Public forum
Integration of electricity storage technologies

Agenda
Thursday 18 June 2015
Sheraton on the Park, 161 Elizabeth Street, Sydney

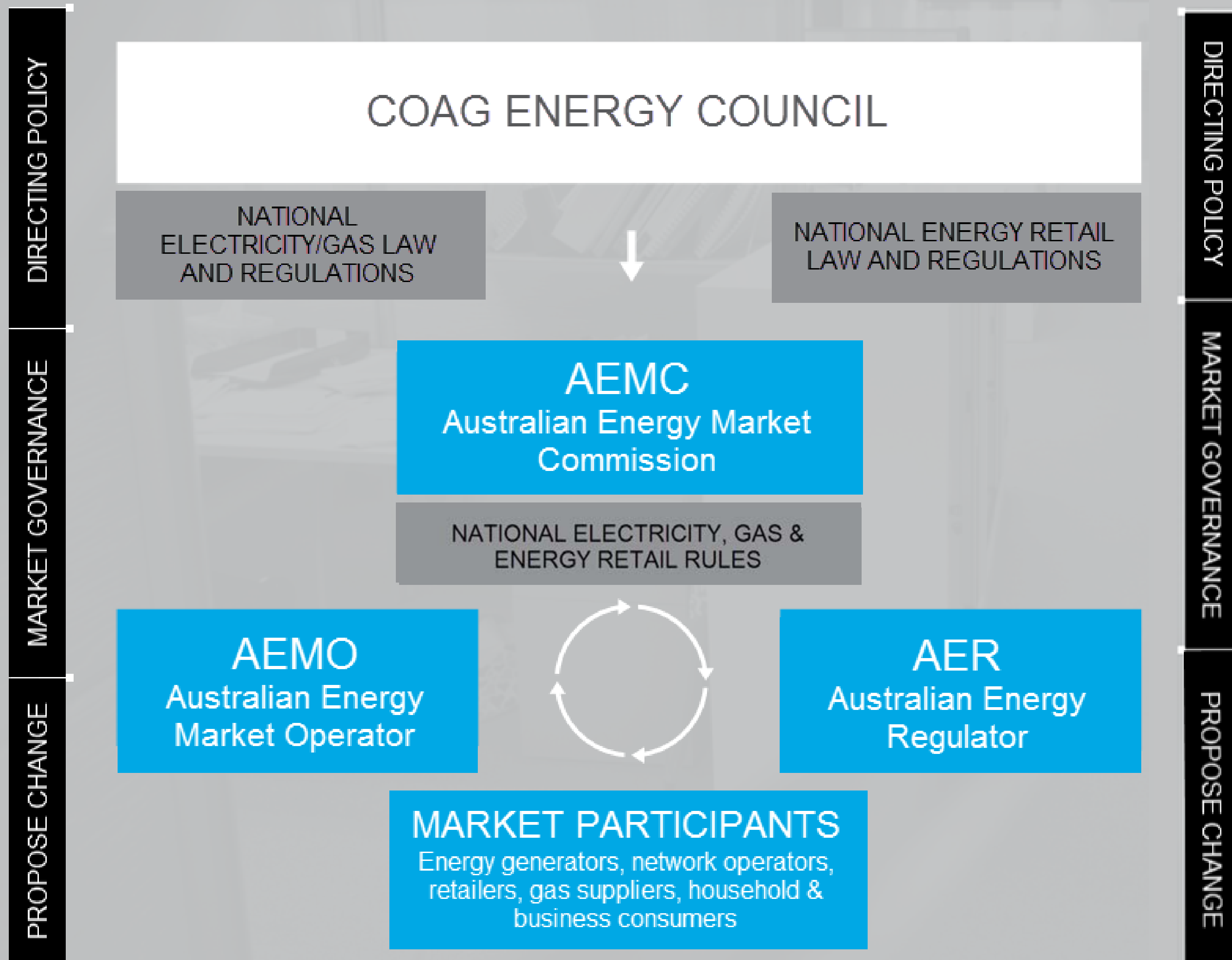
Time	Item	Speaker
From 9:00am	**Registration**	
9:30am	Welcome and objectives of the AEMC's work	Brian Spalding, Commissioner, AEMC
10:00am	The CSIRO's findings – Electricity storage technologies and their applications	— Mark Paterson, Domain Leader, Grids + Renewable Energy Integration, CSIRO — Sam Behrens, Research Group Leader, Demand Side Energy Technologies, CSIRO
11:15am	**Morning tea**	
11:30am	Guest speaker 1 – Integrating a grid-scale storage device	Bill Jackson, Pricing Manager, ElectraNet
12:00pm	Guest speaker 2 – International experiences of integrating storage behind the meter	Phil Keogan, General Manager for Australia and New Zealand, Sunverge Energy
12:30pm	**Lunch**	

Integration of storage in Australia’s energy markets

Public Forum – 18 June 2015

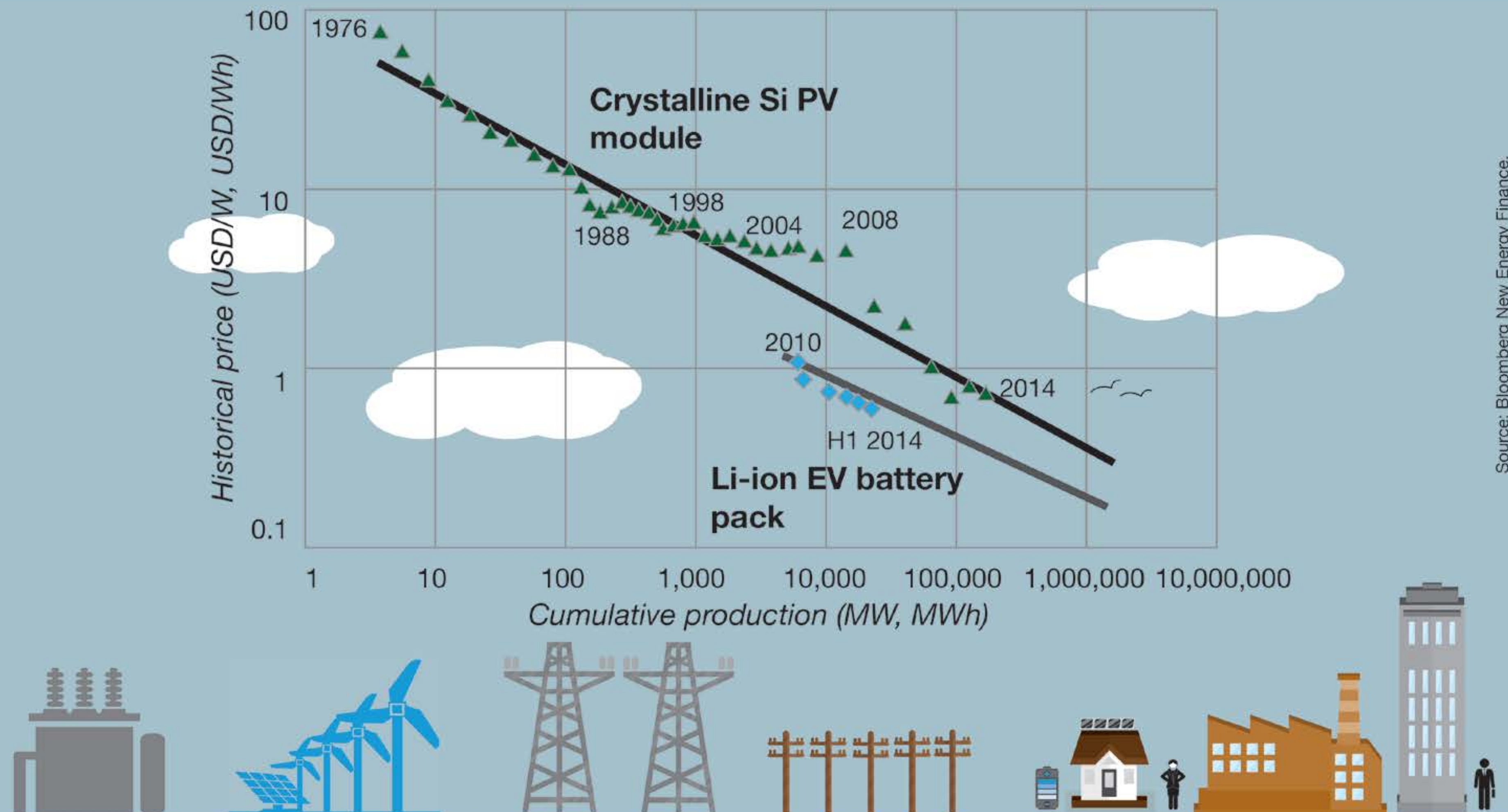
BRIAN SPALDING
COMMISSIONER
AUSTRALIAN ENERGY MARKET COMMISSION

Australian Energy Markets
Regulation and governance arrangements



Increasing impact of technological change
AEMC is undertaking a technology work program

