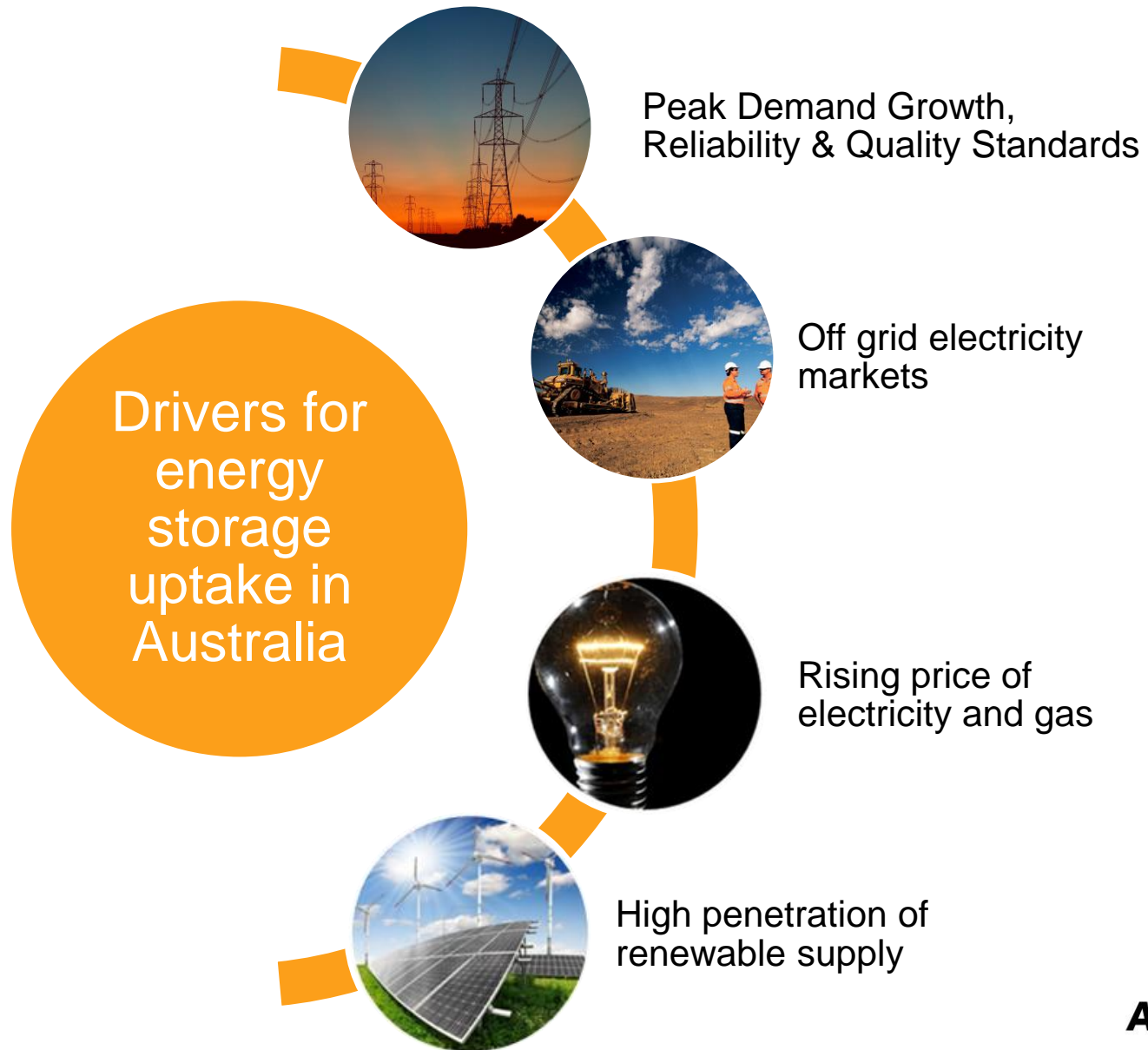


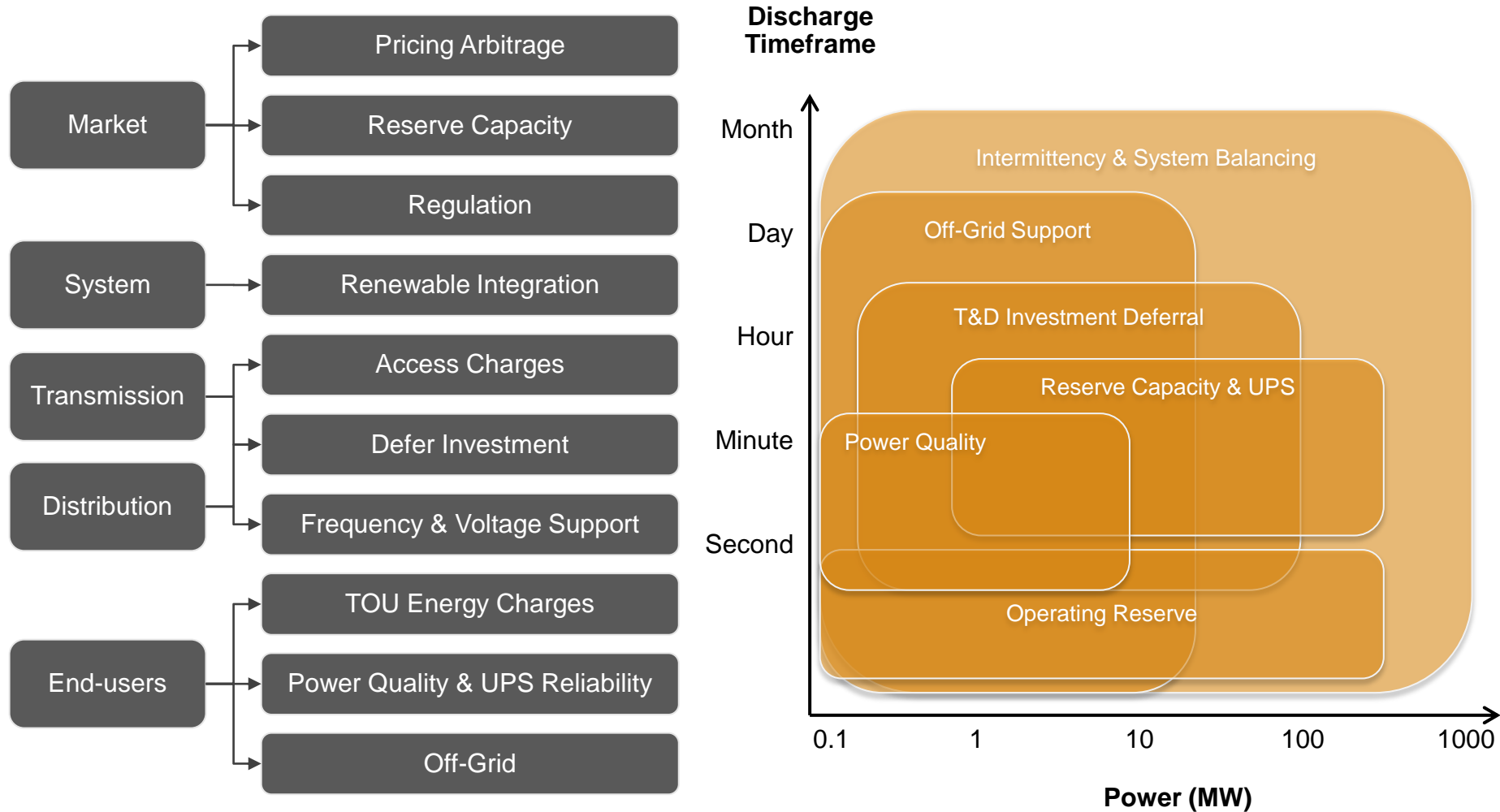


Enlivening Energy Storage Technology Status, Drivers and Economics

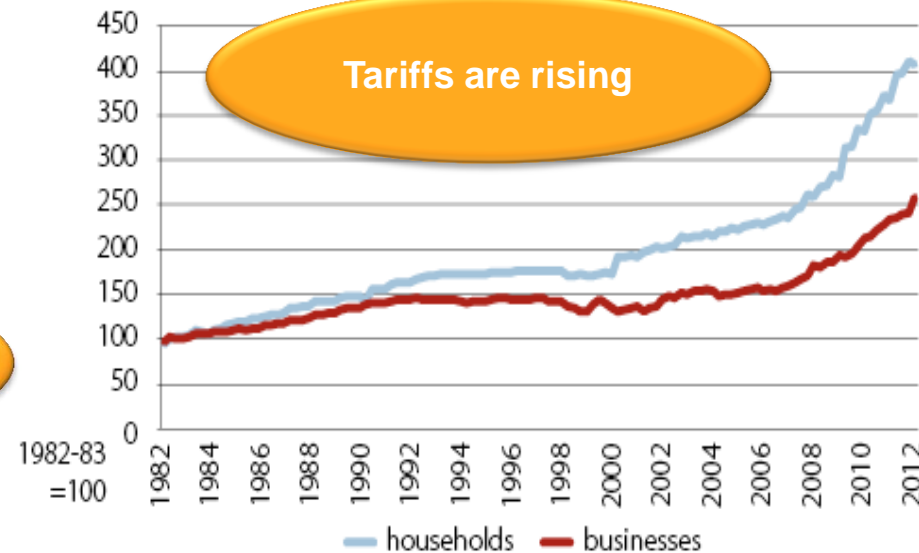
