NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

Energy Research Institute @ NTU

REIDS

Renewable Energy Integration Demonstrator - Singapore

An ERI@N Flagship Project

Systems & technologies for a sustainable & affordable energy access-for-all in Southeast Asia

Roch Drozdowski-Strehl – Deputy Director & Co-Principal Investigator, REIDS

May 2017

NTU structure

13 QS World University Rankings 2017

1 QS Top 50 Under 50 2017

2 THE Top 150 Under 50 2017

2 THE Asia University Rankings 2017

"High-quality global education" **Students:** 33.000 **Faculty and research staff:** 4.300

COLLEGES AND SCHOOLS, e.g.

- Nanyang Business School
- College of Engineering
- College of Humanities, Arts & Social Sciences
- College of Science
- Lee Kong Chian College of Medicine

RESEARCH INSTITUTES, e.g.

- Energy: ERI@N
- Water: NEWRI
- Media: IMI
- Healthcare: NIHTM
- Consumer Insight: ACI
- Catastrophe Risk: ICRM
- Maritime: MI@NTU
- Complexity Institute

NTU 2020 Research Focuses

- Sustainable Earth
- Global Asia
- Secure Community
- Healthy Society
- Future Learning

ERI@N structure

ERI@N

Energy Smart, Research Innovation

Flagship Projects : Eco Campus & REIDS

Electro mobility

Wind & Marine Renewables

Solar Energy & Solar Fuels

Maritime Clean Energy

Sustainable Building Technologies

Energy Storage

Fuel Cells

Materials, Simulation & Modeling, Electrical Power / Control, Reliability

Colleges of Sciences, Engineering, Humanities, Arts and Business

NANYANG TECHNOLOGICAL UNIVERSITY

Energy Research Institute @ NTU

REIDS

Renewable Energy Integration Demonstrator - Singapore

REIDS is a Singapore-based RD&D platform
dedicated to designing, demonstrating and testing solutions
for sustainable multi-activity off-grid communities in Southeast Asia

Rationale for REIDS

- 1.2 billion people on this earth do not have access to electricity.
- An even higher number do not have access to proper sanitation, including drinking water.
- Most of this population live in Africa, in Southeast 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.

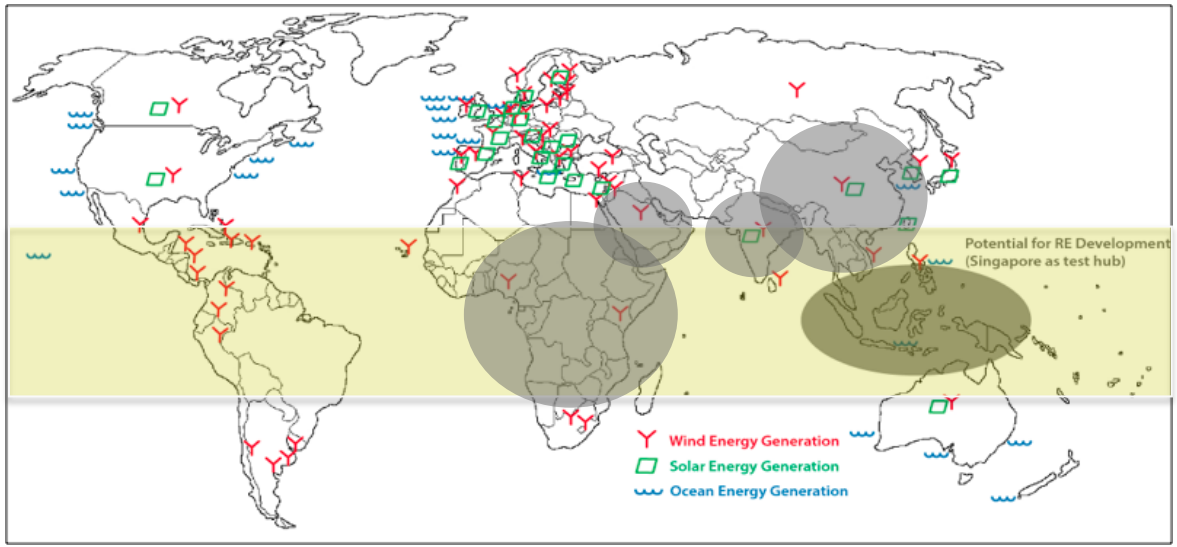
The solution must be localized networks - off-grid microgrids.