- Changes in technology, as well as the **pace of those changes**, have the potential to fundamentally alter Australia's energy markets
- Energy policy and the associated regulatory framework must be able to **adapt** to these changes to allow a dynamic market response
  - The AEMC needs to have a strong understanding of this **new market dynamic** and its likely impacts on consumer **costs and behaviours**, as well as the incentives and **business models** of market participants
- The AEMC is undertaking a **technology-focused work program** to identify:
  - **Possible barriers** to the deployment of new technologies by new or existing market players
  - Whether the **consumer protection framework** remains fit for purpose
  - Incentives or disincentives for **business model evolution**



Generation

Ramping

Spinning reserve

Wind farm integration

Frequency control

Black start

Transmission & distribution

Reduces T&D congestion

Substation overloading

Power quality and outages

Reduces conductor upgrades

Support distribution generation

Consumers

Leverage TOU pricing

Demand charge reduction

Demand response

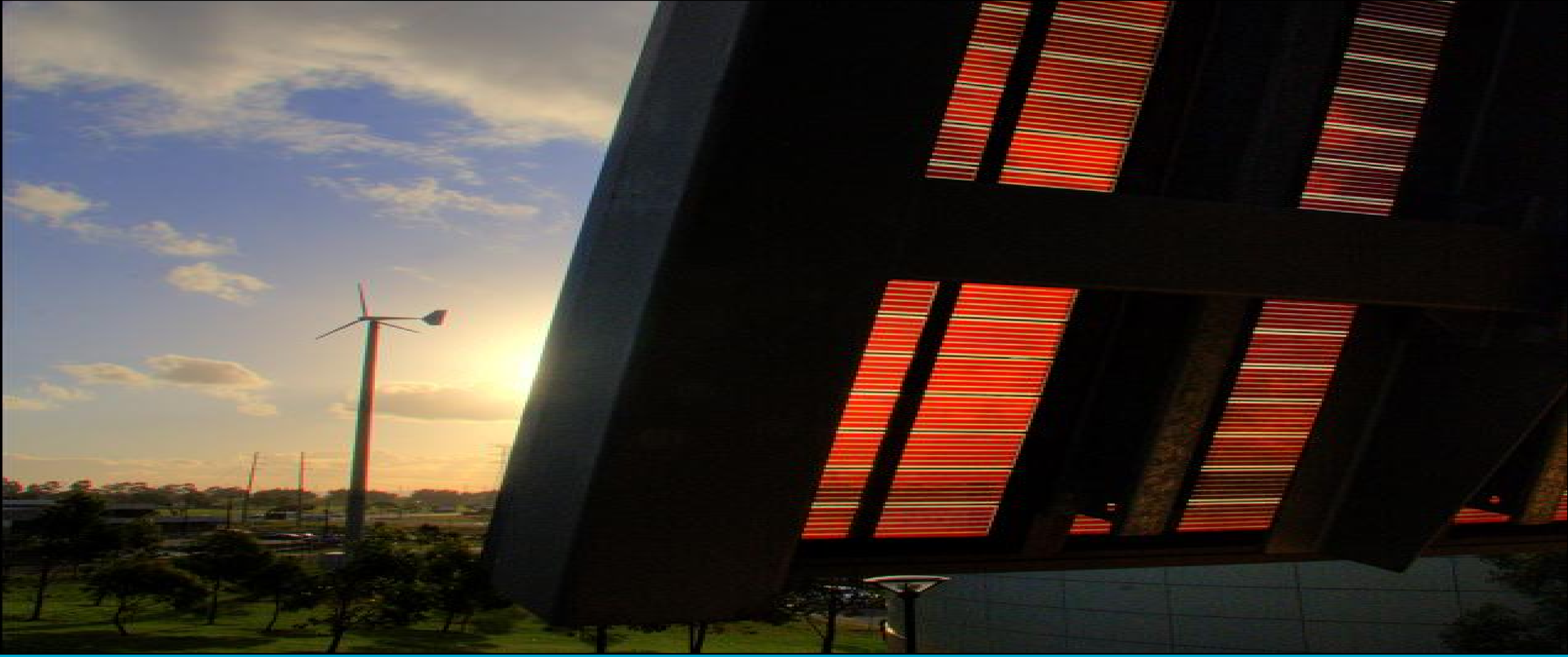
Firms distributed solar

Critical load support

AEMC Integration of Storage project
Objectives and output

How will storage play across the supply chain?	What are the key barriers and regulatory issues?	How could those issues be addressed?
Public forum – 18 June	Draft report – September	Final report
• CSIRO technical research on storage applications • Sunverge international case studies • ElectraNet case study	• AEMC report on key regulatory issues associated with the integration of storage • Published for public consultation	• Final report incorporating stakeholder feedback • Highlighting key areas for consideration and possible way forward

AEMC



Electrical Energy Storage:
Technology overview and applications

Mr Mark Paterson & Dr Sam Behrens
18th June 2015

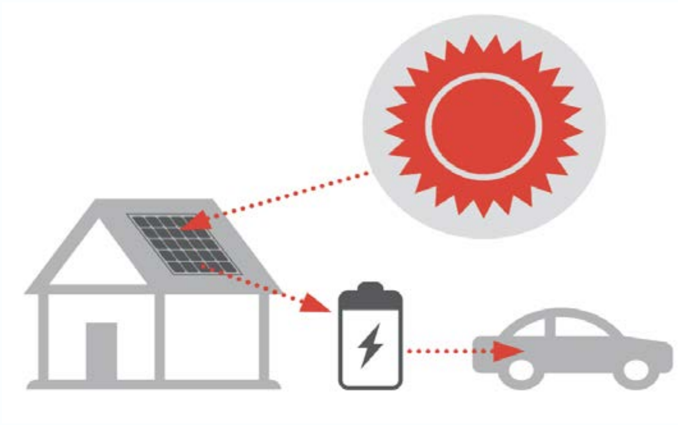
The most significant transformation since Edison...?

"The world's electricity network will change more in the next 20-years than it has in the last 100"

IBM Energy & Utilities, 'Smart Infrastructure – Building the Intelligent Grid of Tomorrow', Enercom Conference (March 2009).

Future Grid Forum 2050 scenarios

Set and forget



Leaving the grid

Rise of the ‘Prosumer’

Renewables thrive

Seven universal observations...

1. Network-centric → Customer-centric
2. Centralised → Hybrid/Decentralised
3. Fossil fuel generation → Continuous decarbonisation and greater intermittency
4. Regulated natural monopoly → Increasing exposure to competition
5. 20 – 50% of electricity generated locally by 2050
6. Grid continues to play a critical (but evolved) role in 2050
7. 2015-25 decade characterised by profound transition

Focus of CSIRO Study

Energy Storage Technical Review

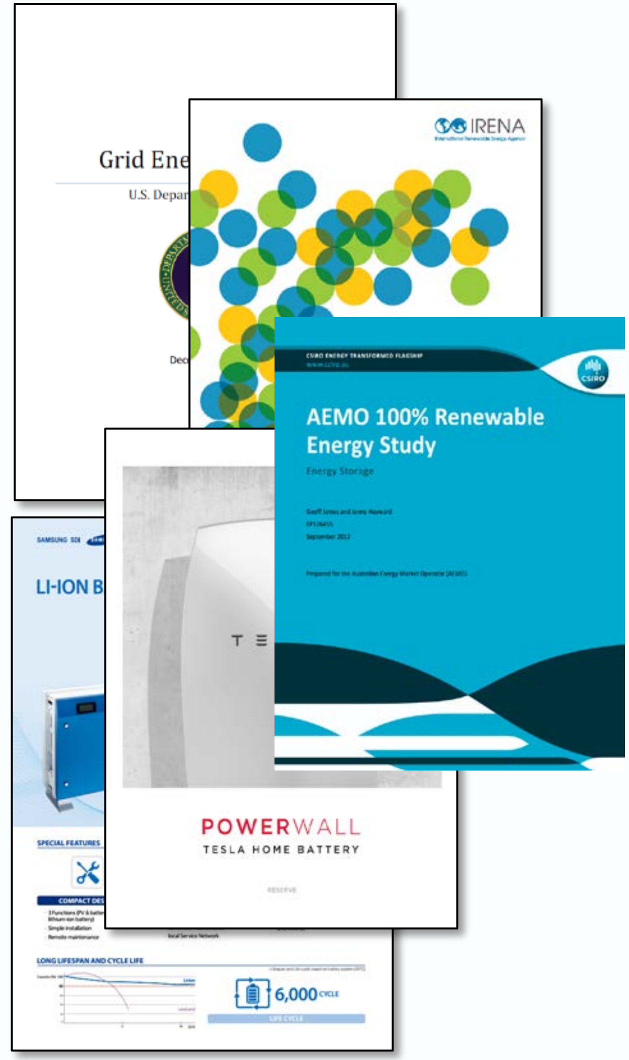
Analytical review of the energy storage (ES) technologies relevant to Australian electricity systems with a focus on:

- The current status and applications of various ES technologies;
- The shortlist of ES technologies most likely to impact Australia's electricity systems over the next 15 – 20 years; and,
- A detailed examination of the current status of and future applications for the shortlisted technologies.