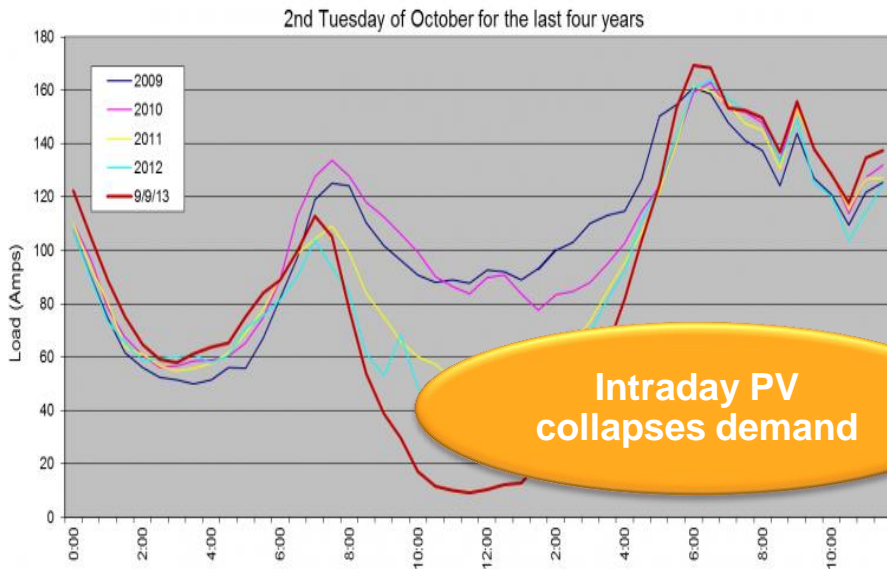
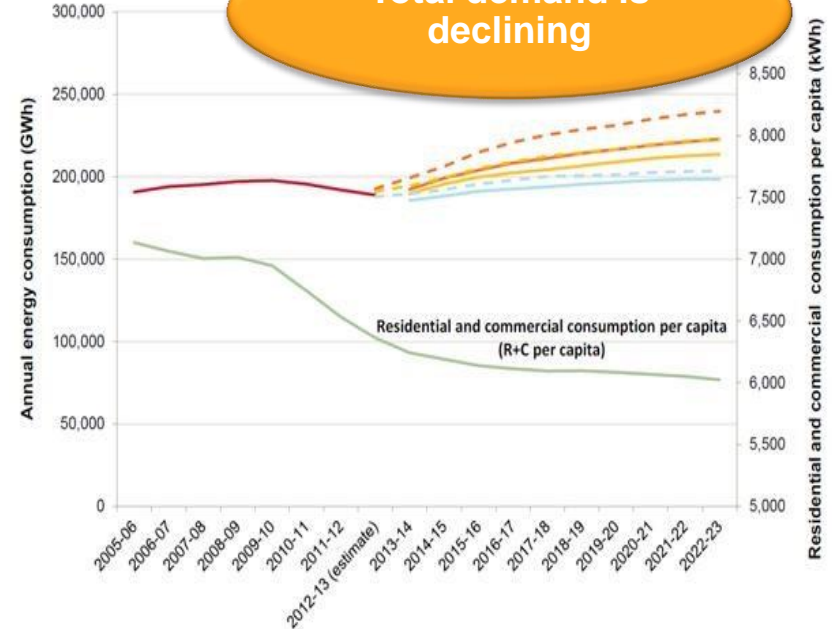
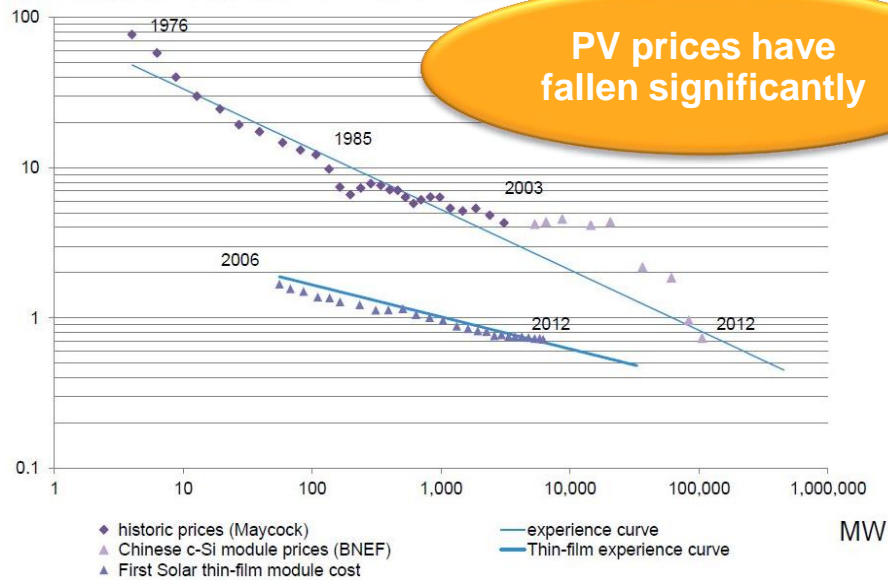
Why is Energy Storage important in Australia?