The deliberate 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

Economic development opportunity

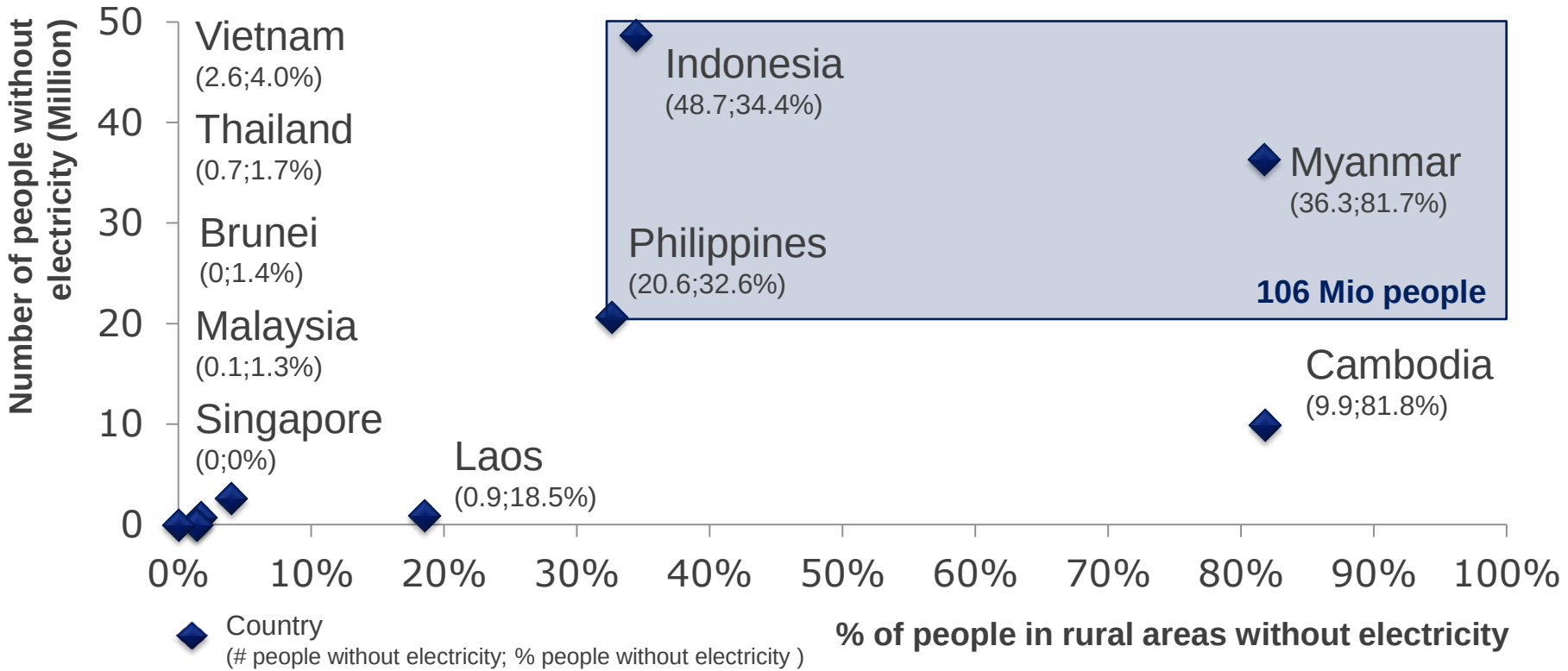
While challenging, energy transitions also represent formidable technology and economic development opportunities for energy infrastructure and systems solutions providers.



