High Renewable Energy Penetrations in Isolated and Remote Area Power Systems

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Opportunities

- Electricity in isolated power systems is traditionally generated using diesel generators.
- High cost of diesel fuel supply (the price exceeds US $1/kWh).
- Incentive for introducing renewable energy generation.

Reducing diesel dependence in isolated grids is becoming an ***accepted option***, with more interest from larger multi-lateral donor and banking organizations.

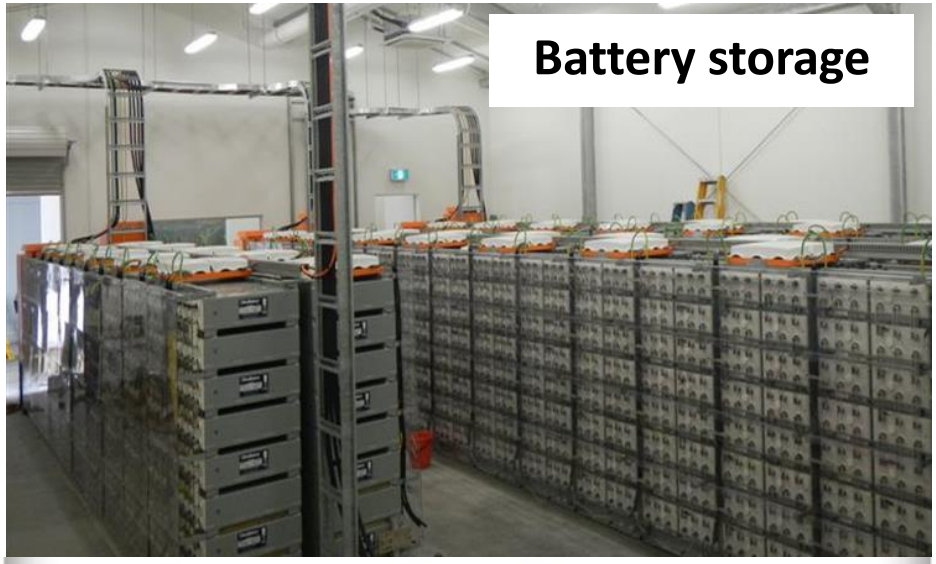
- Australian experience is typical of progress in transitioning to renewable generation. The smallest Australian states adopt the most aggressive renewable targets, 100% by 2020 and 2022 for the Australian Capital Territory (ACT), and Tasmania, respectively.
- This trend of small networks to lead renewable integration derives primarily from their ability to achieve high renewable penetrations for moderate renewable capacity addition.

Technology portfolio

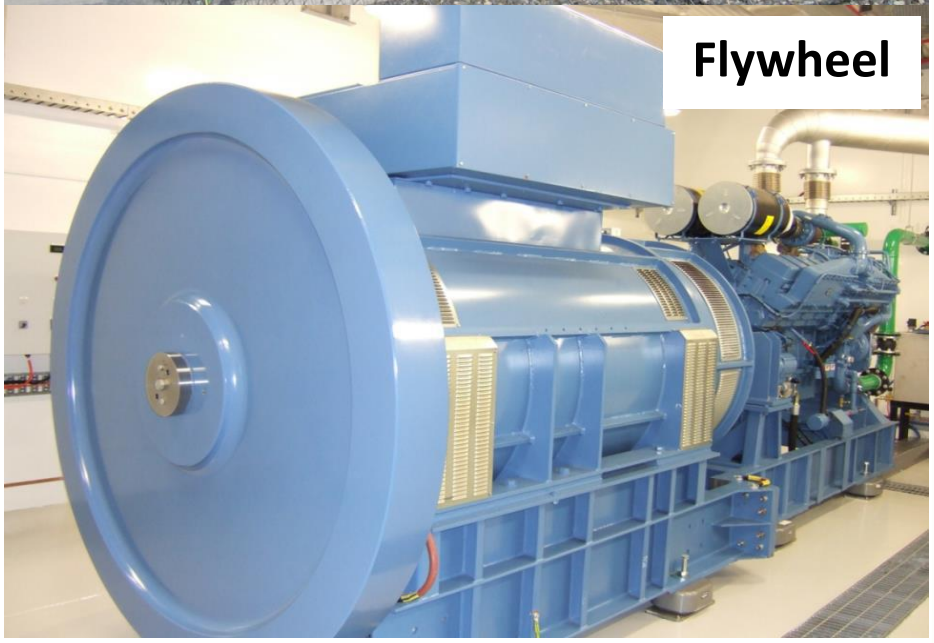
- Wind and solar,
- Dual axis solar PV tracking system,
- Dynamic resistive frequency control,
- Flywheel diesel uninterrupted power supply,
- Biodiesel blending ,
- Demand side management, and
- Battery energy storage.