Energy Storage applications & drivers for future uptake



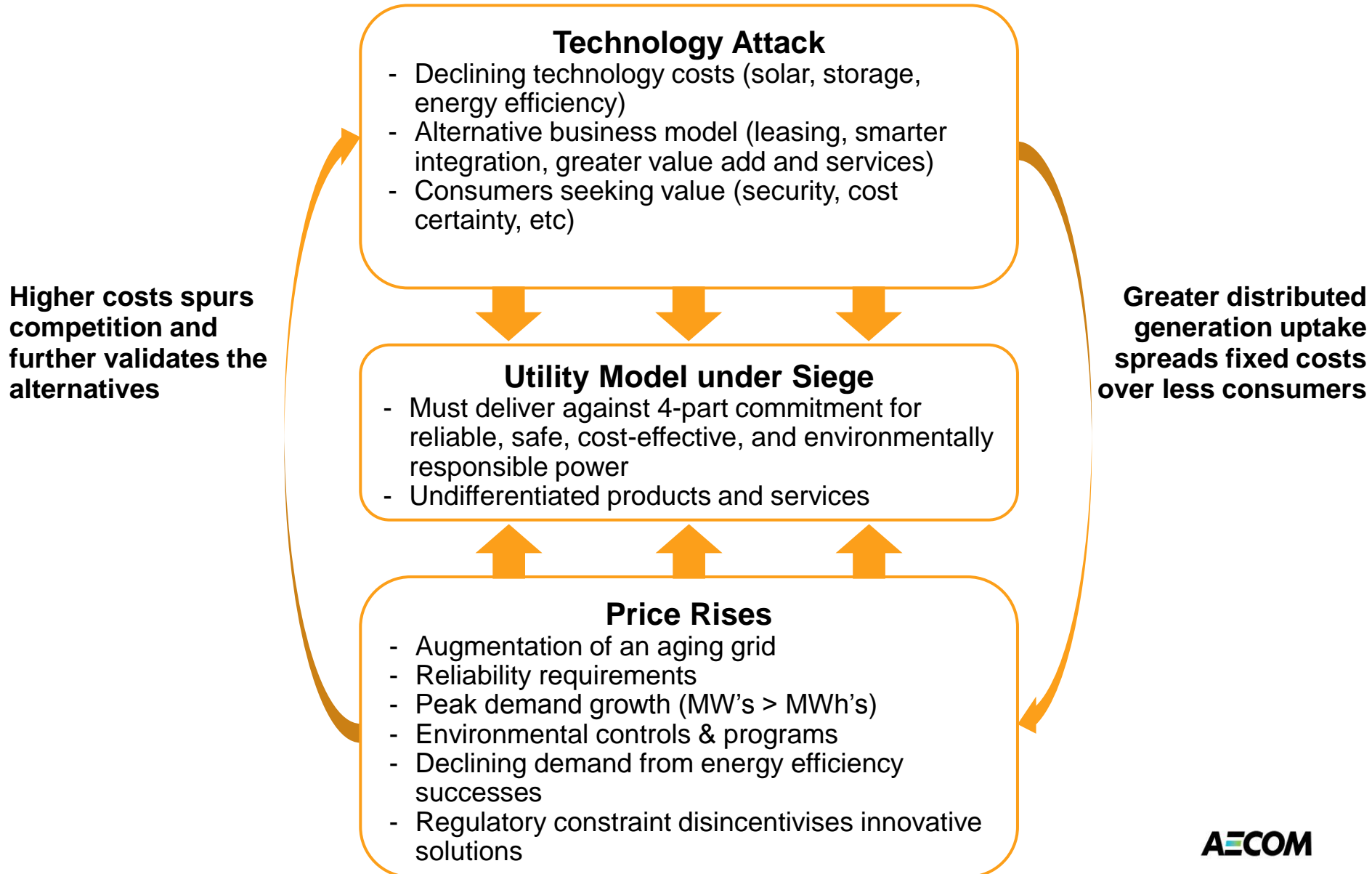
Titanic Failure or Massive Opportunity



Source: Graph (Mike Swanston of Energen – Presentation given to the All Energy Conference, Melbourne, October 2013)

Source: Bloomberg (2013) PV Experience curve 1976-2012 in 2012 \$/W

How will utilities and consumers respond?

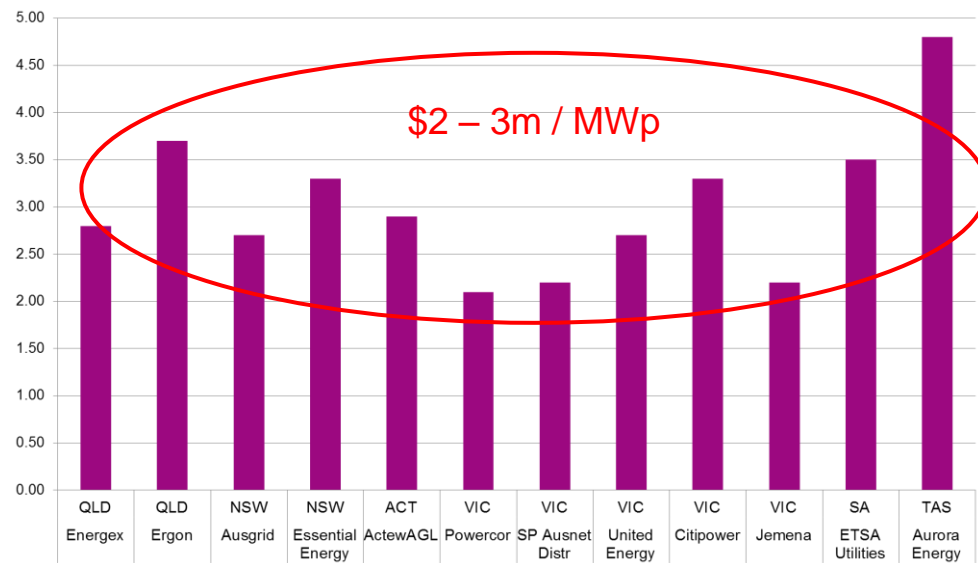


Our capacity addiction...

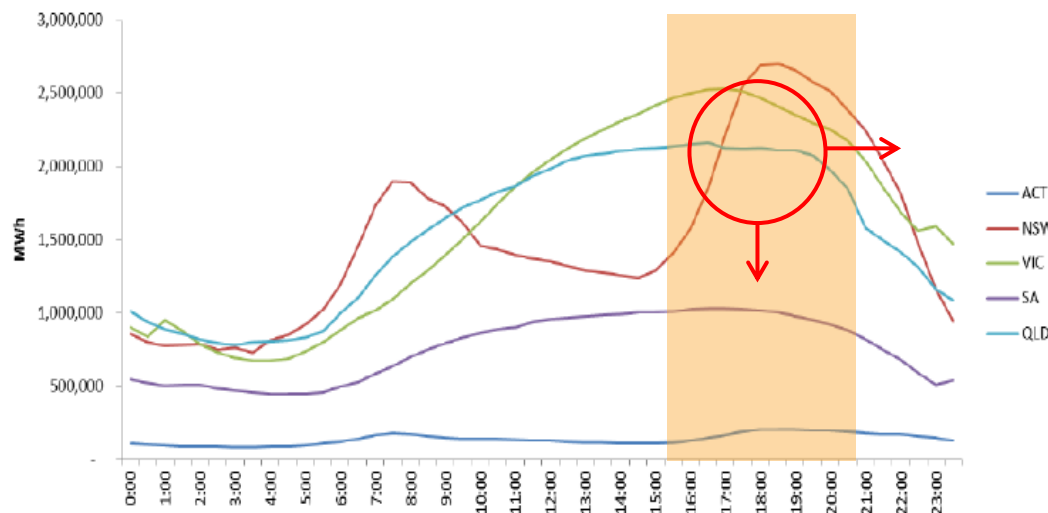
Current Regulatory Period

(09 –14) Source: DRET(2013) & AEMO

- \$36 bn investment in **DISTRIBUTION**
- \$7 bn investment in transmission
- Critical peak events occur 40-80 hours p.a. (typically in summer) which is <1% of the year.
- 36% to 63% of network expenditure (depending on the network) is dedicated to addressing peak demand increase.
- NOW - Regulatory & technical focus on non-network alternatives