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

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

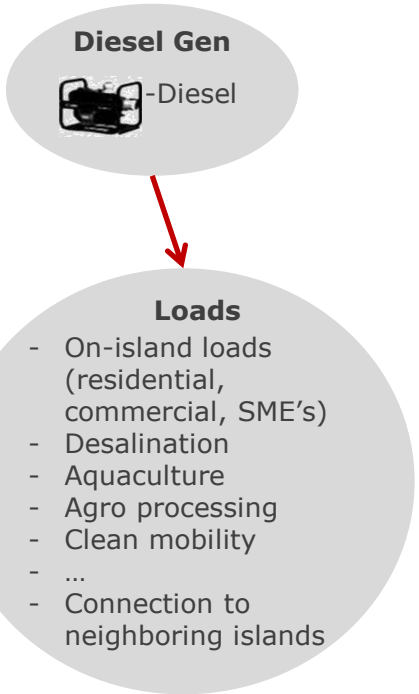
Rural electrification in Southeast Asia



Semakau Island – An emblematic site for REIDS

REIDS Technology Road Map – 1/4

Legacy



REIDS Technology Road Map – 2/4

Microgrid Infrastructure

Renewable & storage enabled

Phase-out of diesel as primary provider

Renewable Energy Generation

Solar Renewables

- Solar PV
- Solar Thermal Electric

Marine Renewables

- In-stream Tidal

Wind Renewables

- Small to Intermediate
- Onshore & Offshore

Hybrid Microgrid

- Remote Monitoring & Control
- AC/DC

Diesel Gen

-Diesel

Energy Storage

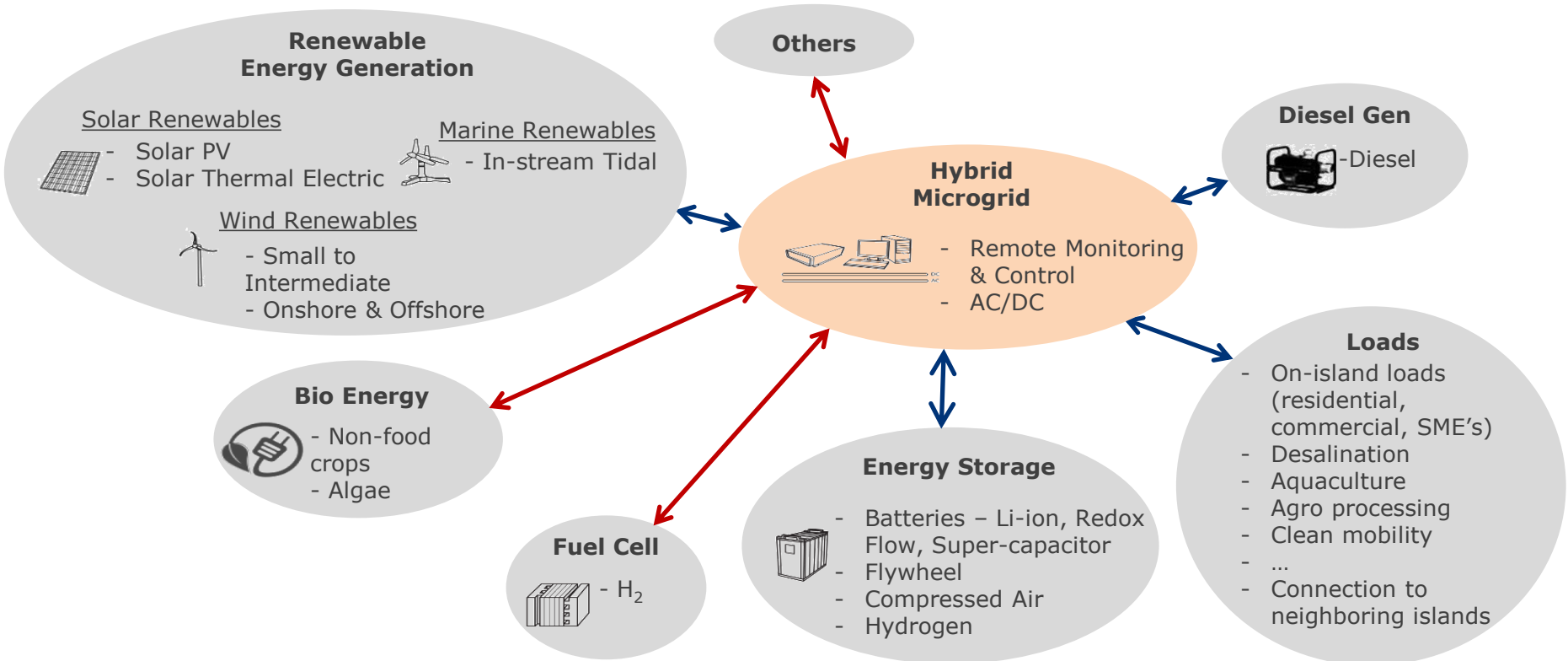
- Batteries – Li-ion, Redox Flow, Super-capacitor
- Flywheel
- Compressed Air
- Hydrogen

