Energy Storage
The Problem- Generator &
Industry Needs & Market Demand

Hydro Tasmania
the renewable energy business

CEIC R&D Forum

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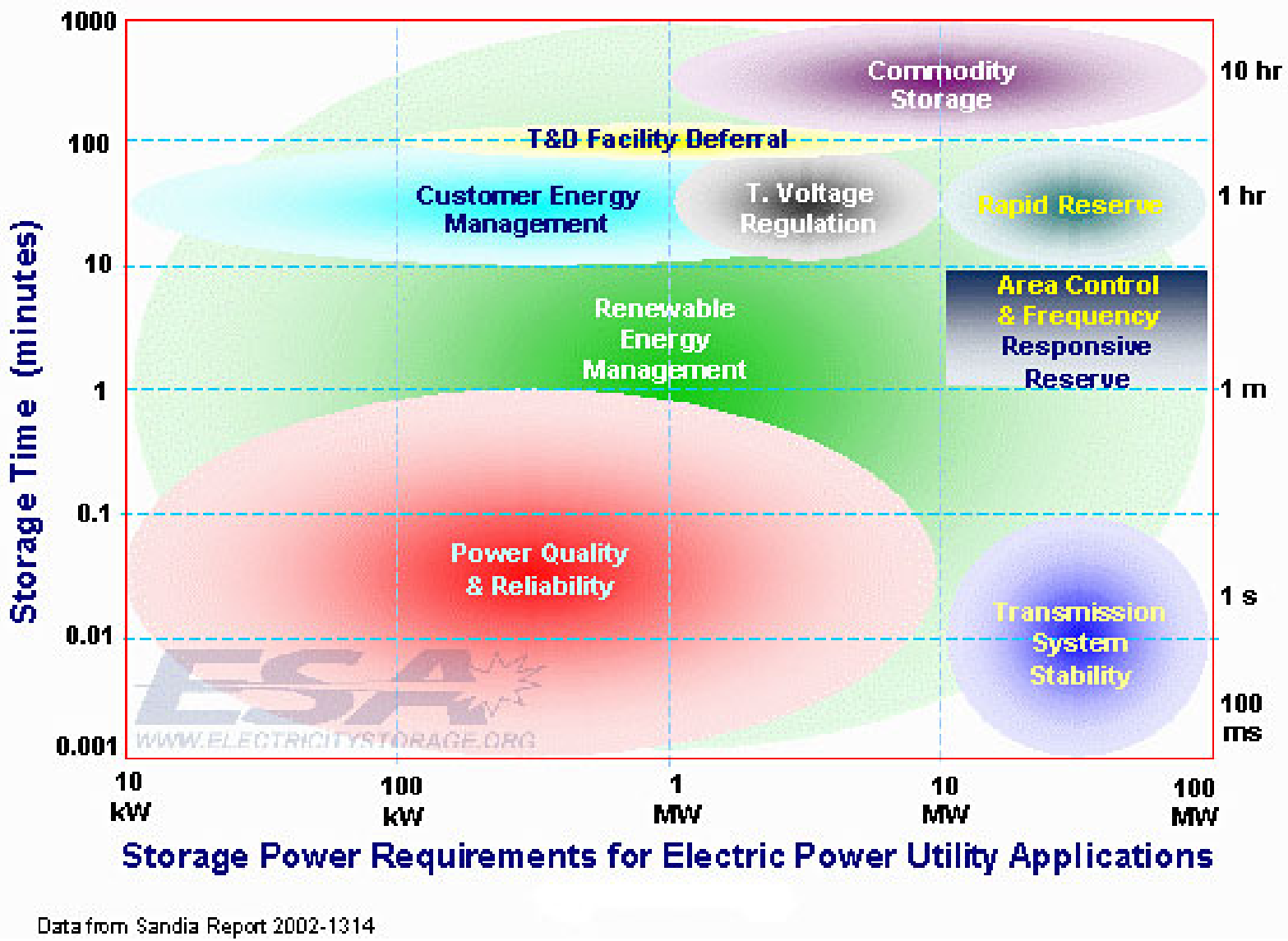
Energy Storage – Utility Interest