Context

Rapidly evolving space:

- New products being released
- National and international reports e.g. IEC, DoE, AEMO, etc.
- Online literature, media releases and magazines
- National and international standards/codes e.g. AS/NZ
- Australian trials e.g. King Island, Stored Energy Integration Facility, Li-ion installation, etc.



… etc.

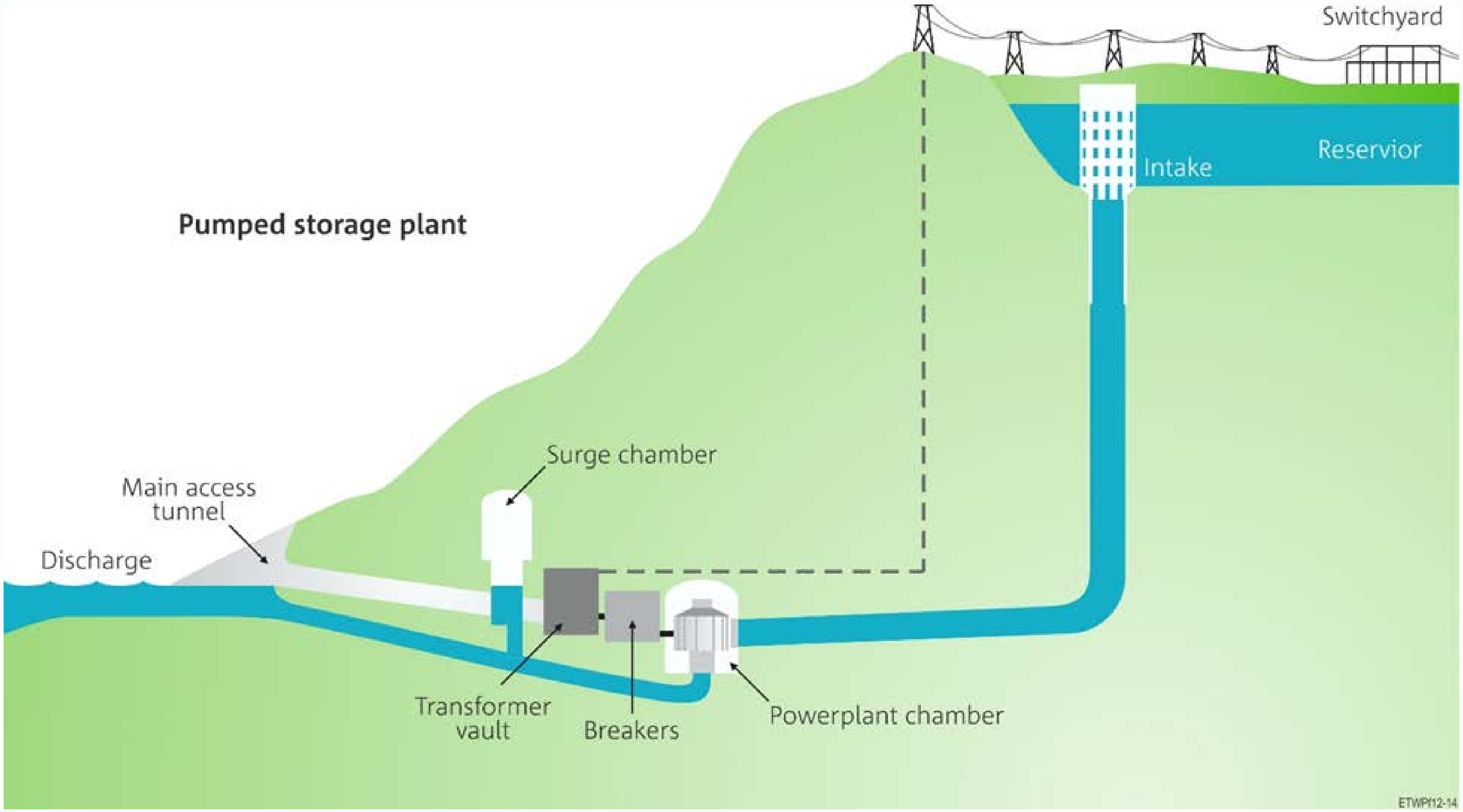
Taxonomy of Energy Storage

- Diverse range of storage are likely to be adopted 2015 – 2030

Mechanical Energy Storage	Thermal Energy Storage	Electrical / Electrochemical Energy Storage	Chemical Energy Storage	Load Coordination
• Pumped hydro • Compressed Air • Flywheel	• Hot water • Molten salt • Phase change material	• Supercapacitors • Superconducting magnetic • Batteries • Fuel cells • Molten ion (salt)	• Hydrogen • Synthetic natural gas • Other chemical compounds e.g. ammonia, methanol, etc.	• Load shaping / smart appliances (e.g. hot water, pool pumps, etc.)

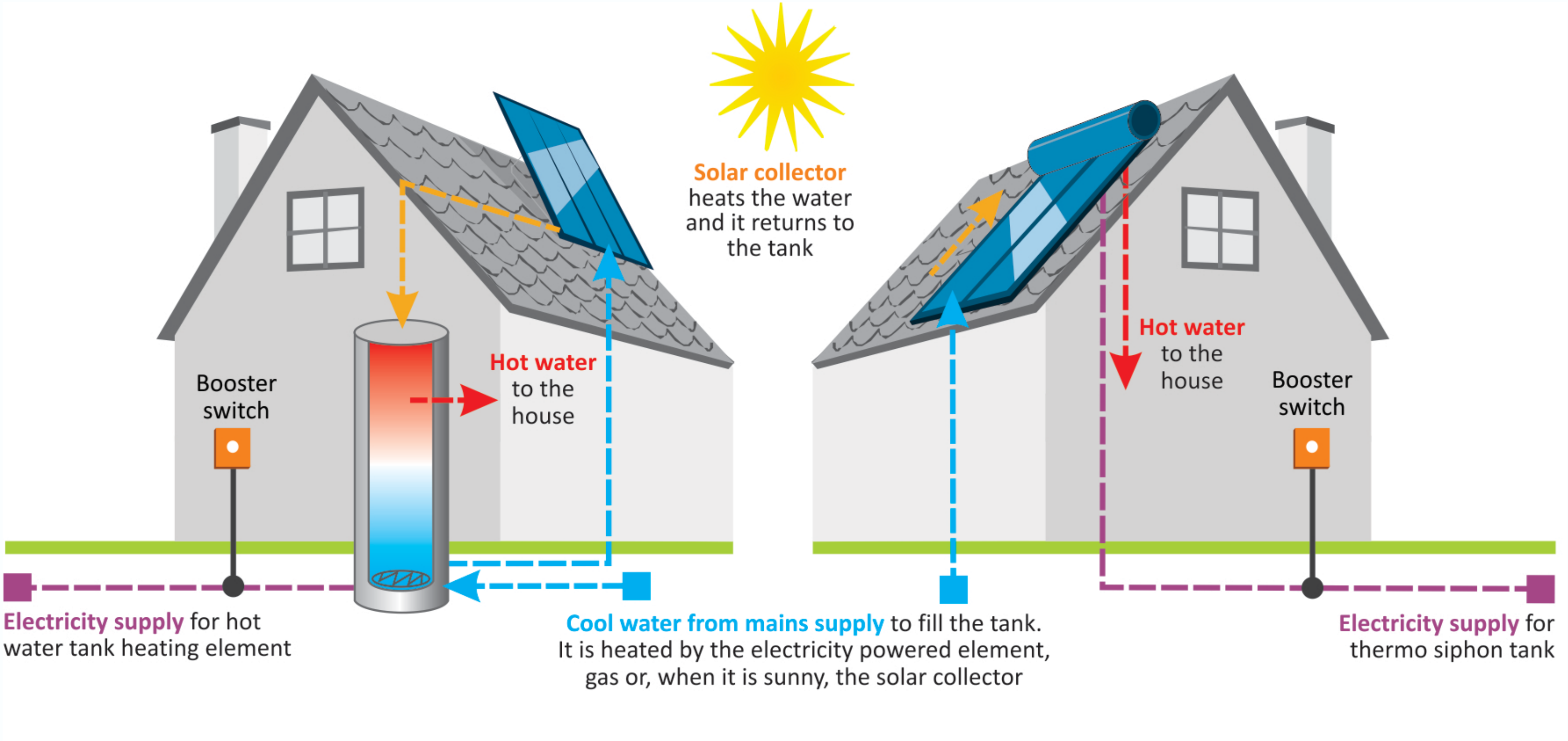
- Each has their advantages and disadvantages subject to their application