Loads

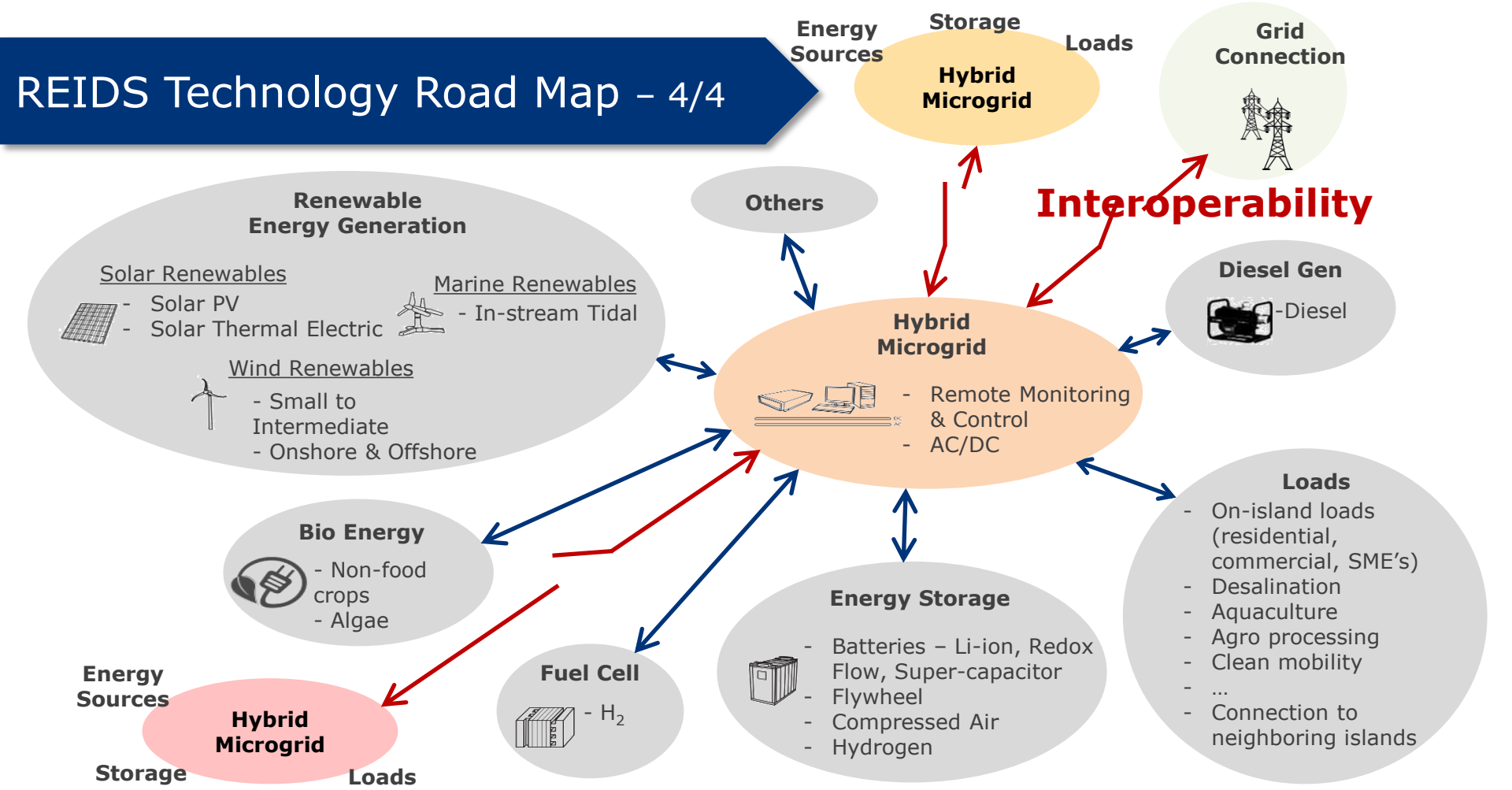
- On-island loads (residential, commercial, SME's)
- Desalination
- Aquaculture
- Agro processing
- Clean mobility
- …
- Connection to neighboring islands