- Storage has significant value
  - ability to inject when market requires – improving efficiency
  - ability to support renewable energy integration, including DG
- Storage is not widely utilised – technology and cost
- Energy storage interest broadly separated into:
  - Utility base applications
  - Transport, HEV,EV - impact on Load, V2G
- Utility based energy storage applications:
  - Utility Support
    - Capital deferral – T&D, Generation Capacity
    - System security / FCAS – reduction in cost of reserves
    - Power Quality
  - Energy Management
    - Arbitrage – Energy shifting
  - Renewable Energy Support
    - Increase the value of RE
    - RAPS

Power & Energy Density Requirements

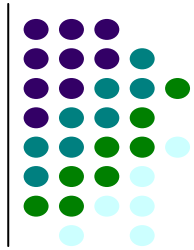
- Requirements of storage are specific to application
- System Security and Power Quality
  - fast discharge – power density
  - eg Flow batteries, Flywheels, Super capacitors
- Energy Management
  - long discharge – energy density
  - eg pump storage, CAES, thermal, conventional batteries
- Capital deferral, RE enabling and RAPS
  - Combination – multiple issues
- Other critical storage properties:
  - Efficiency, cycle life, size & weight, capital cost

Power & Energy Density Requirements



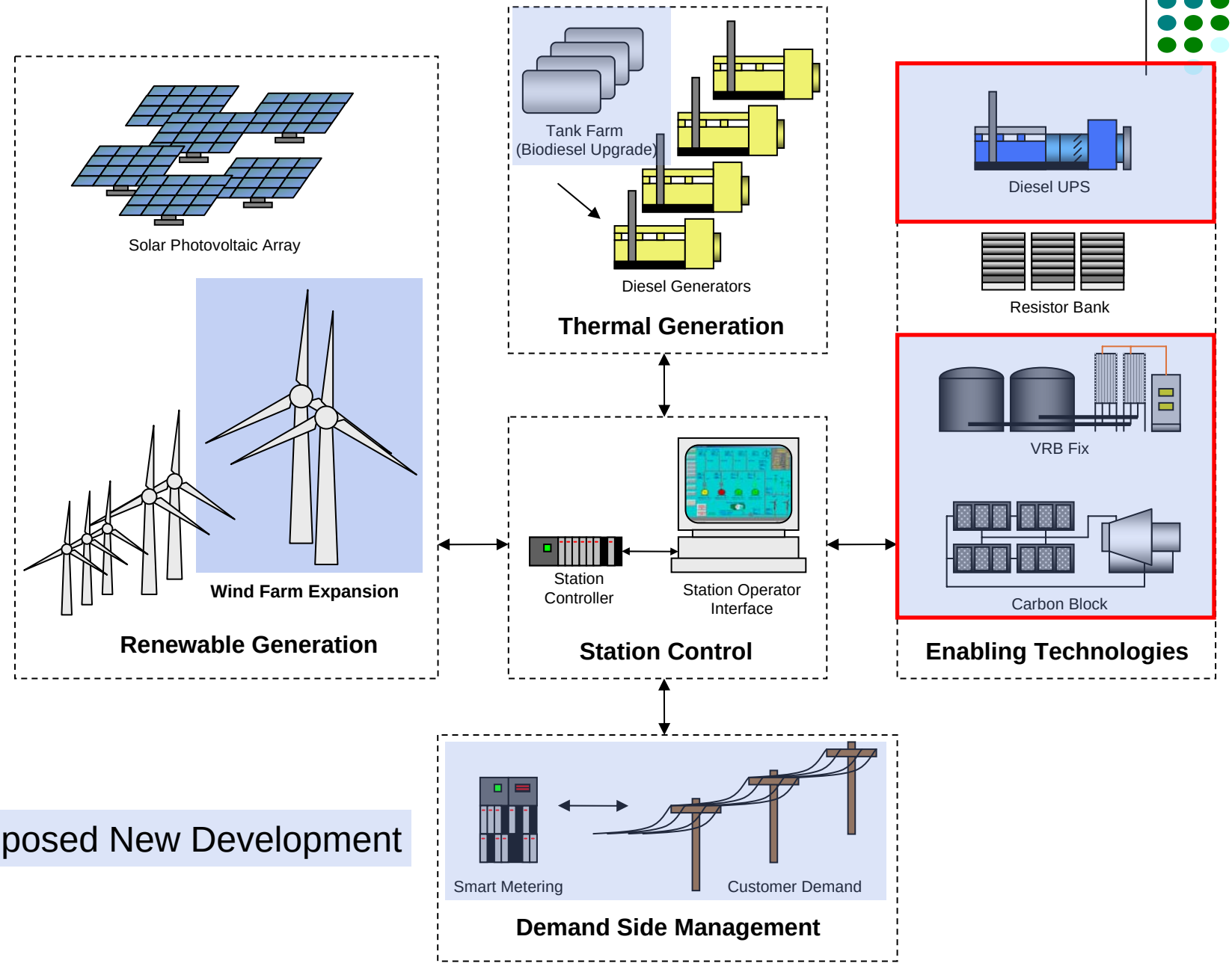
Data from Sandia Report 2002-1314

Renewable Energy Context
Market Demands – Need for Storage



- Wind
  - Reduce variability – reduce regulation FCAS
  - Increase in wind displaces plant capable of providing FCAS – provide reserves
- PV & Solar Thermal (8-10hr cycle)
  - Load shift to high demand periods
    - 4-6 hours shift
    - Solar thermal - thermal storage – molten salt, concrete, carbon block
    - PV – conventional or flow batteries
- Hydro
  - Storage intrinsic to most systems - dependent on topography
  - Pumped storage
- Wave – similar wind
- Tidal – similar solar

