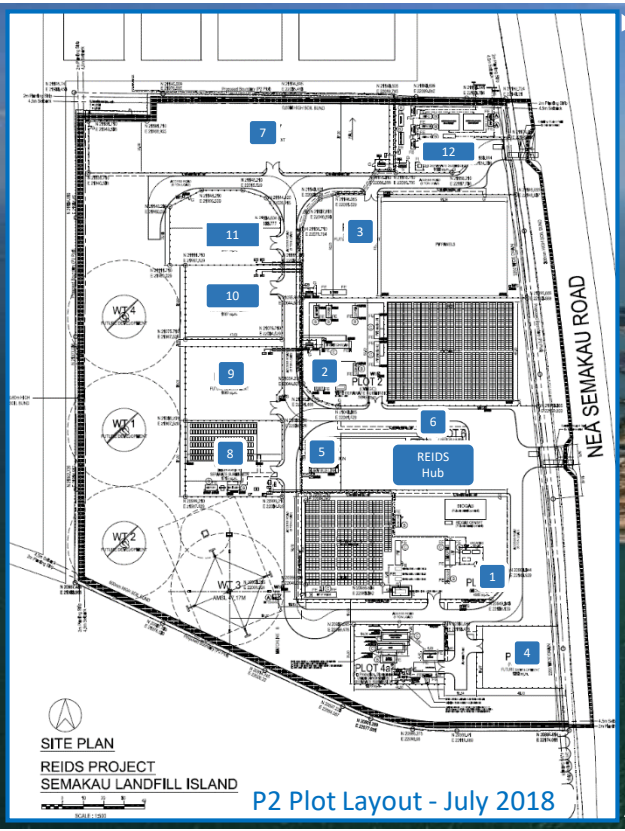
NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE | Energy Research Institute @ NTU

Supporting Agencies

EDB singapore | National Environment Agency (Safeguard · Nurture · Cherish) | Energy Market Authority (Smart Energy, Sustainable Future) | National Research Foundation

Semakau Island - An emblematic site for REIDS

REIDS site - Semakau Landfill



REIDS Microgrid Projects

Phase-I

- 4 Independant Microgrids
- Typical Capacity 500kW-1MW

6.4 ha Plot

Semakau Landfill Island

Phase-II

- 4 Microgrids in a Cluster Configuration
- Typical Capacity 100kW-250kW

Rationale - Needs

- 1.2 billion people on Earth do not have access to electricity and drinking water.
- Most of the affected population lives in Africa, in South-East Asia and in Latin America.
- Given the shear geographical size of the territories involved, in the near term, it is unrealistic to access these populations by way of interconnected transmission systems.

Solution – Sustainable and affordable localized networks of off-grid microgrids

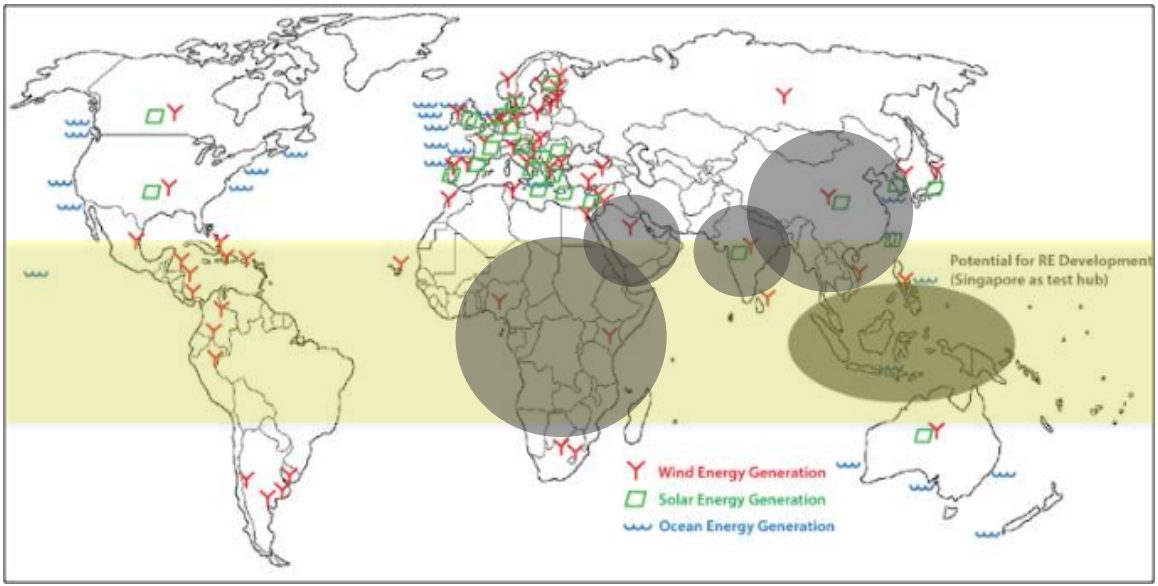
The primary focus of REIDS is on microgrid applications for:

- Islands & Remote villages
- Emergency situations – earthquakes, tsunamis, refugee camps, etc.
- Remote mining operations
- “Fringe” networks
- Military bases
- Ships

Urban microgrids

Economic Opportunities

While challenging, energy transitions also represent formidable technology and economic development opportunities for energy infrastructure and systems solutions providers.



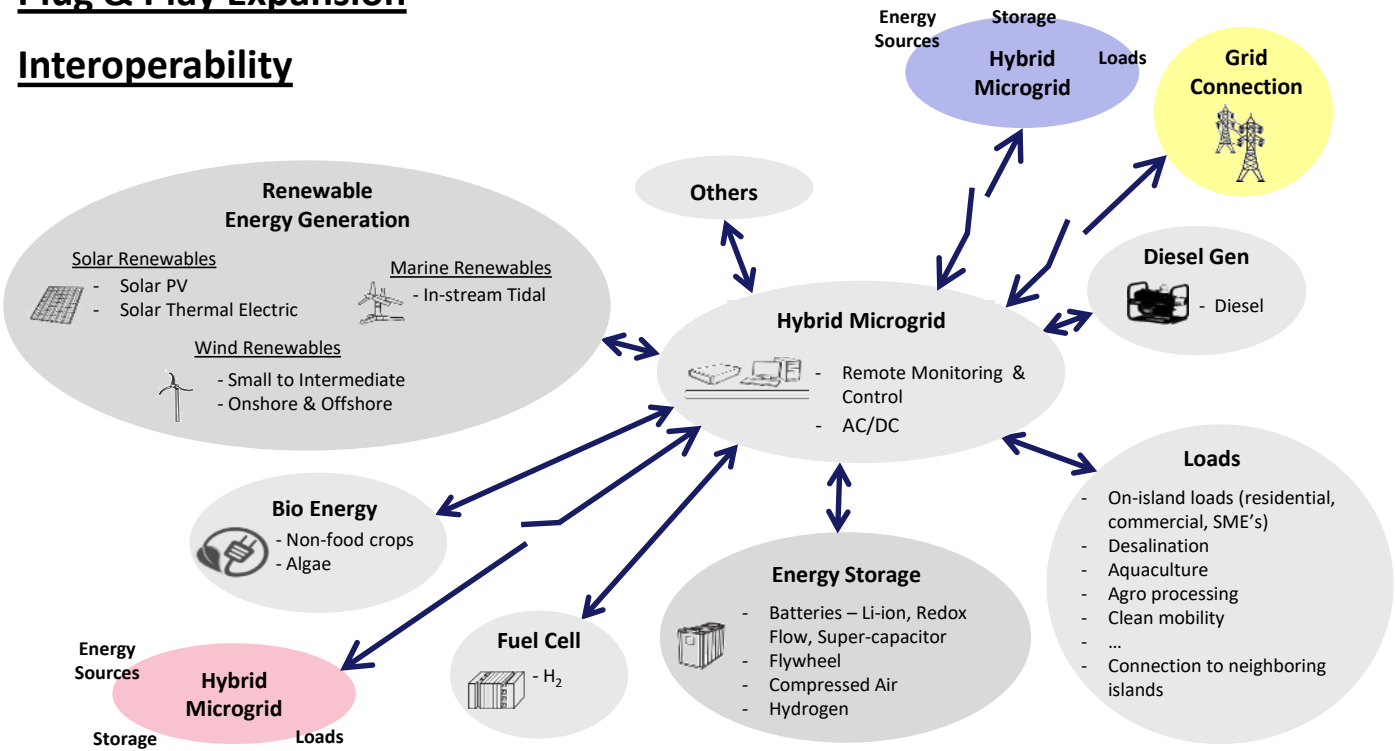
Indonesia : 17,508 islands – **Philippines** : 7,107 islands