Dynamic resistor

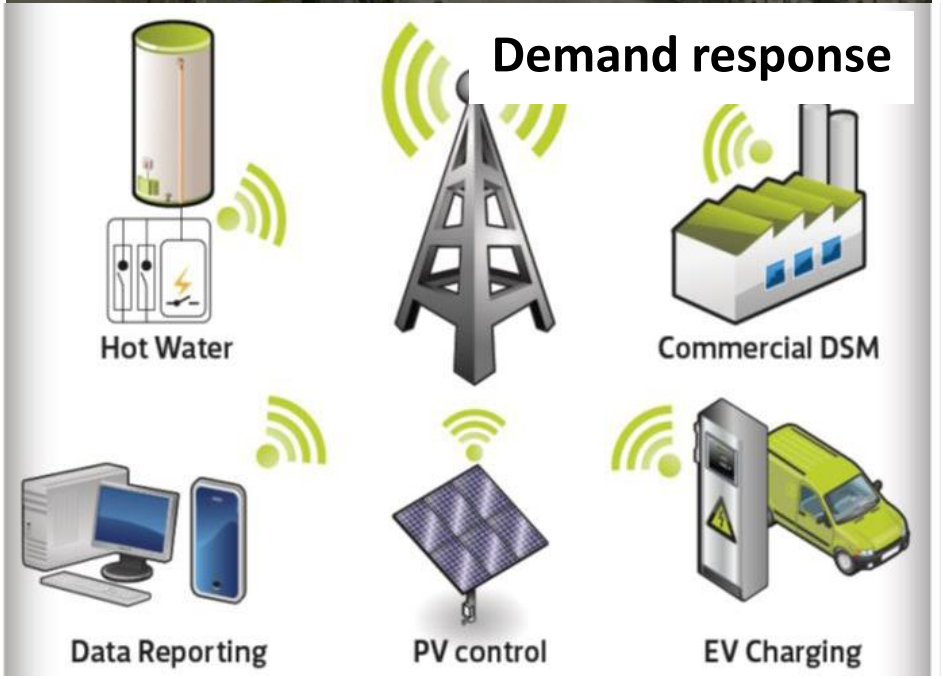
Battery storage



Flywheel



Demand response



Battery energy storage?

- As penetrations of renewable energy increase within a system, conventional approaches may become unable to manage system security.
- Battery energy storage is a common solution. But it is an emerging technology and currently expensive.
- Australian experience advocates approaches able to reduce both the system cost and complexity.

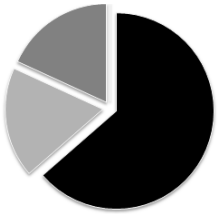
Challenges

- **Projects can be expensive.** Costs as high as $17 per Watt have been reported for small (100-kW) installations.
- **The need for energy storage**. Especially in larger grids.
- **Poor performance compared to modelled predictions.** Poor resource assessment (wind and solar); poor system modelling; few qualified people to manage projects; long contracting and deployment timelines; lack of ongoing technical assistance; use of new, untested technologies in remote communities.
- **Environmental regulations can limit potential project sites.** Especially in islanded communities with protected or endangered species.

Main challenges

- **Institutional.** Poor understanding of the technology by decision makers; lack of trained personnel; no coordinated outreach, targeted industry or users group, or expanded communications network.
- **Policy**. Subsidized fuel markets and a lack of consideration of environmental impacts; perceived risk and associated higher financial costs; complicated, costly, and multi-jurisdictional permitting processes; and risk-averse culture.

Case study metrics

	King Island renewable energy integration project	Flinders Island hybrid energy hub	Rottnest Island water and renewable energy nexus
Generation Configuration			
	■ Diesel (MW) ■ Wind (MW)	■ Solar PV (MW)	▨ BESS Capacity (MW)
Peak Load (MW)	2.5	1.3	1.2
Average Load (MW)	1.4	0.8	0.6
Annual Generation (GWh p.a.)	12	6.7	5
Generation Capacity Total (MW)	8.35	4.4	3.3
Generation Capacity Renewable (MW)	2.35	1.4	1.2
Renewable Capacity (MW) WIND	2.25	1.2	0.6
Renewable Capacity (MW) Solar PV	0.1	0.2	0.6
Battery ESS Capacity (MW,MWh)	3, 1.6	0.75, 0.3	n/a
Flywheel System	Yes	Yes	No
Renewable Energy Penetration (% p.a.)	65%	60%	50%
Development Period	1998-2015	2014-2017	2016-2017
Utility Network Connection	No	No	No
Capital Cost ($m)	28.15	15.38	9.81
Capital Cost ($m/per MW installed)	**11.98**	**10.99**	**8.18**

Technology trends (Australian experience)

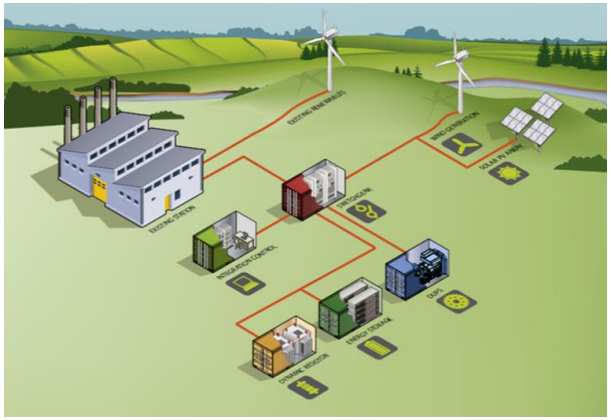
Technology Progression	King Island renewable energy integration project	Flinders Island hybrid energy hub	Rottnest Island water and renewable energy nexus
Wind	↑	—	—
Solar PV		↑	↑
Battery		↓	↓
Flywheel		↓	↓
Low Load Diesel			↑

— No Change

↑ Increasing Relevance

↓ Decreasing Relevance

Modular scalable enabling systems for rapid deployment



Want to see a 100% renewable energy island system operating?

www.kireip.com.au

Want to learn more about isolated power systems with high renewable energy penetration?

http://ipsconnect.org/