Mechanical Energy Storage



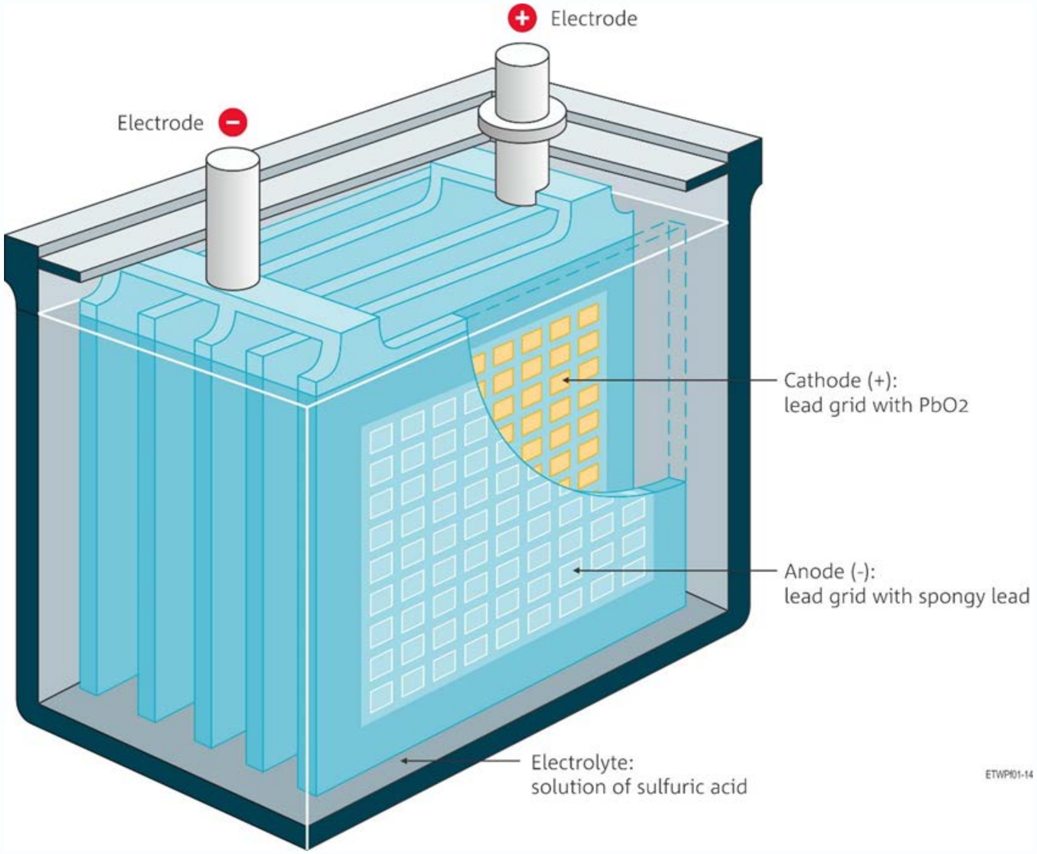
Pumped hydro

Thermal Energy Storage



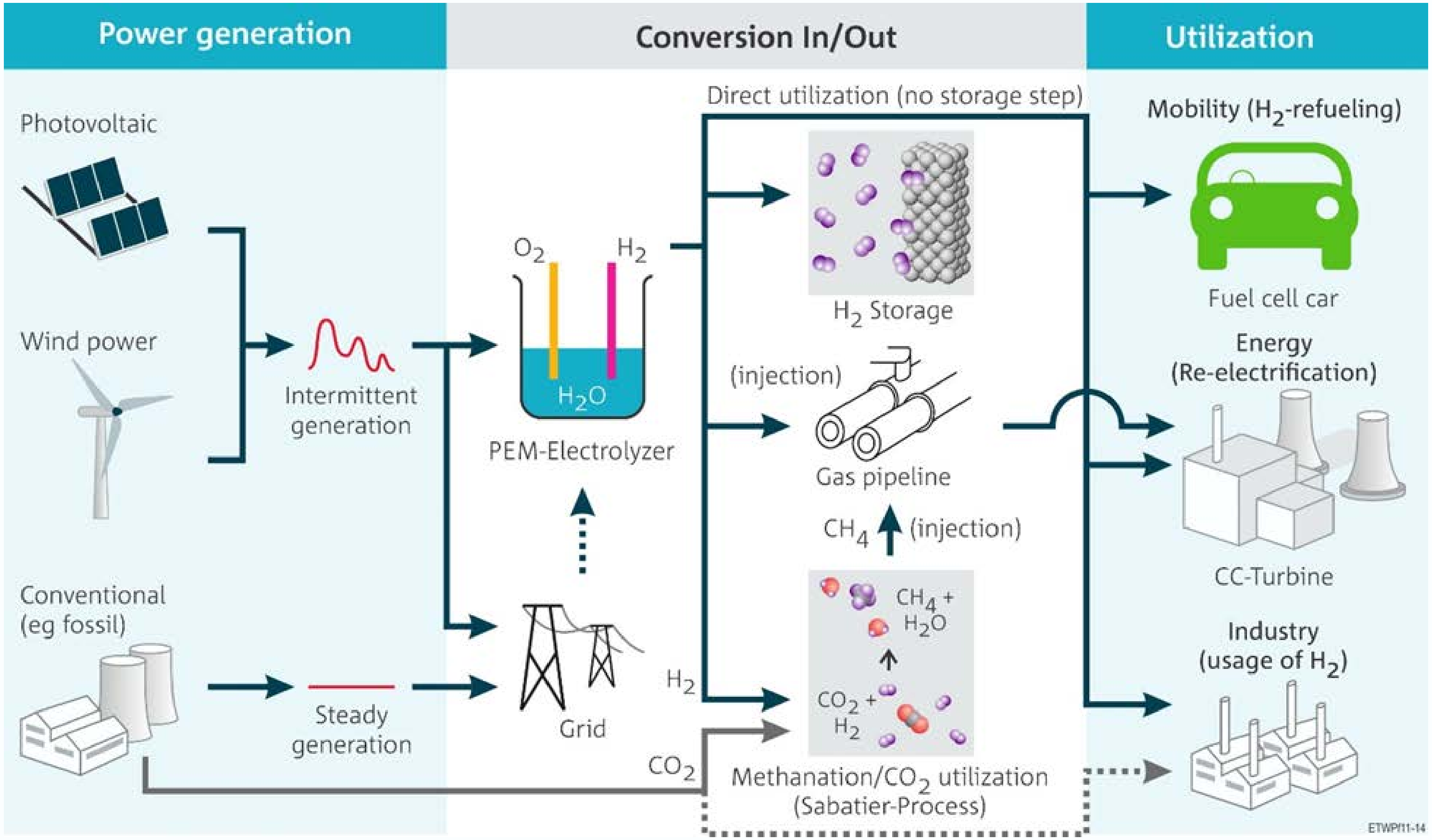
Thermal storage

Electrical/Electrochemical Energy Storage



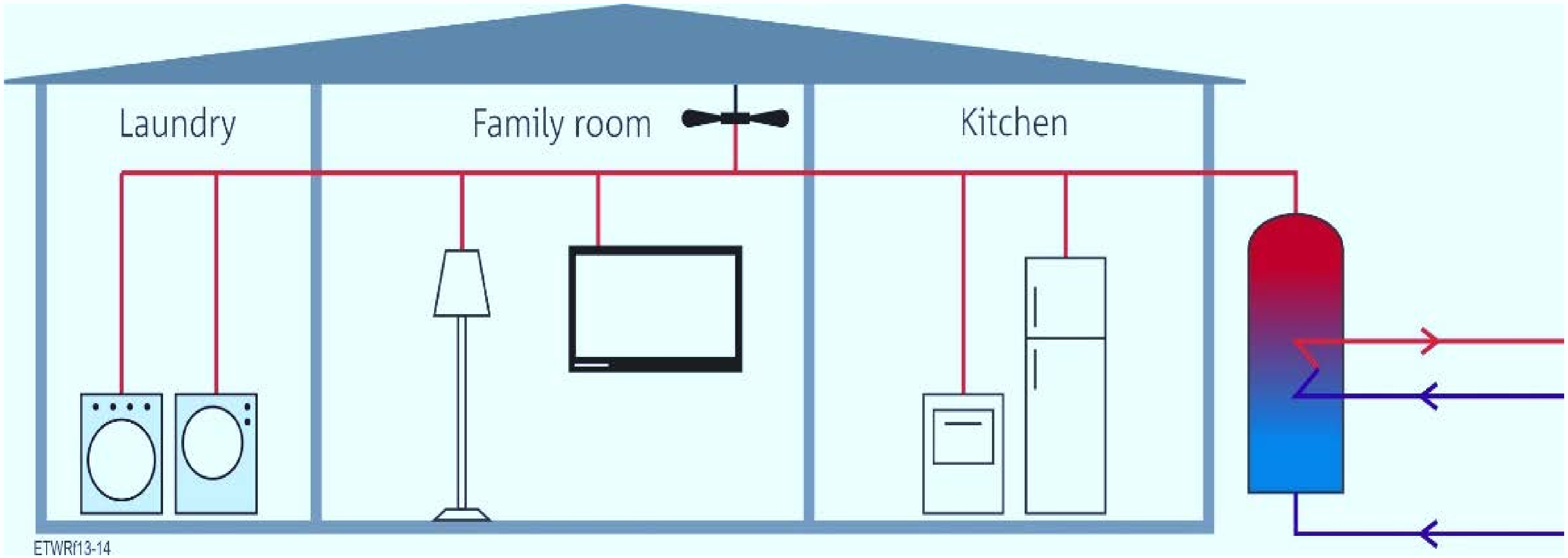
Battery

Chemical Energy Storage



Hydrogen

Load Coordination



Load shaping / Smart appliances

Different types of ES - examples

- Various ES technologies available
- Some are more technically feasible than others i.e. >TRL-8 and >MRL-8
- Others require further development

Example types	Power applications (rate of change)	Energy applications (duration)	Life (cycles)
Advanced lead-acid	✓	✓	✓✓
Lithium iron phosphate (LFP)	✓✓	✓	✓✓
Lithium Nickel Manganese Cobalt oxide (NMC)	✓✓	✓	✓✓
Zinc bromide flow battery	✓	✓✓	✓
Sodium nickel chloride (molten salt ion battery)	✓	✓✓✓	✓✓

TRL = Technology Readiness Level
MRL = Manufacture Readiness Level

Focus Applications Areas

Diverse energy storage deployment applications to improve Australia's network

Large scale renewables integration	Transmission and distribution support	Commercial and industrial energy management	Residential energy management	Electric vehicles
• Regulation • Peak demand	• Upgrade deferral • Congestion relief	• Peak shaving • Regulation	• Power quality • Power reliability	• Grid to vehicle

Need for a range of different ES technologies, tailored to specific application needs