World's top five fastest growing electricity production regions from 2010 to 2030

Technology Roadmap

Plug & Play Expansion

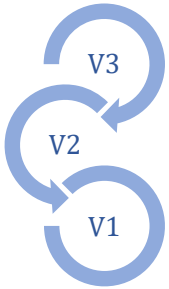
Interoperability



Microgrid Infrastructure

Power & Energy Management, Interoperability, Plug & Play

REIDS Vision



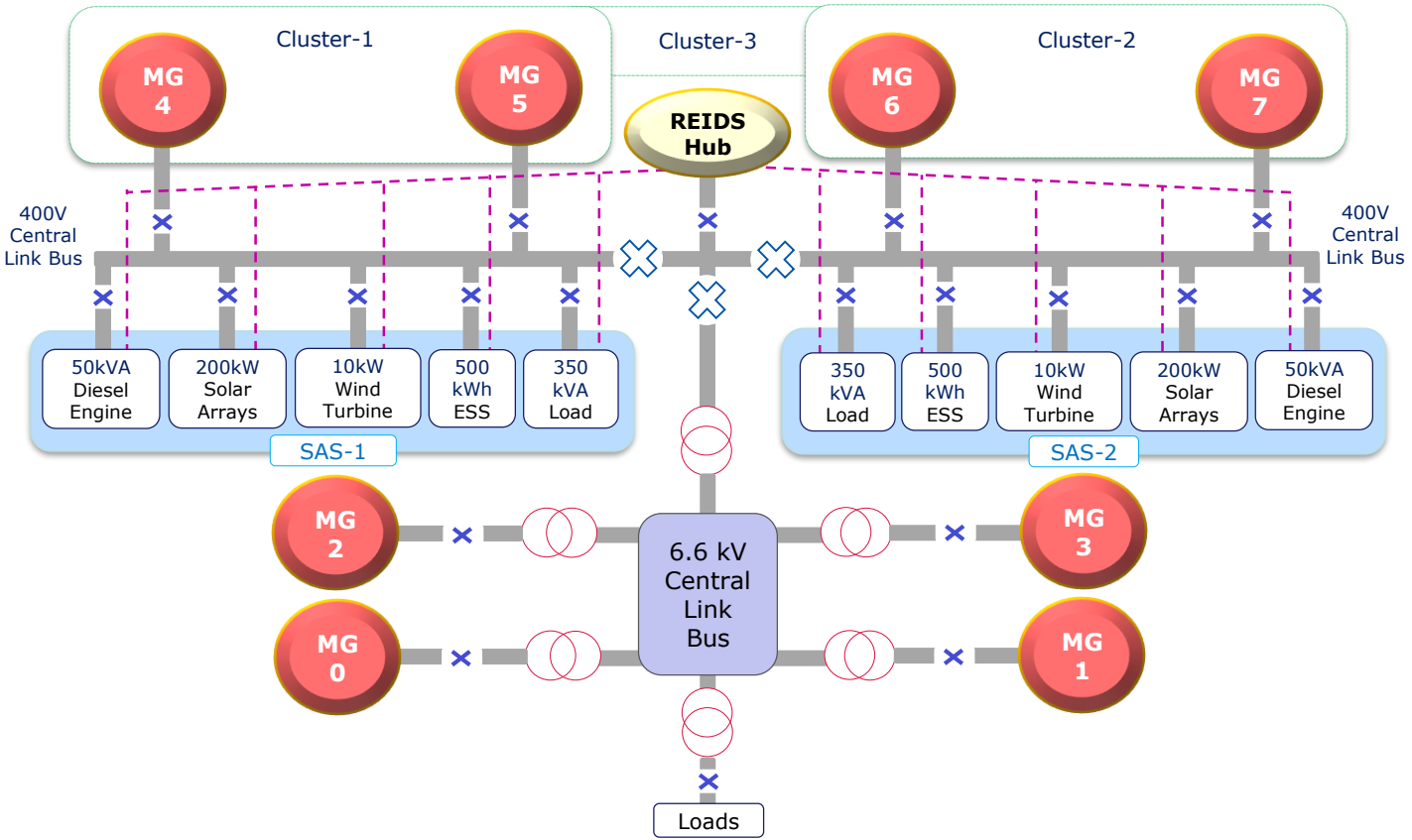
REIDS Low Voltage Microgrid Cluster - LVMGC

- REIDS Low Voltage Microgrid Cluster (LVMGC) on Semakau Landfill is a living lab for research collaborations between academia and industries to solve engineering, economic, environmental and societal energy transition challenges for off-grid and urban microgrids.

- Bolstering flexible reconfiguration capabilities, LVMGC platform enhances REIDS by enabling comprehensive multi-microgrid test scenarios, dynamic system optimization, energy exchange and interoperability which are instrumental to explore pre-competitive RD&D opportunities in energy sector.