Distribution NSP's Estimated Capex / Peak Demand Growth (\$Mn / MW additional peak)

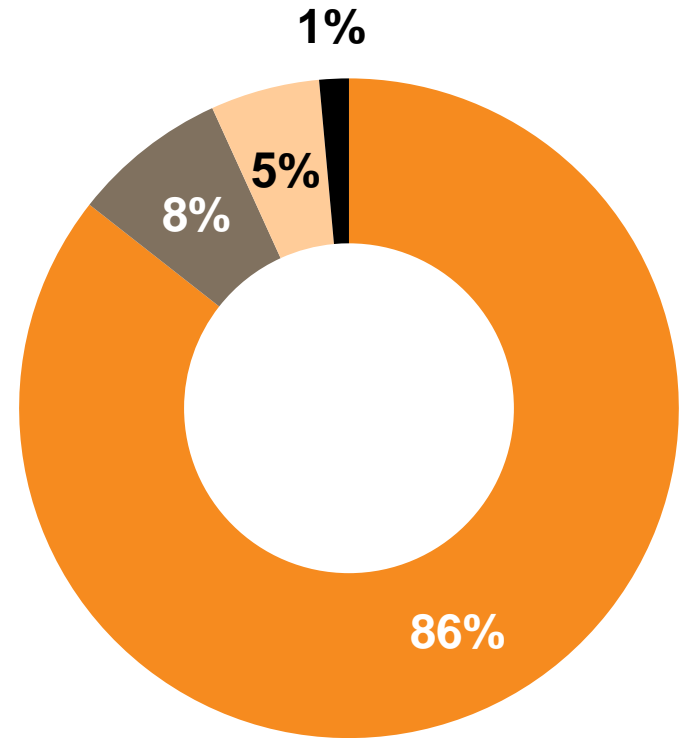


Aggregated Net System Load Profiles for the NEM

Source: AEMC (2012)

Remote Energy Market Overview

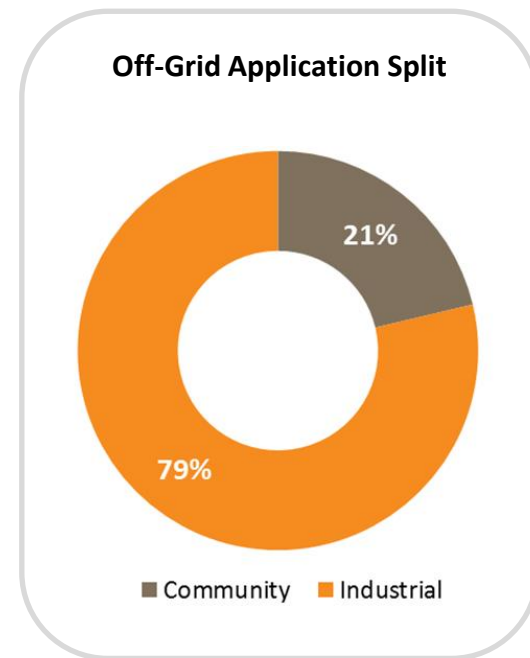
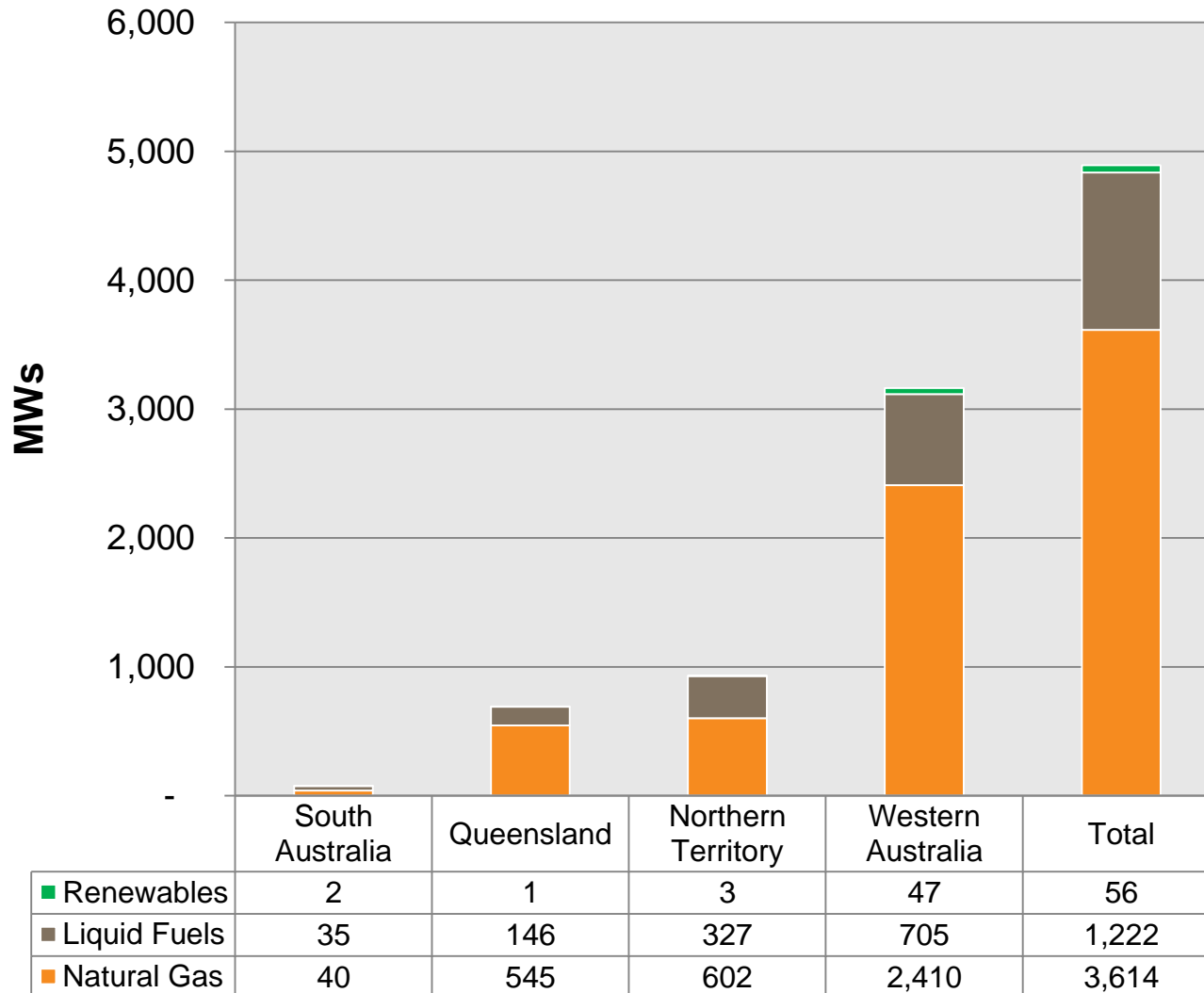
- 2% of Australia's population live in remote regions yet they consume 6% of energy demand
- Currently mainly supplied by Fossil Fuels;
 - Natural Gas (72%)
 - Liquid Fuels (25%)
 - Renewables (1%) vs. NEM (>13%) or SWIS (6%)