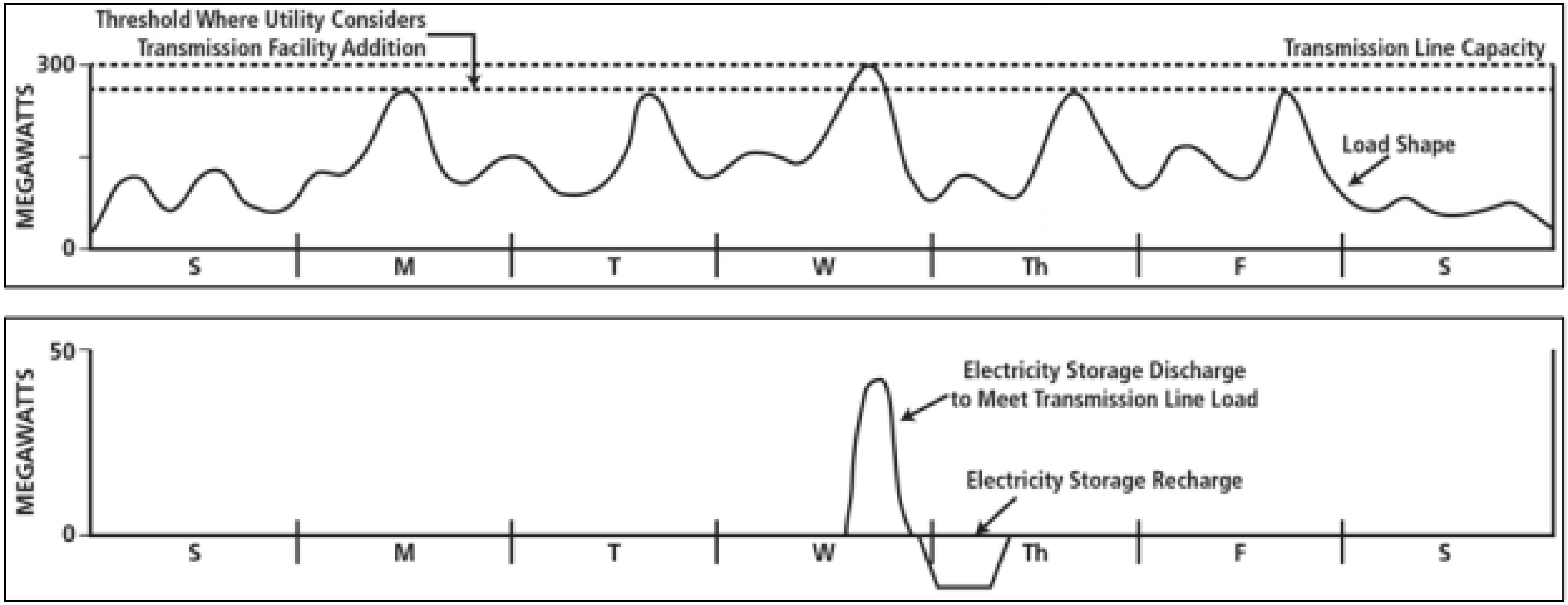
CSIRO

Large Scale Renewables Integration

Regulation

Source: Ecoult/CSIRO Hampton Wind Farm

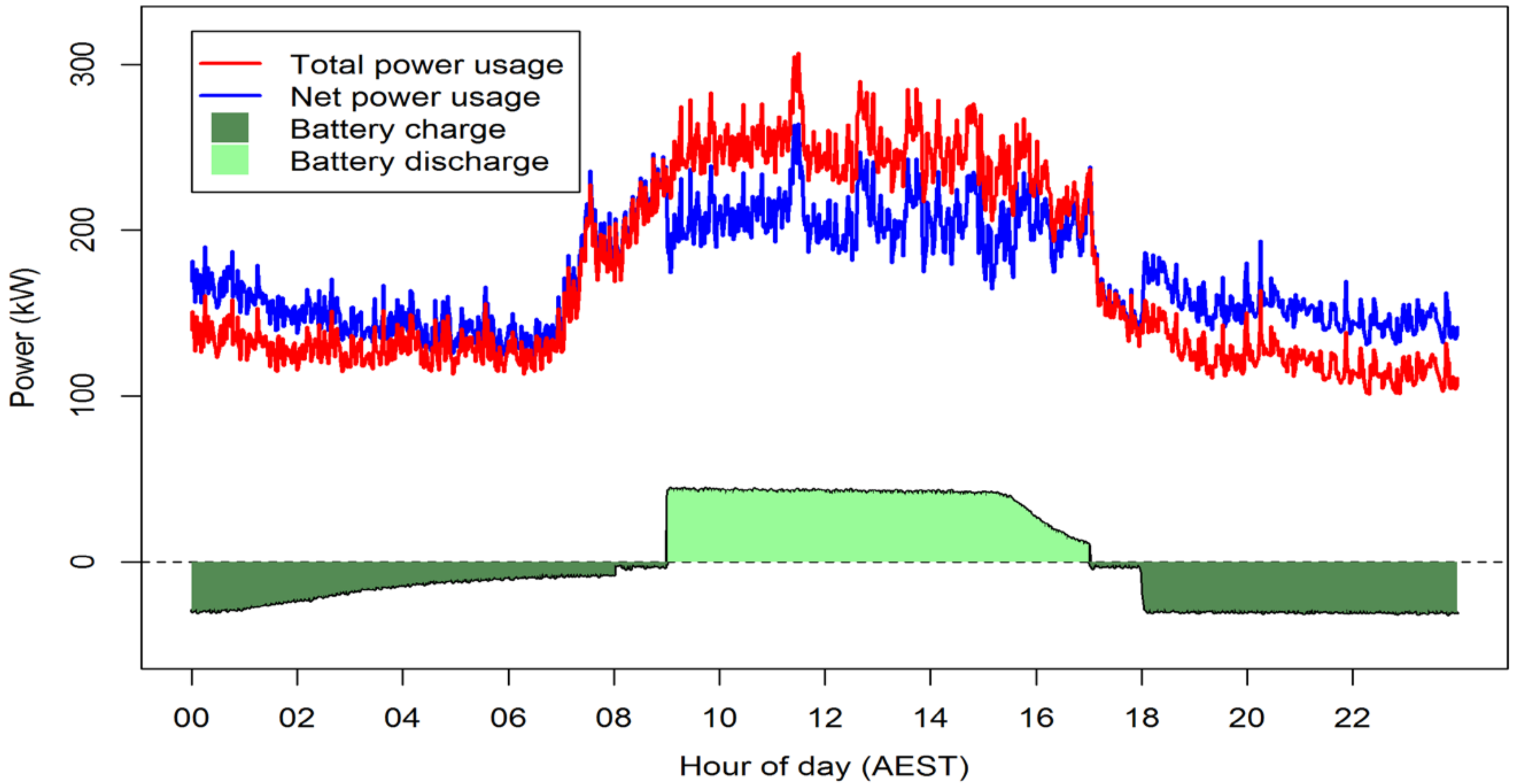
Transmission and Distribution Support



Deferral

Source: DOE/EPRI Electricity Storage Handbook in Collaboration with NRECA

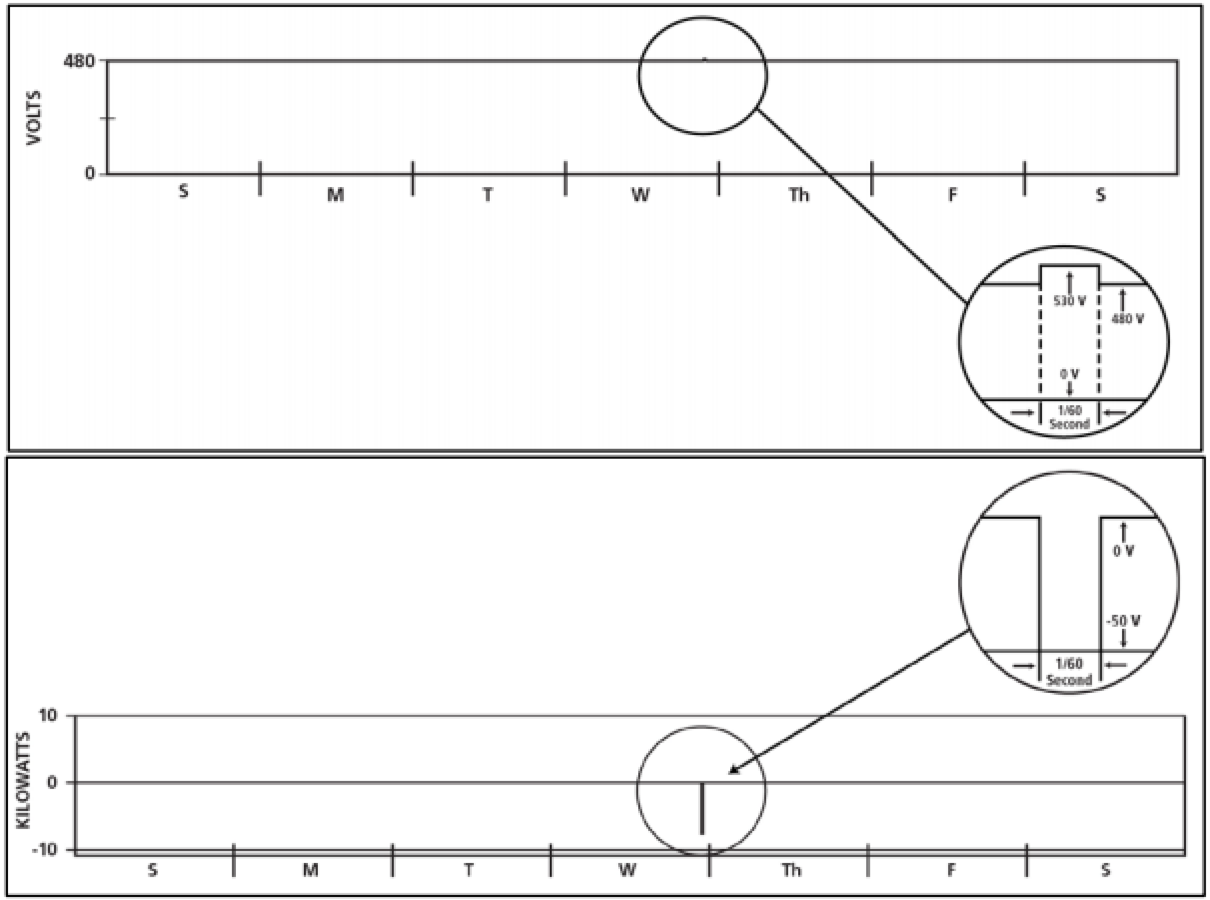
Commercial and Industrial Energy Management



Peak Shaving

Source: CSIRO Storage Energy Integrated Facility