- This unique concept allows the REIDS initiative to feature three types of research collaborators:
  1. Independent Microgrid Operator (IMO)
  2. Cluster Microgrid Operator (CMO)
  3. REIDS Hub-based Operator (RHO)

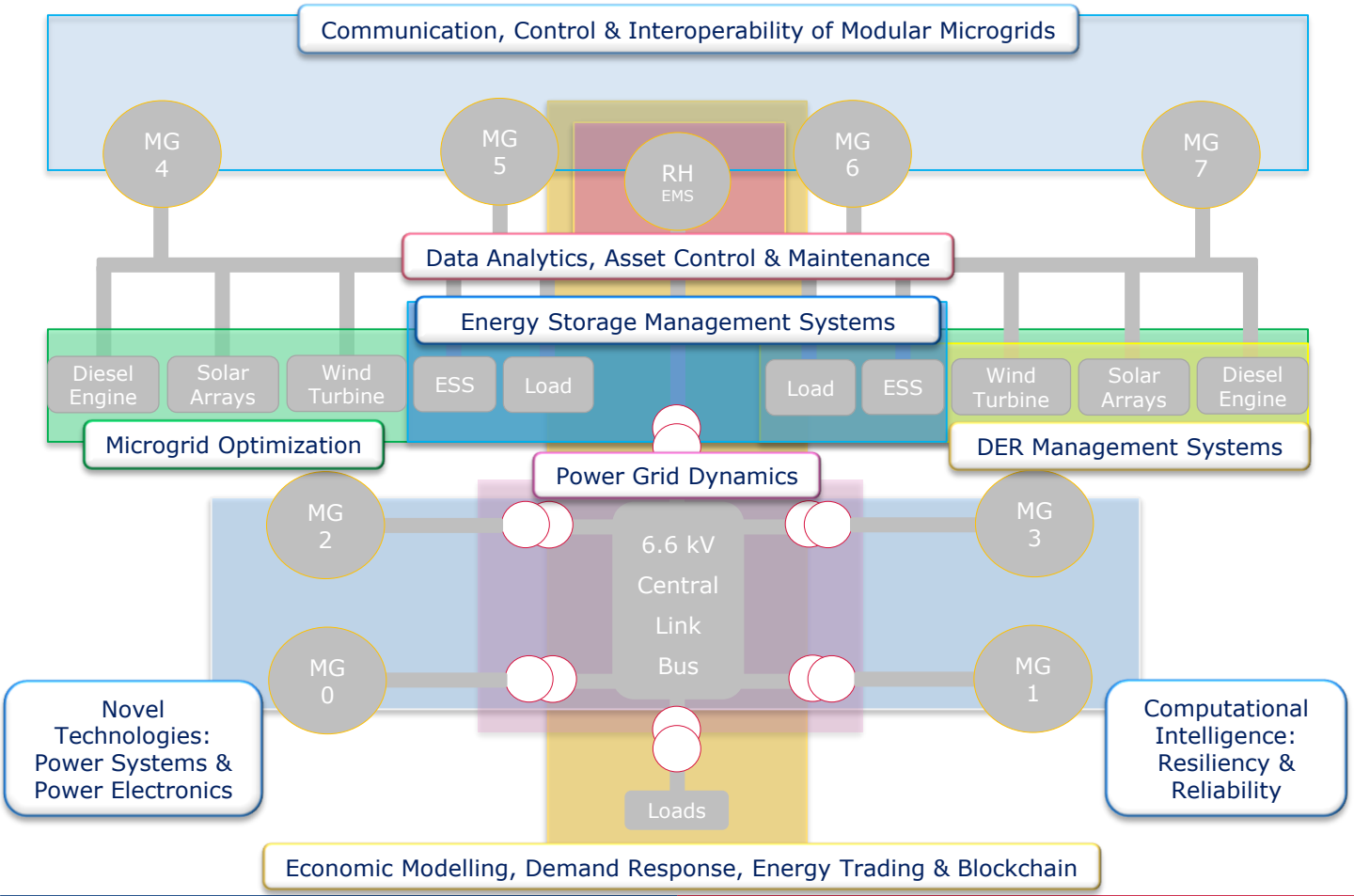
REIDS LVMGC - System Architecture



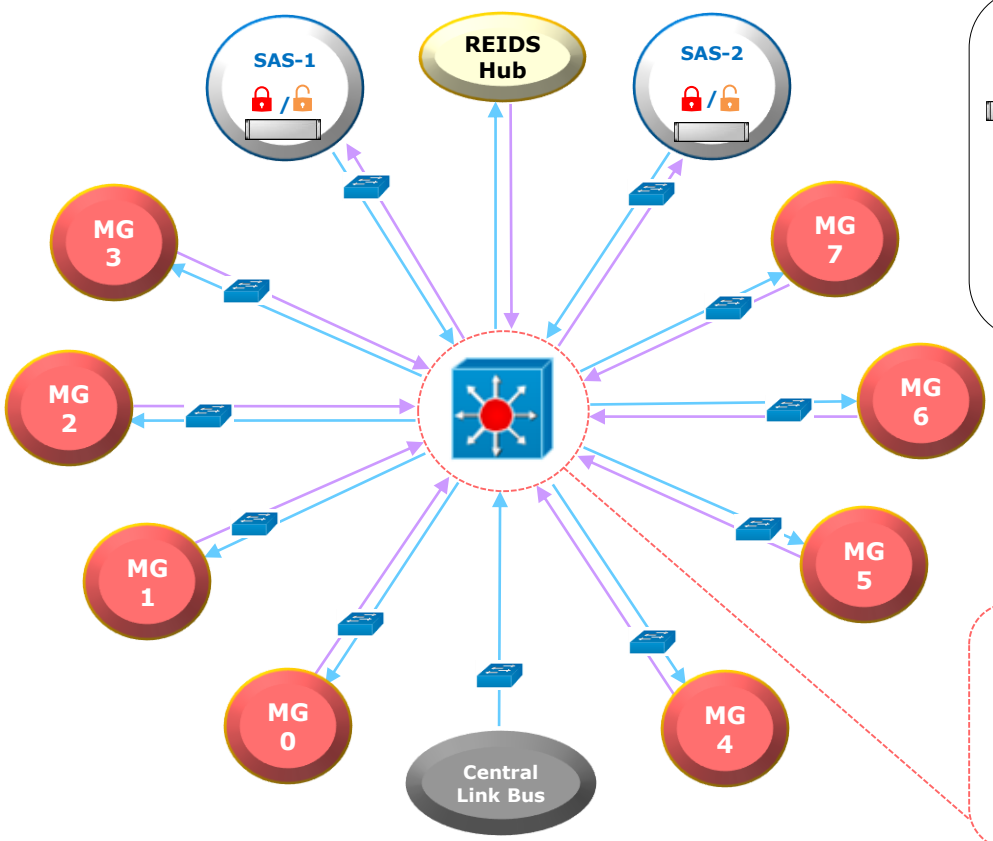
SAS – Shared Assets Set

LVMG –Low Voltage Microgrid

REIDS LVMGC - RD&D Opportunities



REIDS LVMGC - ICT Architecture



Legend

- Controlling direction
- Monitoring direction
- Gateway / Data Concentrator
- Central Multilayer Switch
- Local network switches
- Data access locked
- Data access unlocked