REIDS Technology Road Map – 3/4

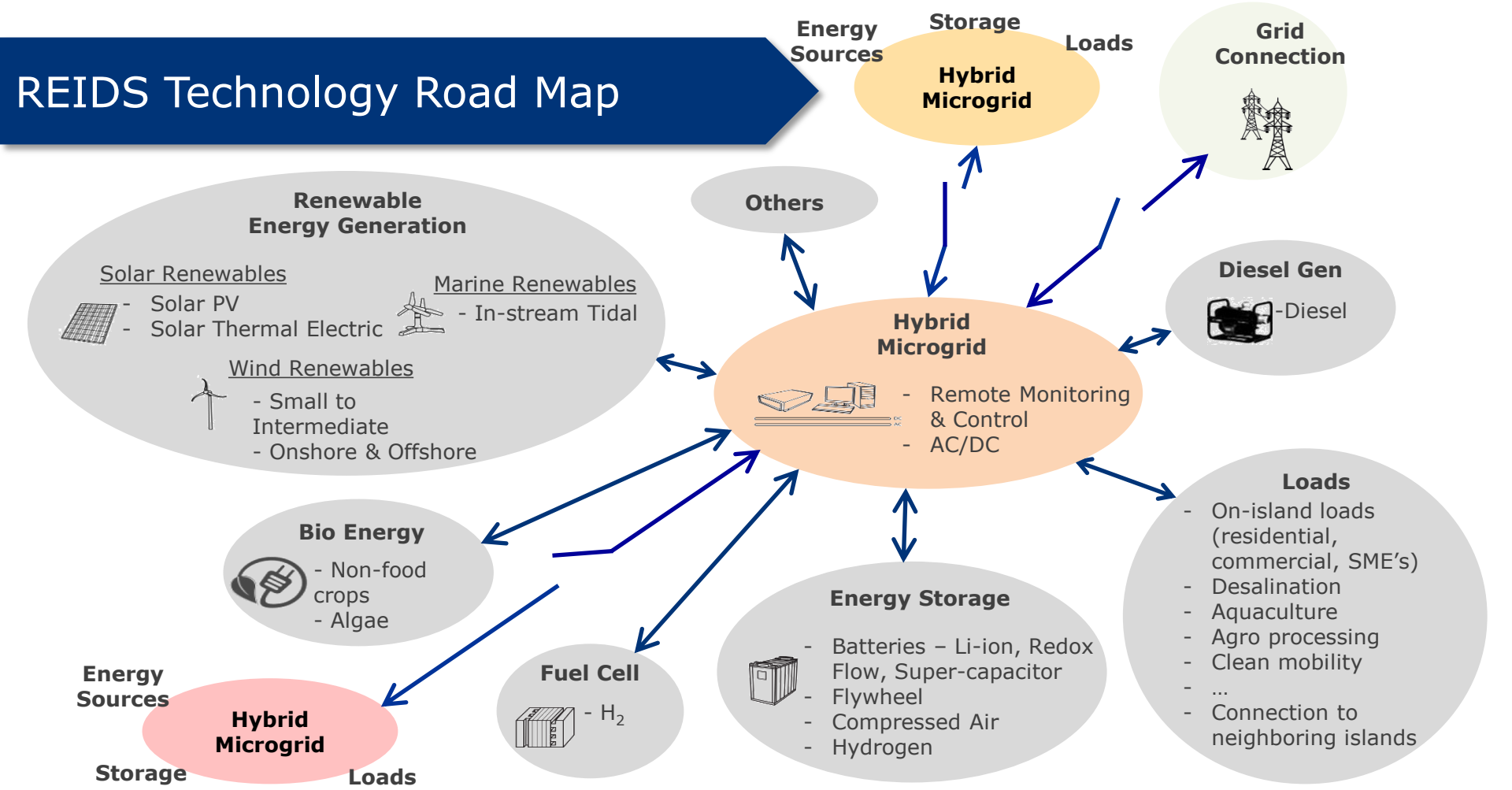
Plug & Play expansion



REIDS Technology Road Map – 4/4



REIDS Technology Road Map



The three pillars of our long-term strategy for excellence

1 Microgrid R&D

- Solving engineering, economic, environmental and societal energy transition challenges for off-grid communities.
- Partnering with Southeast Asia private, public and civil society organizations.

2 Microgrid systems demonstration and equipment testing

- Implementing large-scale microgrid system demonstrations under Southeast Asia climatic conditions.
- Designing and executing equipment performance assessment tests in a neutral environment under in-the-field operating conditions.

3 Outreach: engineering support, seminars, presentation & publications

- Broadly disseminating the REIDS message in Southeast Asia: conference participations, seminars, executive education – Singapore and off-site.
- Road-mapping energy transition strategies in Southeast Asia.
- Enrolling REIDS public and private sector members in Southeast Asia.

REIDS
Key R & D challenges

1. Power and Energy management
2. Systemic integration of supply, demand and storage
3. Supply-side and demand-side requirements reconciliation
4. Plug & Play operations
5. Centralized vs local monitoring and control
6. Energy road mapping for off-grid communities
7. Economic performance evaluation of microgrid solutions
8. Standardization

NANYANG TECHNOLOGICAL UNIVERSITY

2 Microgrid systems demonstration and equipment testing

REIDS key technological building blocks	
	1. Renewable energy generation (solar, wind, in-stream tidal, ..)
	2. Energy storage (batteries, hydrogen, flywheel, compressed air, ..)
	3. ICT architectures
	4. Energy management systems
	5. Aqua and agriculture energy systems integration
	6. Desalination and fresh water production
	7. Sustainable mobility
	8. Power-to-gas and fuels
	9. Micro-algae and others

3 Outreach: engineering support, seminars, presentation & publications

Outreach value propositions for REIDS Members	
	1. Presenting REIDS results at conferences and symposia in the region
	2. Delivering seminars and executive education in collaboration with REIDS partners
	3. Enhancing knowledge of local market dynamics for REIDS partners
	4. Providing additional information channels complementary to existing corporate M & S
	5. Participating in REIDS microgrid technology and market intelligence watch
	6. Gaining enhanced insights of Southeast Asia regulatory and legislative dispositions
	7. Benefiting from proactive engagement in REIDS marketing and showcasing programs