- NEM
- SWIS
- Off-Grid Industrials
- Off-Grid Communities

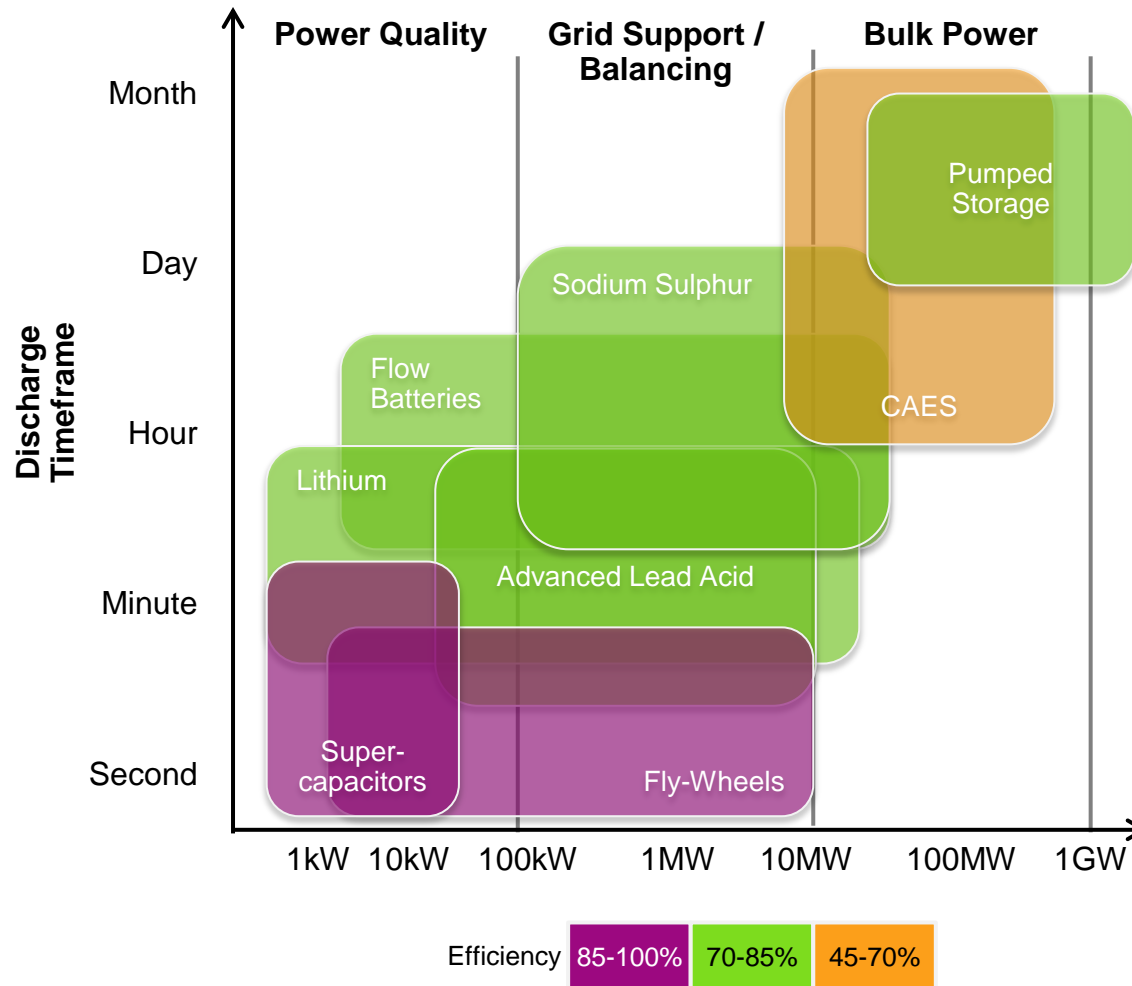
Remote Energy Market

In 2012, 15,857 GWh was produced by **almost 5GW** of remote installed capacity



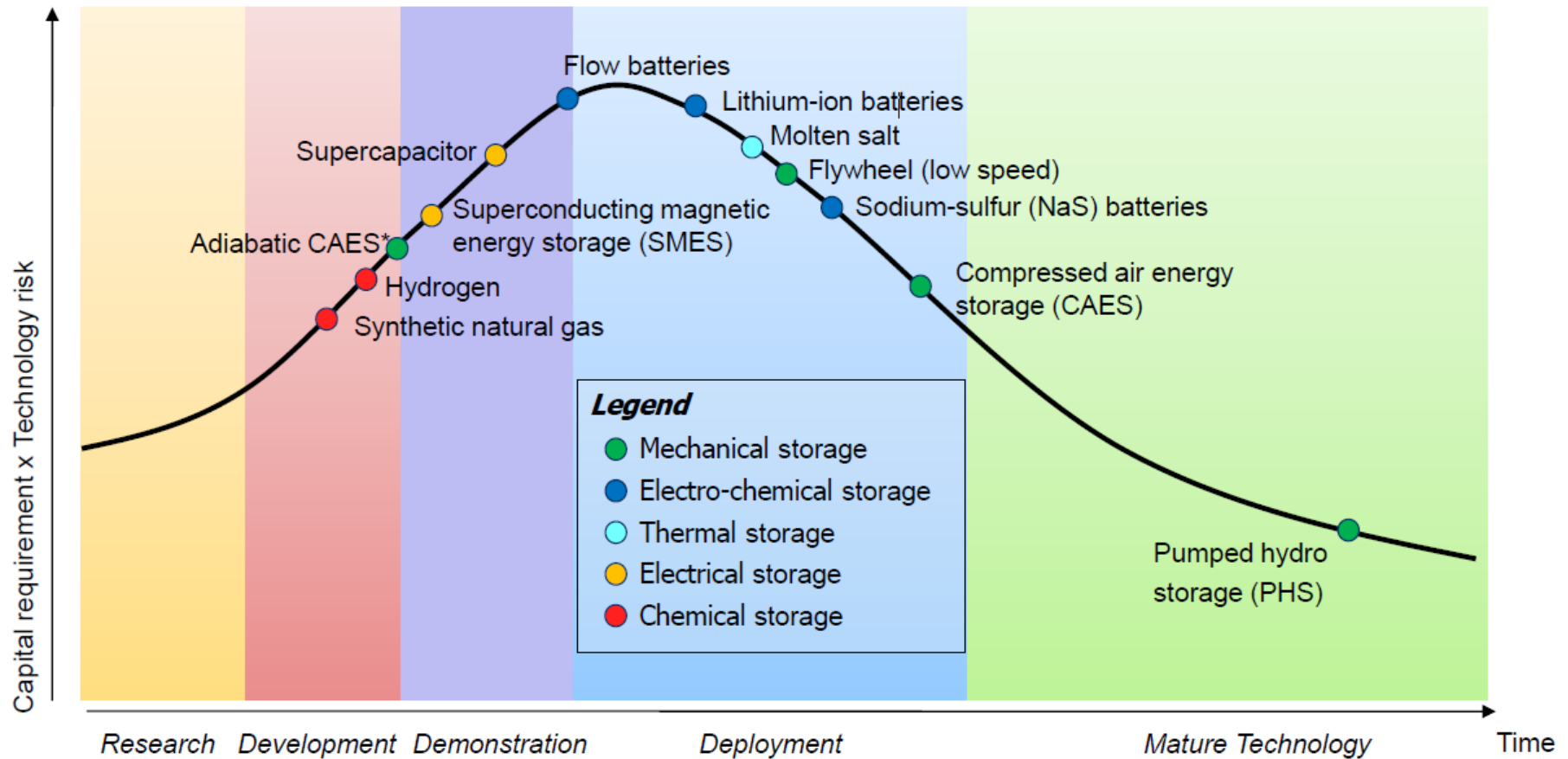
Storage Technology Overview

With such a large variation of technologies, each with its own characteristics, it is unlikely that a single “best” solution will emerge in the near future.