Compatible Platforms for Interoperability

Ethernet TCP/IP based Protocols

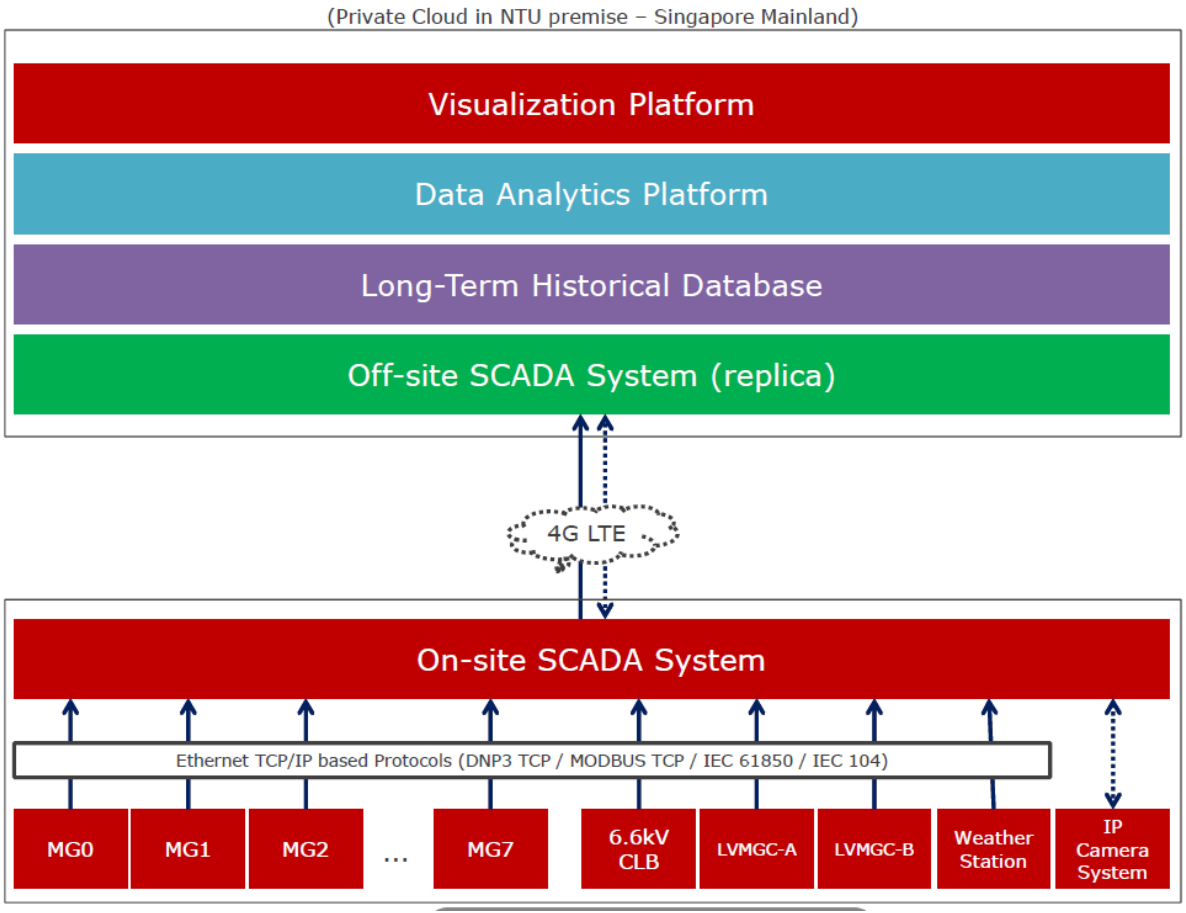
DNP3 TCP

MODBUS TCP

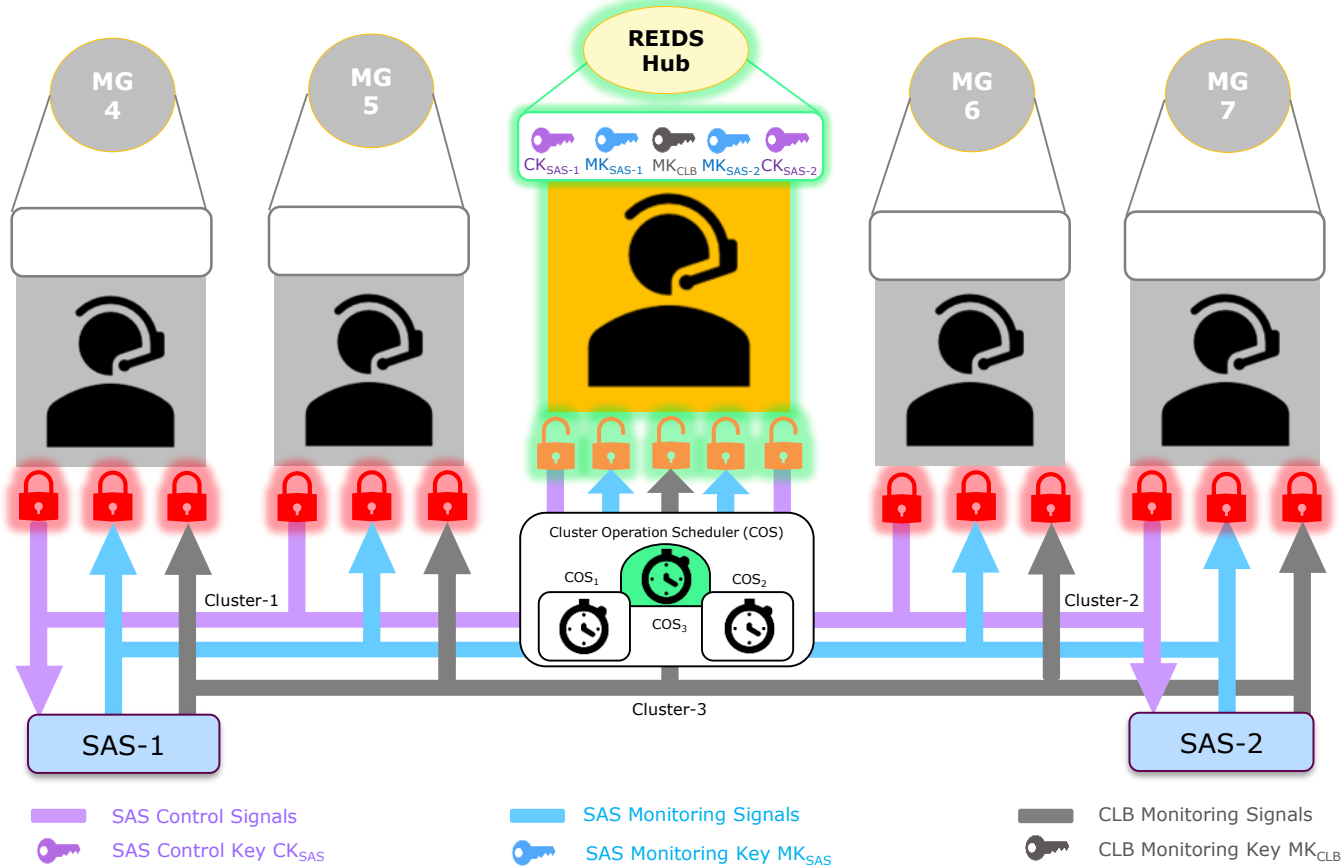
IEC 61850

IEC 104

REIDS LVMGC – System Integration [Power & ICT]