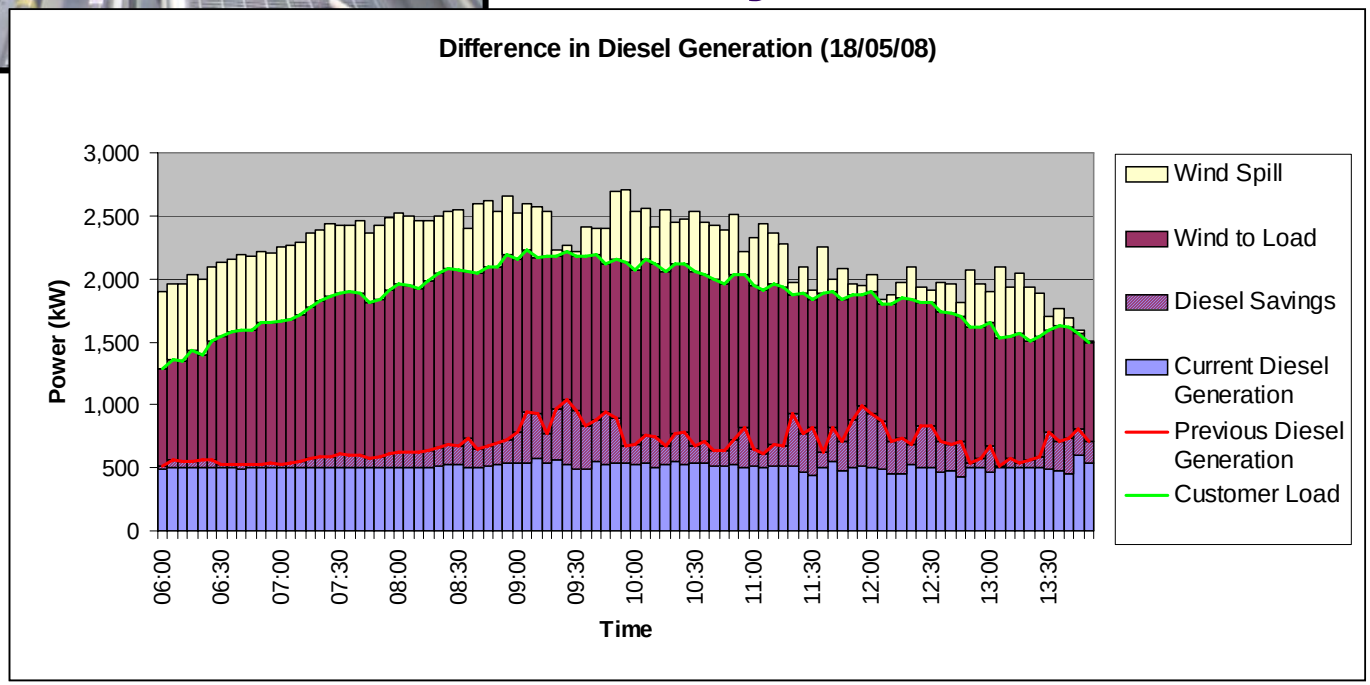
Hydro Tasmania Activities - King Island



Proposed New Development

Vanadium Redox Battery

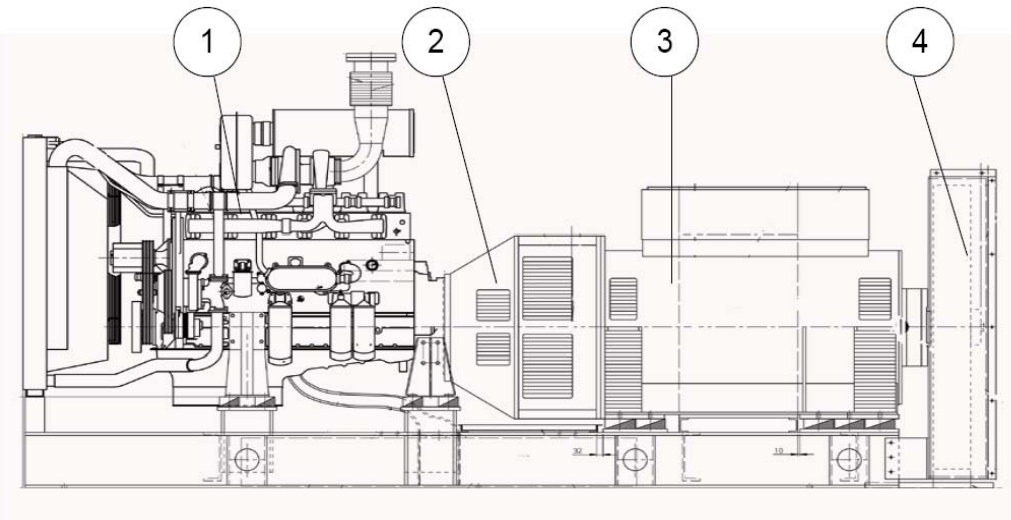
Dynamic Resistor

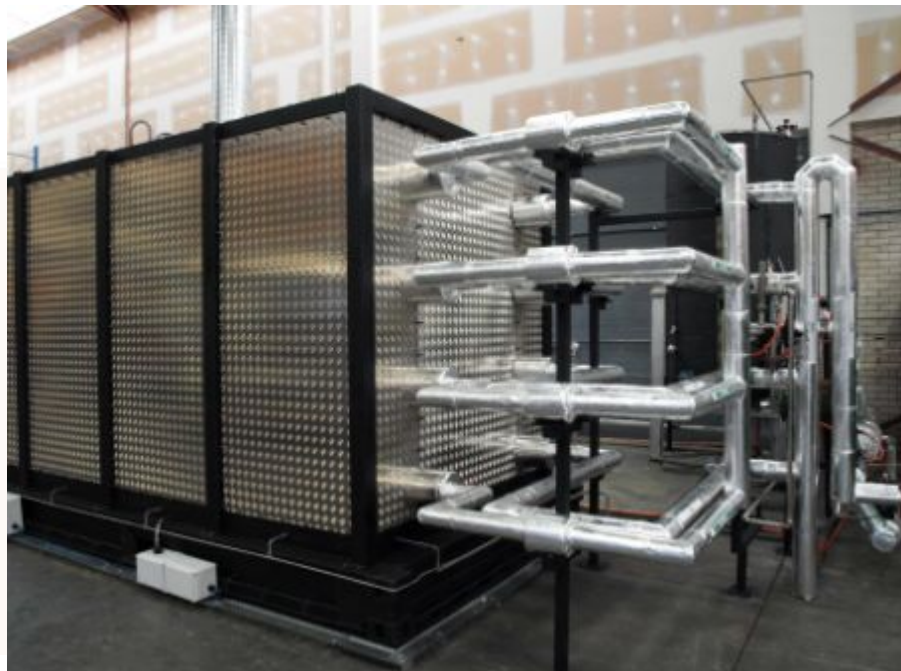


Future KI Energy Storage Options

- Diesel UPS
- Short term reserves for contingency events
- Integrated flywheel and generator unit

- Carbon Block - thermal
- Energy recovery & management





Utility View on Storage

- Valuable contribution to enable implementation and increased penetration of renewable energy
- Limited large scale applications in Australia – pumped hydro, but opportunities not significant
- International applications
  - Japan – 37MW NaS supporting wind farm
  - Germany – number of smaller NaS
  - Increasing interest in flywheels (US, EU)
- Renewable energy deployment targets are likely to require storage solutions:
  - Energy management and variability reduction
  - System security
  - Integration of DG (mitigate T&D impacts)
- Solutions exist - most products are in early commercialisation phase
- Many technologies remain cost prohibitive for widespread adoption – niche at present