Storage Technology Maturity

Electricity storage technologies are at very different levels of maturity with many clustered at the high capital requirement and risk.

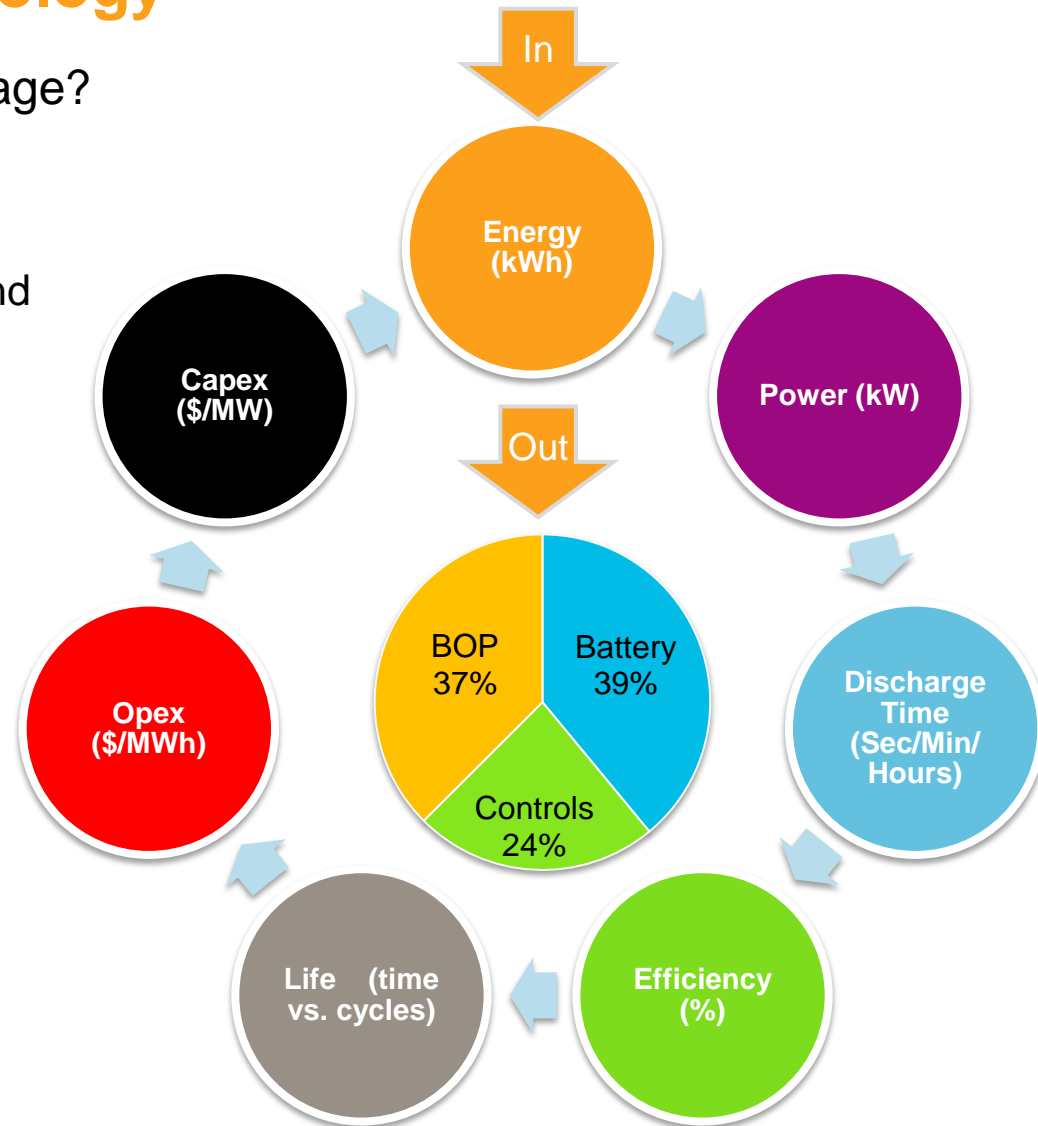


Choosing the right technology

What are you wanting from the storage?

Other Considerations

- Balance of plant including system and controls integration
- Round trip efficiency
- Location
- Noise
- HVAC
- Safety
- Backing of the supplier
- Maturity of the technology
- Ownership structure
- Warranties and Guarantees
- Revenue forecasts