REIDS - Cluster Operation Management



REIDS - Semakau Landfill

Energy Storage Management Systems

Distributed Energy Resources Integration

Techno-Economic Analysis, Socio-Enviro-Impact, EIA, Certification

Multi-Microgrid-Systems Inter-operability & Resiliency

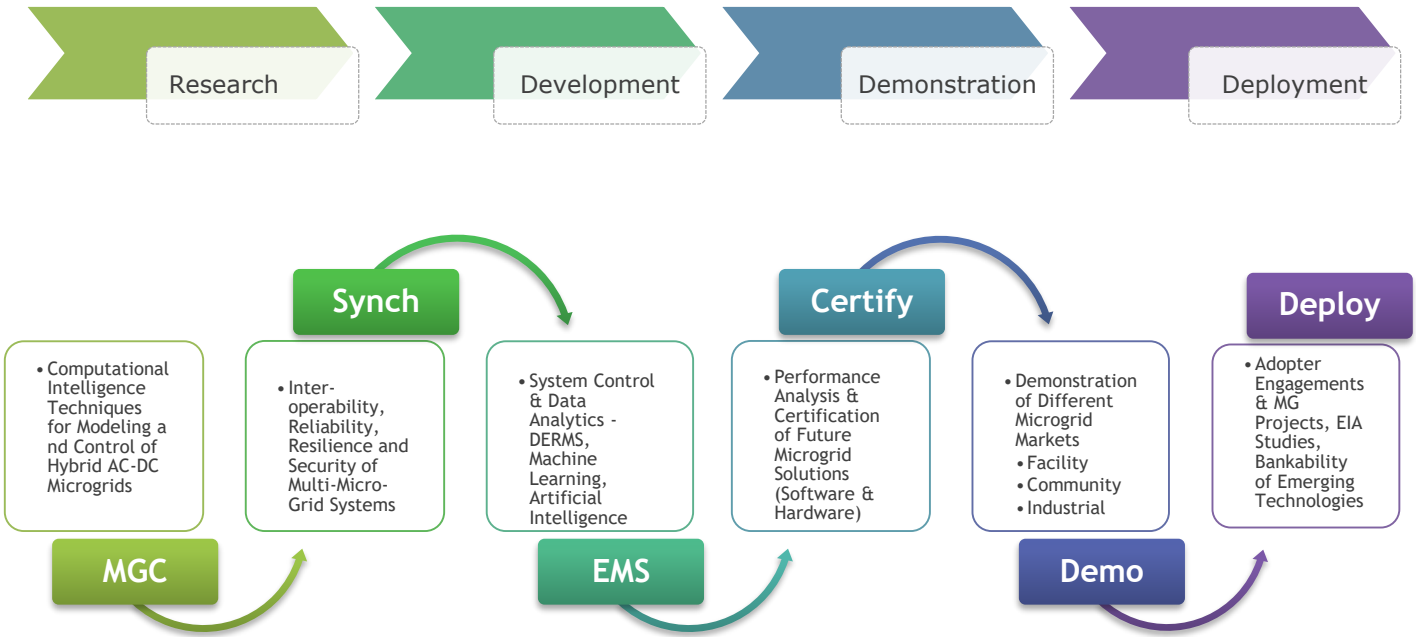
End Users – Utilities, EV, Agri/Aqua, Desalination loads