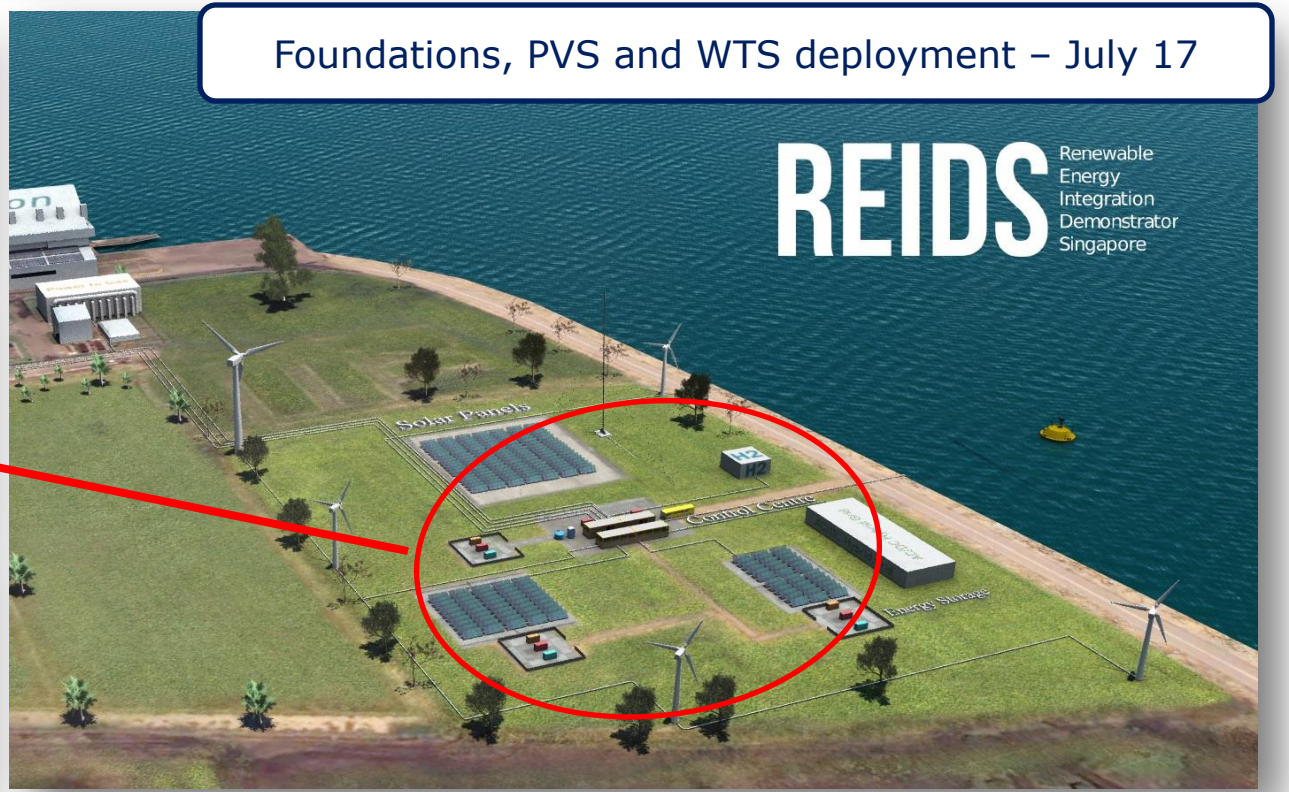
REIDS 3D rendering

REIDS Development status – "Microgrid 0"

MG0 Test & Commissioning - March 2017

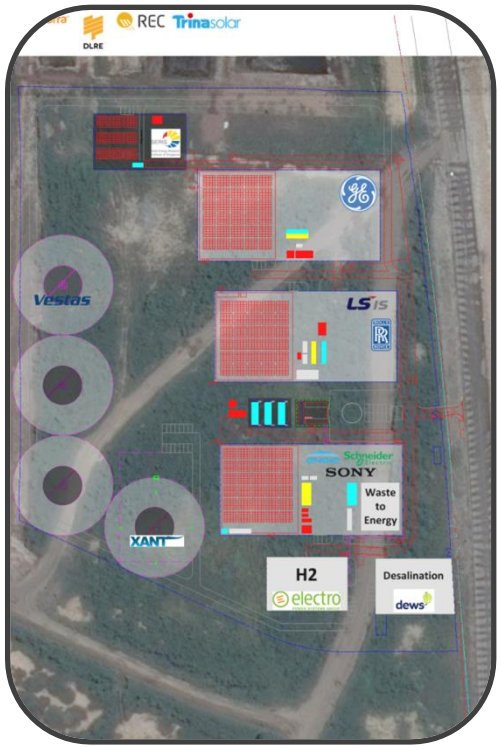
REIDS Development status – "P2 plot"