Residential Energy Management



Power Quality

Source: DOE/EPRI Electricity Storage Handbook in Collaboration with NRECA

Electric Vehicles

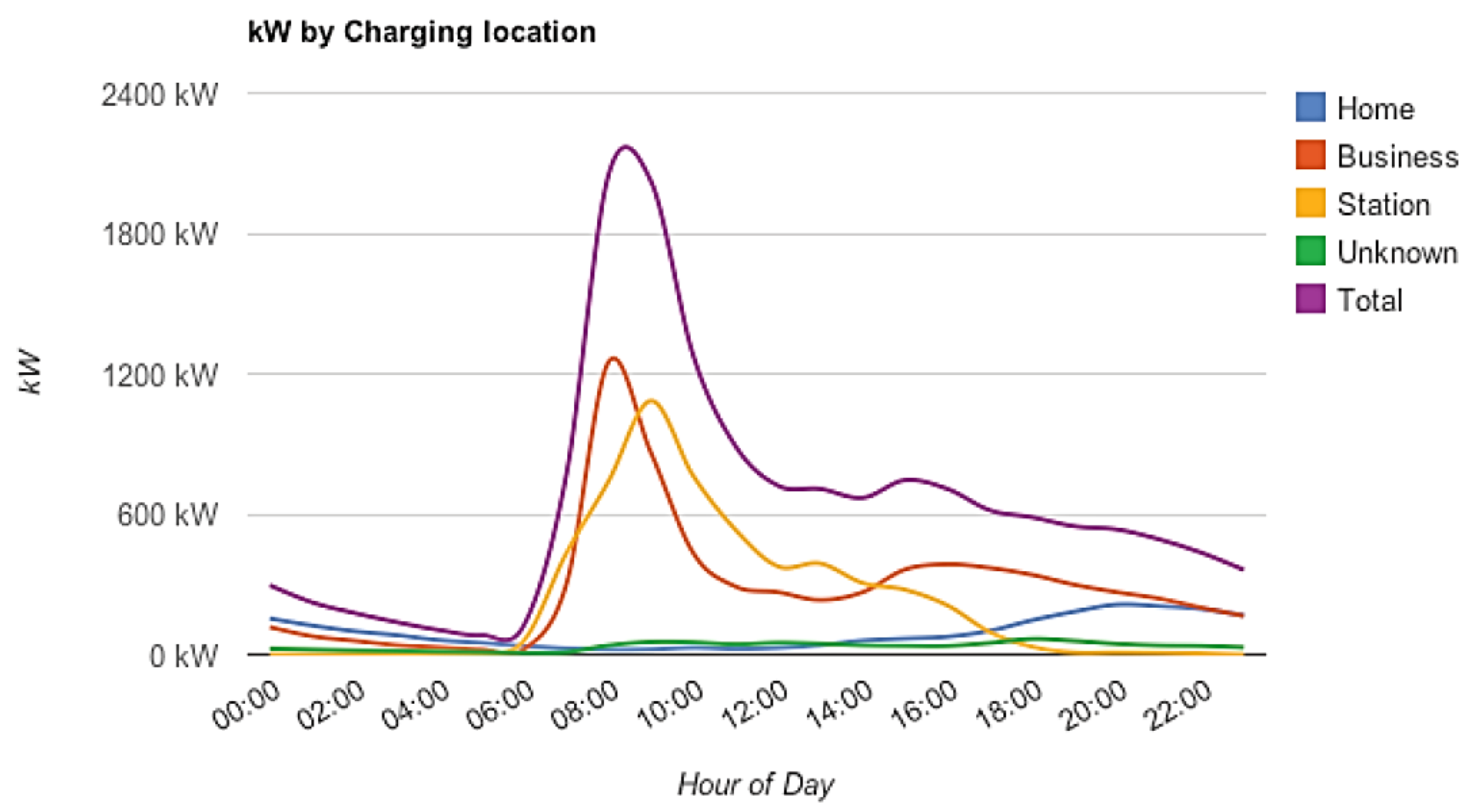


Figure 1: EV charging station usage over time of day for the WA EV Trial

Source: Western Australian Electric Vehicle Trial

Methodology – ES Shortlist

Various ES technologies (and applications) available. Some more technically feasible than others, others require further development.