Visualization, AI, Energy Management & Security

AC-DC Hybrid Microgrids Solutions, Power Electronics, System Optimization

Data Analytics, Predictive & Preventive Asset Management

REIDS - Roadmap

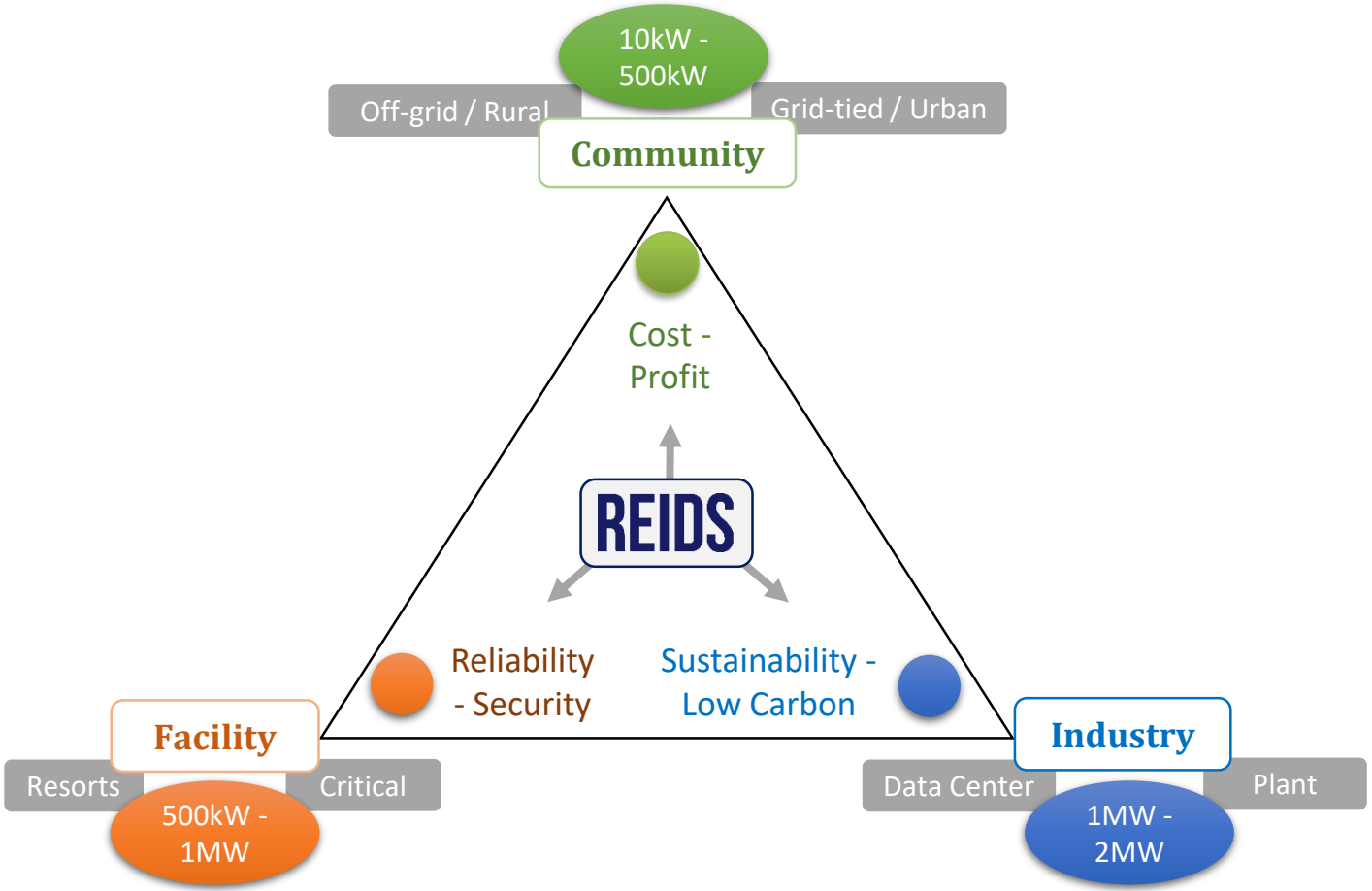


MGC – Microgrid Controllers

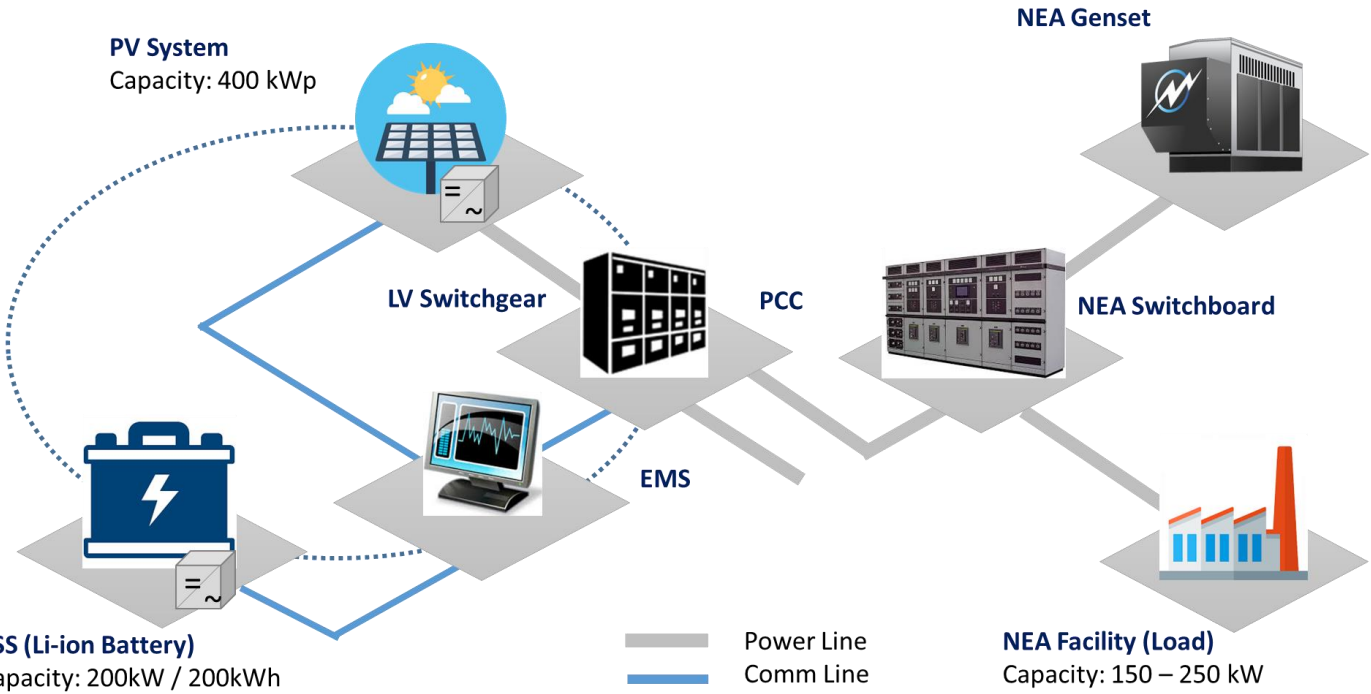
Synch– Synchronization

EMS - Energy Management Systems

REIDS - Microgrid Market Focus

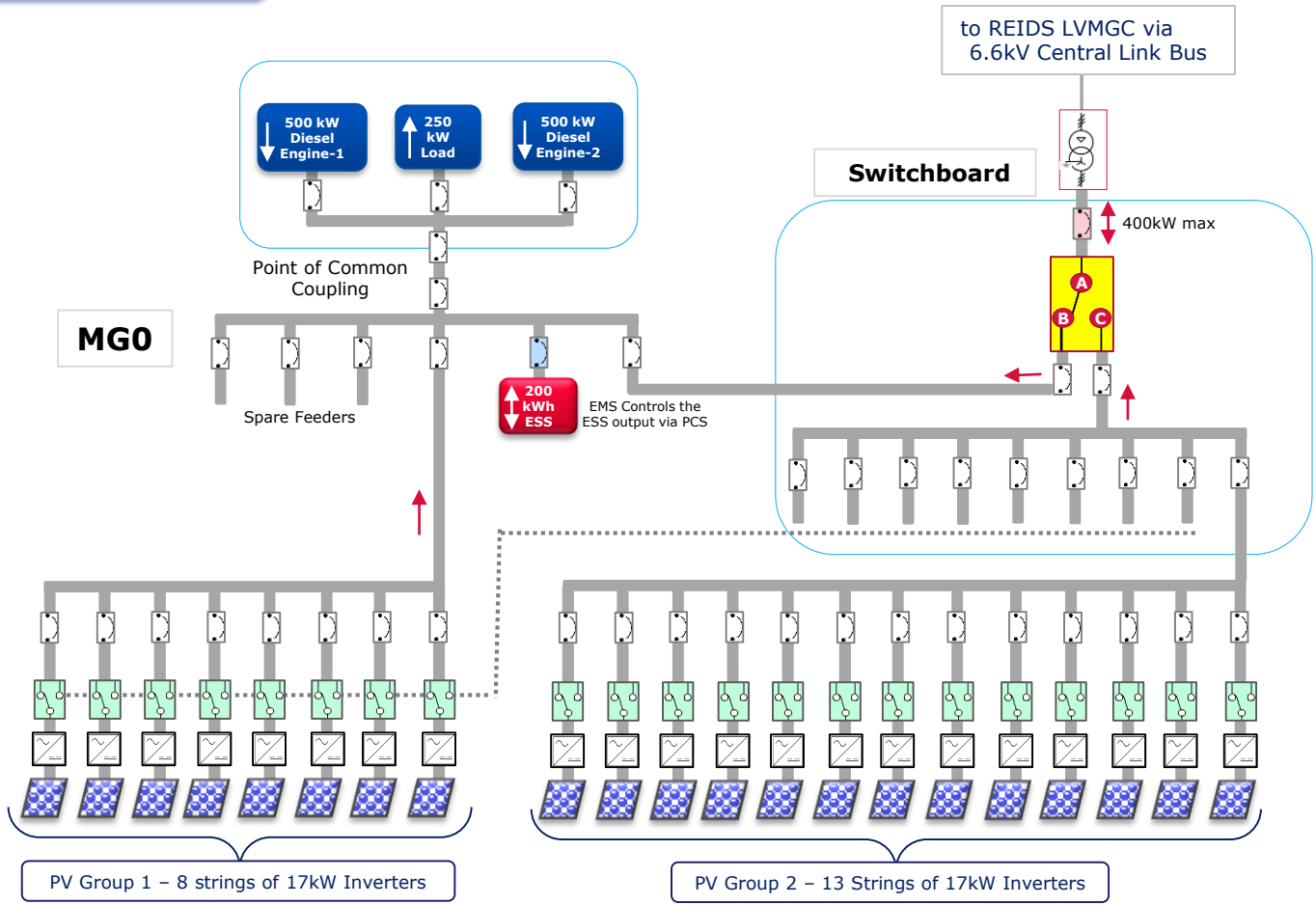


Microgrid-0 (MG0)