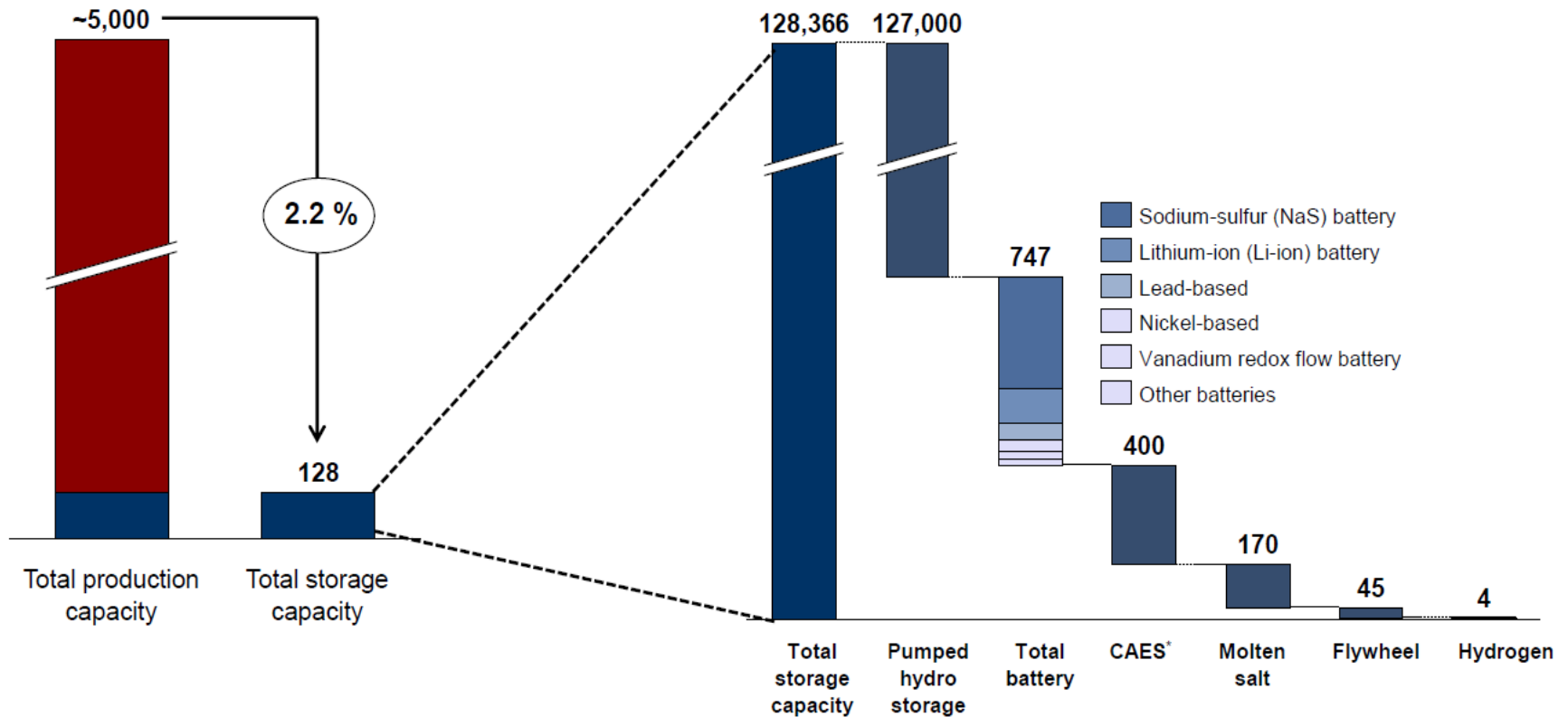


Global Energy Storage Capacity

Worldwide storage capacity currently stands at 128 GW, 99% of which is pumped hydro storage.

EXISTING WORLDWIDE STORAGE CAPACITY
GW, 2012

SHARE OF STORAGE CAPACITY BY TECHNOLOGY
MW, 2012



Global Battery Markets

Germany

In May 2013, launched €25 million storage system incentive on new and retrofitted systems whereby up to 30% of equipment installation costs is subsidised, capped at 30kWp. Predicted to lower the costs of residential PV energy storage systems by 45% over the next 5 years . \$260m for grid storage project with \$170m already allocated.

Japan

Currently experiencing a solar boom and an expected 381MW of PV with storage will be installed by 2018.

Japans Ministry of Economy, Trade and Industry invested US\$294 million to build the world's largest batteries, to be operational by 2015.

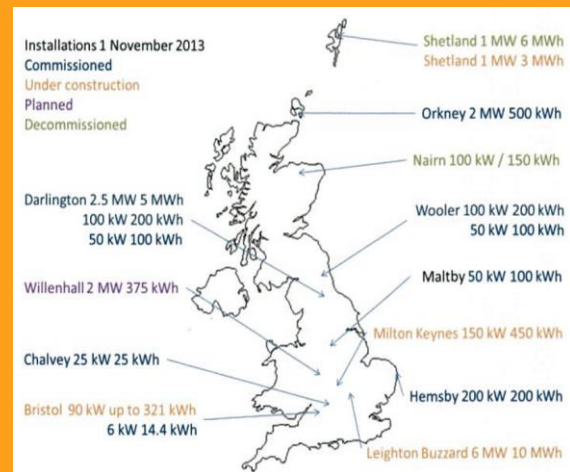
- redox flow batteries; 60 MWh
- lithium-ion batteries; 20 MWh

California & Nth America

Recently (Oct'13) proposed to mandate 1.325GW on the grid by 2020 to support the 33% targeted renewable uptake.

Puerto Rico (Dec'13) mandate storage to all new renewable development with Texas and NY also tipped to be a future energy storage hotspots.

UK



New Zealand

Vector offering a trial of leases to its customers to install rooftop solar and battery storage for similar cost as relying entirely on the grid.

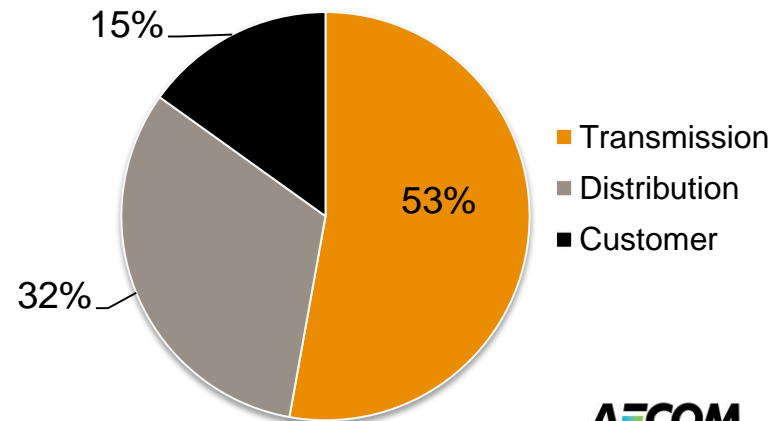
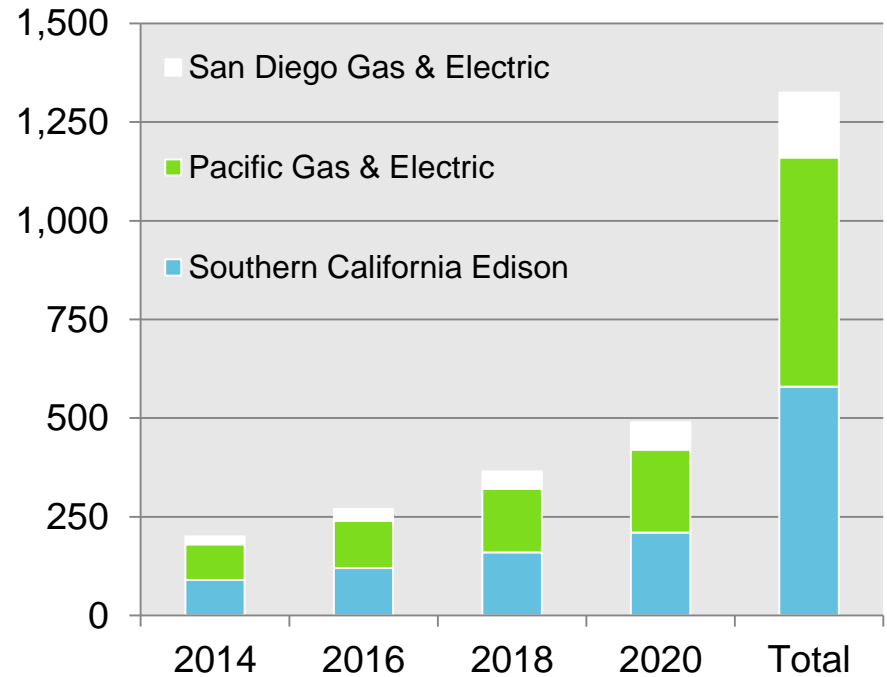
California Energy Storage Targets

Mandated at least 50% from independent developers and must be cost effective (ie. at no additional cost to consumers)

Storage can be used for capacity, ancillary services, and peak shaving but must provide real-world data to inform future expansion.