Hence, we shortlisted ES by:

- Considered technical characteristics of different ES technologies
- Compare them to the technical requirements of different supply chain applications
- Took into account technical (TRL) & manufacturing (MRL) readiness level. Excluded mature technologies e.g. pumped-hydro
- Demonstrated long-term field trials and cycle-life
- CSIRO's prior experience and know-how

Applications vs ES Technologies

Application → Technology ↓	Large scale renewables integration	Transmission and distribution support	Commercial and industrial energy management	Residential energy management	Electric vehicles
Advanced lead-acid	✓✓	✓✓	✓✓✓	✓✓	✓✓
Lithium iron phosphate (LFP)	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓
Lithium Nickel Manganese Cobalt oxide (NMC)	✓✓	✓✓	✓✓✓	✓✓✓	✓✓✓
Zinc bromide flow battery	✓✓	✓✓	✓✓	✓	
Sodium nickel chloride (molten salt ion battery)	✓✓✓	✓✓✓	✓✓		

Shortlisted ES Technologies

Energy storage technologies most likely to impact Australia's electricity systems over the next 15 years, include:

- Advanced lead acid battery
- Lithium-ion battery (Lithium Iron Phosphate)
- Other Lithium-ion battery (e.g. Lithium Nickel Manganese Cobalt Oxide)
- Flow battery
- Molten salt battery (electro-chemical)

Concluding Observations

- Diverse range of storage types are likely to be adopted between 2015 – 2030
- Each has their advantages and disadvantages subject to their application
- Mainstreaming of residential energy storage is a recent development. There is limited experience with benefits, coordination, longevity and operational performance; installation and energy management standards are still being developed.

Concluding Observations

- Consumers aspiring to entirely disconnect from the grid in the medium term will likely have to:
  - Significantly modify energy use behaviours; and/or,
  - Accept substantial over-investment to cover both peak demand and reliability expectations for their site.
- Grid-connected Solar PV + Storage bundles adoption motivated by exploiting TOU arbitrage could lead to:
  - Reduced energy storage operational lifespan;
  - Mismatched to actual technical needs; and
  - Increased national greenhouse gas emissions (due to round trip efficiencies).

Thank you

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Acknowledgments

Dr John Ward

18 June 2015

ElectraNet

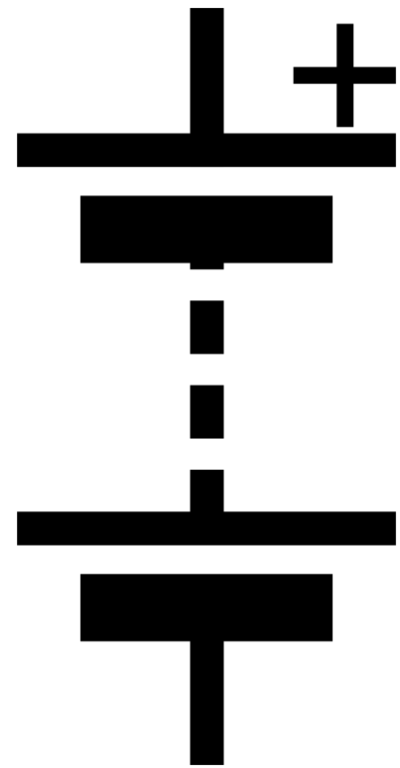
Integrating a grid-scale storage device

The regulatory framework

Name: Bill Jackson
Position: Pricing Manager

Presentation Outline

- Context
- ESCRI-SA Project
- Regulatory framework
- Commercial framework



Context

> High level of Wind Energy in SA

– *South Australian wind farms generated a new record amount of power yesterday (4/6/15), when the previous record of 1,274.3 MW was exceeded at 16:30 (4.00 pm) with 1,286.4 MW*

> Renewable Energy Integration in SA - AEMO & ElectraNet Report Oct 2014

– *Total installed wind capacity in SA of 1,475 MW.*

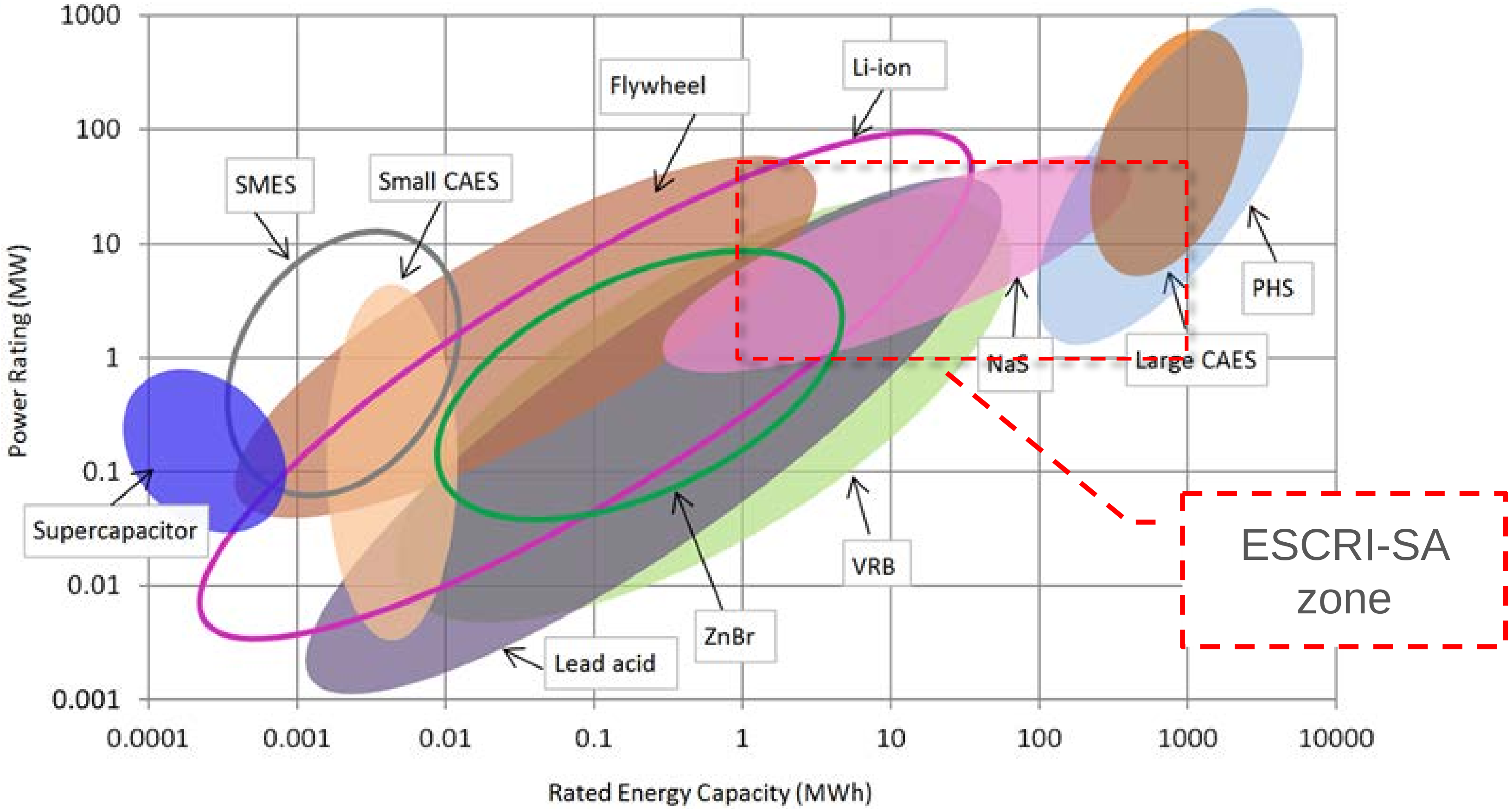
– *In July 2014, 43% of SA's total energy was supplied by wind generation.*