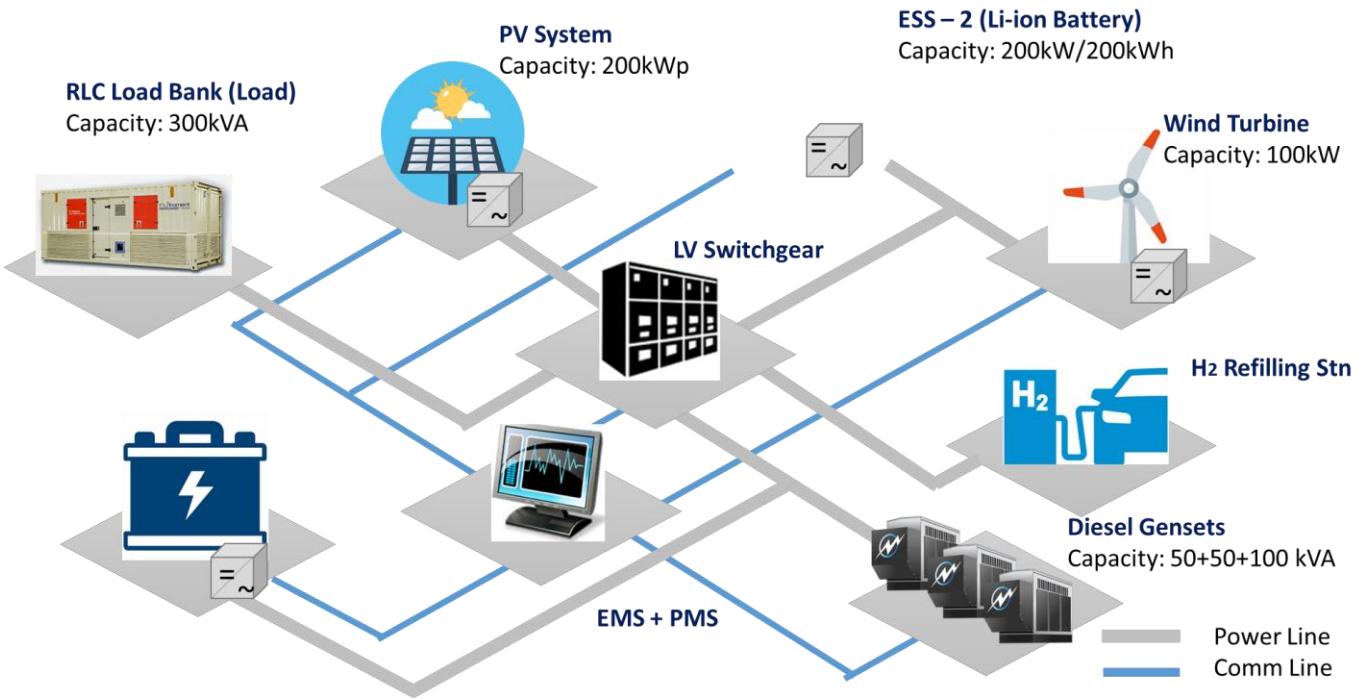


MG0 - Development Status

MG0 - EMS


to REIDS LVMGC via
6.6kV Central Link Bus
Switchboard
400kW max
A
B
C
500 kW
Diesel
Engine-1
250
kW
Load
500 kW
Diesel
Engine-2
Point of Common
Coupling
MG0
Spare Feeders
200
kWh
ESS
EMS Controls the
ESS output via PCS
PV Group 1 – 8 strings of 17kW Inverters
PV Group 2 – 13 Strings of 17kW Inverters

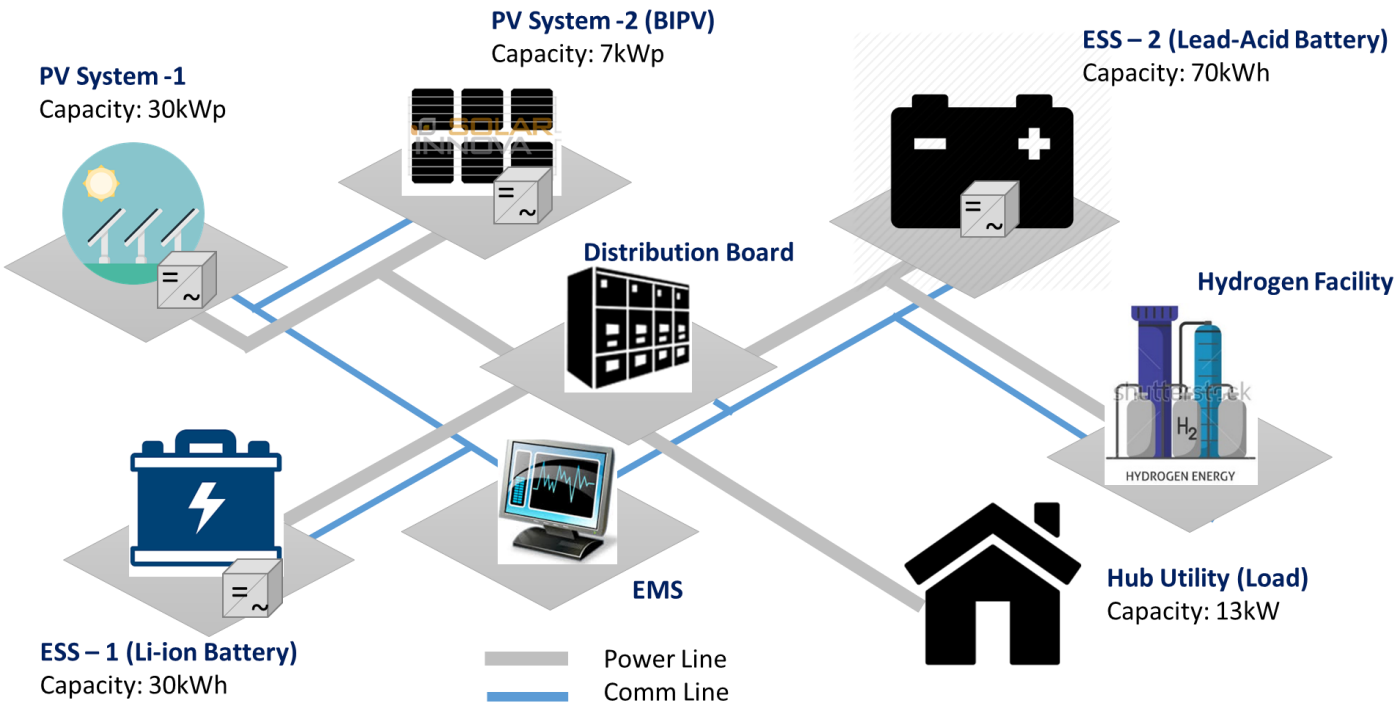
Microgrid 1 (MG1)