Key objectives;

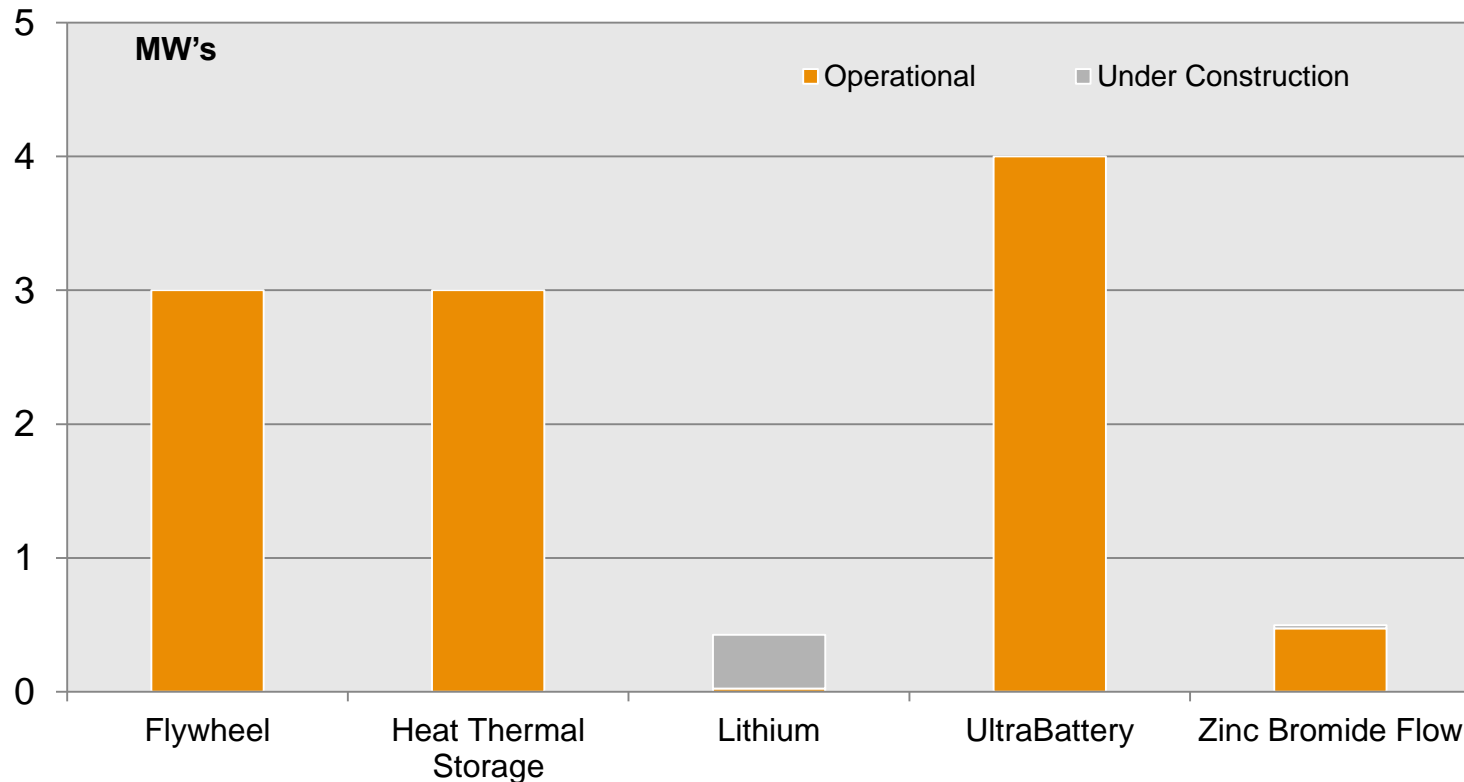
- Lack of cohesive regulatory framework and interconnection processes,
- Lack of cost recovery understanding,
- Lack of commercial operating experience, and
- Grid stability concerns as a result of self generation incentives and high penetration of renewables.



Storage in Australia

- Australia currently has over 2.2GW of pumped hydro storage and just over 4.5MW of utility scale batteries installed.
- Potential is up to 3,000MW of energy by 2030 (Source: CEC) in comparison Australia has installed a total capacity of 3.5GW of PV in since 2009.

Existing Australian Storage Project Status (non Hydro)



Australian Storage Case Studies

Horizon Power specifies measures for energy storage systems to enable renewable energy smoothing. Focus is on Broome, Exmouth and Carnvan.

Marble Bar and Nullagine Solar – Diesel Hybrids include ABB (Powercorp) flywheels.

SP Ausnet GESS is installing a 1MW/1MWh grid connected lithium ion system (online end 2014). The aim of the project is to create knowledge and experience to prepare for the future battery use.

The largest battery based energy storage system in Australia is set for completion by the end of 2013 by **Hydro Tasmania**. Ecoult is to supply the 3MW / 1.6MWh storage system for the King Island Renewable Energy Integration Project.

For **Ergon Energy**, energy storage already supports their constrained rural electricity network with the successful trial of 100 kWh **Grid Utility Support Systems (GUSS)** providing electricity during peak periods on the Atherton Tablelands. Called for tenders in August 2013 to build 25 more GUSS units over 5 years, which consists of a power conversion unit, communications and energy storage.

ZBB's 100kWh EnerSystem at the University of Technology Sydney

Magellan Power has been awarded a contract to supply a demand management system to TransGrid, the owner and operator of one of the largest high-voltage transmission networks in Australia. The system uses 400 kWh lithium polymer batteries sourced by Zest Energy.

Obstacles

Market structure

Markets are still maturing to adapt to renewables and the need for storage.

Early Deployment

True value is only now being understood.

Economics

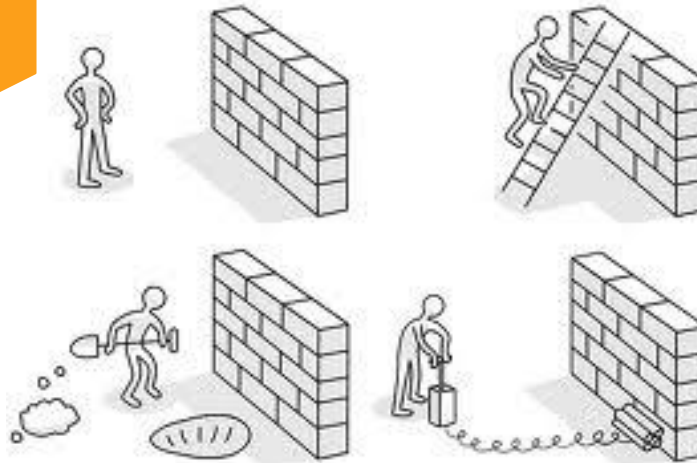
Economics must compete commercially and technically with the alternatives

Standards & Regulation

Barriers to uptake can simply be supported by regulation changes.

Costs

Economies of scale are essential to significant cost reductions in commercially available energy storage technologies.



Concluding points...

- **Global rather than Australian markets** will drive uptake and economics
- The **features of storage technologies must match application, there is currently no one storage panacea to all our needs.**
- With the exception of pumped hydro storage, the deployment of **electricity storage is at an early stage.**
- The **business case** for electricity storage are complex and are viable under certain market conditions and subsidy programs
 - Off-grid hybrids / Fringe of Grid / Constrained Grid
- **Regulations, pricing structures and standards will support uptake**
 - RIT-D, Demand Management Innovation Allowance, AEMC Power of Choice
- **Greater integration of variable renewable sources** of energy requires additional flexibility in our electricity systems and markets
- **How will EV the impact the energy market?**

Contact Details

Craig Chambers

Market Sector Director – Power Generation

D +61 2 8934 1060

M +61 419 992 380

Craig.Chambers@aecom.com



Thank You