Foundations, PVS and WTS deployment – July 17



Microgrids 1, 2 and 3 on a 64'400 m^2 greenfield – Plot 2 (P2)

P2 plot conceptual diagram:



Three separate microgrids

400 VAC – DC distribution possible

Within each microgrid:

- PV – several 100 kWp
- Wind – 50 to 200 kW
- Energy storage – Li-Ion, Redox flow, supercapacitors, etc.
- 400 kW 3Ø passive load
- Microgrid-specific loads
- Possibility to connect to shared loads and sources

Each microgrid should be capable of operating in a fully islanded / isolated mode.

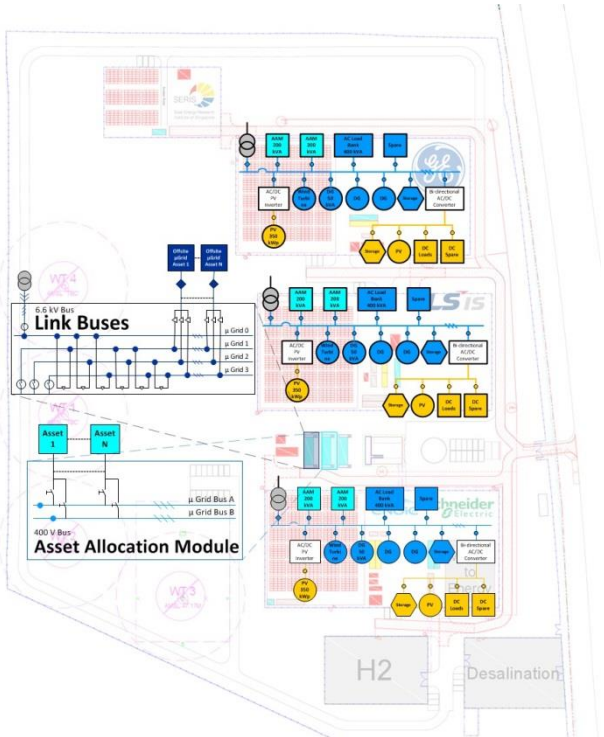
Inter-microgrid operation "interoperability demonstration" by way of 6.6 kVAC network.

Connection to off-P2 assets: 6.6 kVAC

- Fish nursery
- Desalination plants
- In-stream tidal machines
- ….

Microgrids 1, 2 and 3 on a 64'400 m^2 greenfield – Plot 2 (P2)

P2 plot conceptual diagram:



Three separate microgrids

400 VAC – DC distribution possible

Within each microgrid:

- PV – several 100 kWp
- Wind – 50 to 200 kW
- Energy storage – Li-Ion, Redox flow, supercapacitors, etc.
- 400 kW 3Ø passive load
- Microgrid-specific loads
- Possibility to connect to shared loads and sources

Each microgrid should be capable of operating in a fully islanded / isolated mode.

Inter-microgrid operation "interoperability demonstration" by way of 6.6 kVAC network.

Connection to off-P2 assets: 6.6 kVAC

- Fish nursery
- Desalination plants
- In-stream tidal machines
- ….

REIDS Partners as of December 2017

Adopters

MERALCO

Bawah PRIVATE ISLAND

Solutions Providers

accenture

ClassNK

DLRE

ENGIE

GE

LS IS

REC

Schneider Electric

SEAS Sustainable Energy Association of Singapore

sembcorp

SONY

Trinasolar

Vestas

Coordinator

NANYANG TECHNOLOGICAL UNIVERSITY

Supporting Agencies

EDB singapore

National Environment Agency Safeguard · Nurture · Cherish

ENERGY MARKET AUTHORITY

NATIONAL RESEARCH FOUNDATION

Thank you

REIDS

Renewable Energy Integration Demonstrator – Singapore

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

Contact:

Mr. Roch Drozdowski-Strehl
Deputy Director, REIDS
roch@ntu.edu.sg

Energy Research Institute @ NTU – ERI@N
Nanyang Technological University
Singapore 637141