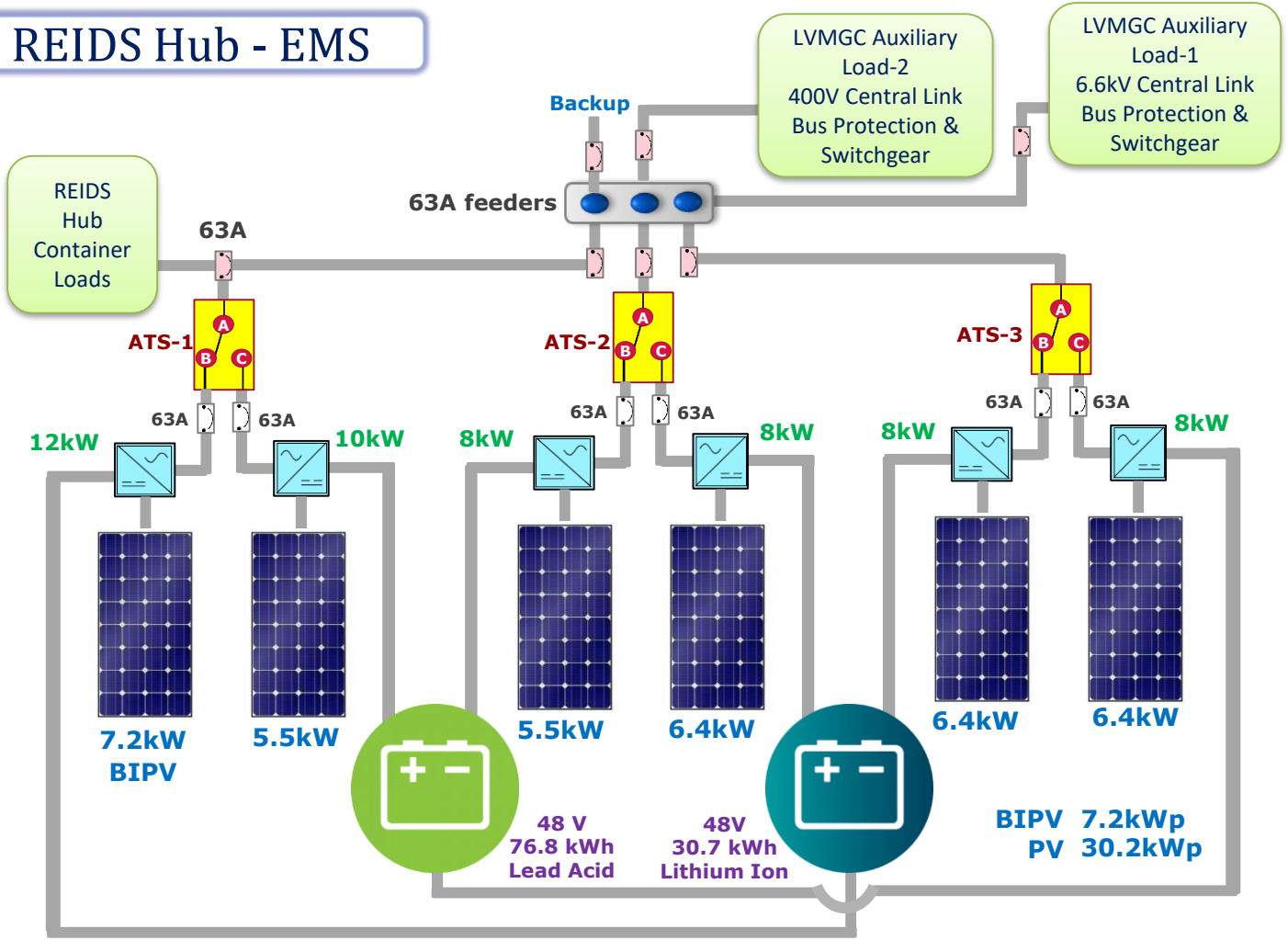
MG1 - 100kW Wind Turbine Deployment Video

MG1 – Battery Container

REIDS HUB (RH) – Visitor Centre

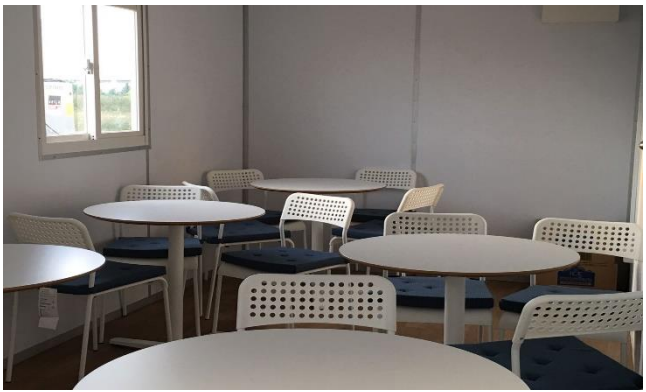


REIDS Hub - EMS



REIDS HUB – Energy Positive Centre (1/2)

REIDS HUB – Visitor Centre (2/2)



REIDS Hub - ACEPT 2017

ACEPT [REIDS Site Visit] - 27 October 2017

ACEPT [REIDS Site Visit] - 27 October 2017

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REIDS – Technologies & Partners

1 Renewables:
Solar, Wind (onshore /offshore) & Tidal

2 Energy Storage/H_2
Batteries, Supercaps, CAES, Flywheels, Power-to-fuels and H2

3 DERs:
Diesel, Bio-mass, Bio-fuels, Fuel Cells

4 Multi-microgrid Systems:
Interconnection, Urban Mesogrids, Trading, Resilience And Security

5 VOI: Visualization, Optimization AI, Energy/Power Management Platforms

6 Microgrid Controller:
SW, HW, AC-DC Hybrid Grids & Power Electronics

7 DACS:
Data Analytics & Control Systems

8 Techno-enviro-socio Impact:
Techno-socio Economics, EIA, Certification

9 Rational End-use:
Utilities, Urban Residential, Industrial, Agri Loads, Desalination & EVs

REIDS Consortium

Research Leader

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Supporting Agencies

EDB singapore

National Environment Agency
Safeguard · Nurture · Cherish

Energy Market Authority
Smart Energy, Sustainable Future

National Research Foundation

Thank You

REIDS Renewable Energy Integration Demonstrator Singapore

Renewable Energy Integration Demonstrator – Singapore

http://erian.ntu.edu.sg/REIDS

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