– *On single days during September 2014, 75% of SA's energy was supplied by wind generation.*

– *At 4.15 am on 28 September 2014, 109% of SA demand was instantaneously supplied by wind.*

– *Maximum instantaneous SA wind generation on 3 July 2014 was 1,348 MW.*

Energy Storage for Commercial Renewable Integration – South Australia (ESCRI-SA)



Competing technologies

- Prices and rate of change uncertain at this stage
- Focused on how it will fit in when (not if) it's economic

Background

- The partners - ElectraNet, AGL and Worley Parsons
- Funding from the Australian Renewable Energy Agency (ARENA)
- Examine the role of medium to large scale (5-30 MW for 5-10 hours) non-hydro energy storage in the integration of intermittent renewable energy into South Australia.
- Key objective is the development of a business case for the trial of a full scale grid-connected energy storage system (comprising Energy Storage Devices, ESDs).
- ESD may potentially act as a consumer of electricity, a producer of electricity, a provider of system ancillary services, and/or a provider of network support services.
- This is the first time in Australia that the commercial viability of an energy storage device that combines all of these potential roles is being evaluated.

Objectives

- *<u>Investigation and feasibility work</u> associated with the development of a utility scale non-hydro battery system specifically designed to facilitate the integration of intermittent renewable energy into the National Electricity Market (NEM).*
- *The novelty of the work hinges on the ability of the resulting asset to combine a number of values, including;*
  - *The <u>time-shifting of large amounts of renewable energy</u> so as to increase its value within the NEM wholesale energy market;*
  - *The ability to better <u>optimise the trading and operations value</u> of both a renewable energy and fossil fuel fleet, and the operations and/or future capital expenditure around utility networks; and*
  - *The provision of <u>ancillary services</u> to the NEM.*

ESCRI-SA business case key tasks

- A review of the regulatory environment as it applies, or could apply, to energy storage devices;
- Identification of a potential site or sites in South Australia where an ESD would be able to access multiple value streams;
- A state-of-the-art technology review of ESDs, leading to storage technology selection; and
- Development of a potential commercial framework.

- Knowledge sharing, which is a key part of this study will occur later in 2015.

Regulatory framework

Regulatory framework

> Energy storage within the Rules
  - Not explicitly contemplated but pumped hydro clearly exists
  - Rules and associated technical standards are technology agnostic
    - What technical standards should apply to ESD’s?
  - Registration and Market participation options impact the benefits that can be realised.

Registration/classification "at a glance"

<table>
<tr><th></th><th colspan="2">Implications from market classification</th><th colspan="2">Implications from scheduling classification</th><th></th></tr>
<tr><td rowspan="6">Registered</td><td rowspan="3">Market generator</td><td rowspan="3">Can access spot prices for purchase / sale of electricity.

Not liable for TUOS charges.

Slightly higher participant charges.</td><td>Scheduled

(generally >30MW)</td><td colspan="2">Must participate in central dispatch.

Market price setter.

Can offer both market ancillary services (subject to satisfying Market Ancillary Service Specification) and non-market ancillary services.</td></tr>
<tr><td>Semi-scheduled

(generally >30MW and intermittant)</td><td>Must participate in central dispatch but only required to observe dispatch level during system contraints.

Market price taker when system unconstrained, price setter during constraints.</td><td rowspan="5">Can only offer non-market ancillary services.</td></tr>
<tr><td>Non-scheduled

(generally <5MW or <30MW and primarily local use)</td><td>Relief from participation in central dispatch, incl. less susceptible to being constrained off.

Market price taker.</td></tr>
<tr><td rowspan="3">Non-market generator (and retail / market customer)</td><td rowspan="3">Must sell output off-market to Local Retailer or customer at the connection point.

Must make separate arrangements for electricity consumed from the grid, which may attract TUOS charges.</td><td>Scheduled

(generally >30MW)</td><td>Must participate in central dispatch, despite not being settled on-market.</td></tr>
<tr><td>Semi-scheduled

(generally >30MW and intermittant)</td><td>Must participate in central despatch despite not being settled on-market, but only required to observe dispatch level during system contraints.</td></tr>
<tr><td>Non-scheduled

(generally <5MW or <30MW and primarily local use)</td><td>Relief from participation in central dispatch, incl. less susceptible to being constrained off.</td></tr>
<tr><td rowspan="4">Exempt</td><td>Standing or individual exemption

(<5MW or <30MW and export <20kWh)</td><td colspan="3">Must sell output off-market to Local Retailer or customer at the connection point.

Must make separate arrangements for electricity consumed from the grid, which may attract TUOS charges.

Relief from participation in central dispatch and particant fees.</td><td rowspan="4">Can only offer non-market ancillary services.</td></tr>
<tr><td>Small generating unit of a small market aggregator</td><td colspan="3">Output sold through the spot market by Small Market Aggregator, who also purchases through the spot market all electricity consumed at the connection point.

Relief from participation in central dispatch and participant fees.</td></tr>
<tr><td>Intermediary arrangement</td><td colspan="3">An intermediary (e.g. an existing market participant) registers in place of the ESD.</td></tr>
<tr><td>No direct connection to the network</td><td colspan="3">Output sold off market at large customer site. May reduce customer's TUOS. NSCAS potentially provided via agreement with network service provider.</td></tr>
</table>

Regulatory framework - connection

> The connection application process will be influenced by whether the connection of the ESD constitutes:

- a connection of new generating plant (and/or new customer load);
- the connection of an embedded generating unit under rule 5.3A (i.e. where the generating unit is connected directly to a distribution network);
- an alteration to an existing connected generating system connected to the transmission network under rule 5.3.9 (e.g. if battery sited behind the meter at an existing wind farm site); or
- an alteration to an existing connected load (e.g. if sited within an existing customer site)

> There may be some interesting challenges for ESDs versus the technical standards

Regulatory framework – network charges

- A storage device is a net consumer of energy (~70-80% efficiency)
- If connected to transmission
  - As a generator (either behind generator meter or direct) – no TUOS
  - As a load (behind customer meter) – TUOS
  - In order to avoid paying TUOS the ESD <u>must not be registered or eligible</u> for registration as a Customer under Chapter 2 of the Rules
  - Can achieve this by registering as a market generator
  - Where the ESD is registered off-market or exempt then it would attract these TUOS
  - Rule change to always treat a generator or direct ESD as exempt from TUOS, or seek clarification of their treatment under the Rules and AEMO registration procedures
  - MLF treatment is unclear (pumped storage can have two)

Regulatory framework – network charges

> If connected to distribution
  - As a generator (either behind embedded gen meter or direct) – DUOS
  - As a load (behind customer meter) – DUOS
  - Is the LRMC for generator case zero or negative?

Regulatory framework - Asset ownership

- There are generally no ownership restrictions provided the owner can satisfy the relevant registration criteria – unless you are a TNSP
- There are no restrictions on a network service provider owning an ESD to fulfil network support functions or defer network spend and, subject to the RIT-T, including this in its regulated asset base
- The treatment of any revenue earned by a TNSP from energy sales (on- or off-market) or the offer of ancillary services (other than NSCAS) is less clear
- ACCC, Statement of Principles for the Regulation of Transmission Revenues: Transmission Ring-Fencing Guidelines, 15 August 2002 still apply…
  - *a TNSP that supplies 'ring-fenced services' (that is, prescribed services) must not carry on a 'related business' (defined as generation, distribution and electricity retail activities)* [extends to JV's, partnerships etc]
  - *exception where it carries on a related business that attracts a total revenue of less than or equal to 5% of the TNSP's total annual revenue*

Regulatory framework – TNSP ownership

- TNSP ownership (subject to the ring fencing guideline)
  - Cost Allocation Methodology would allow an asset to provide both prescribed and other service and be partially recognised in the RAB
  - The shared asset guideline presents another option where the asset is in the RAB but a share of the unregulated revenue goes to customers
- The issue of the charging and discharging remain unresolved:
  - If a pure network alternative then could be treated as loses and not appear in the market.
  - Could contract with the local retailer (but what to do with the surplus/losses?)
  - Auction out the market component and abstract the TNSP from the market.
    - Auction fees to customers and used to support RIT-T?
    - Auction fees to TNSP and CAM or Shared Asset treatment?
- What are the objectives of the ring fencing guideline?
- Should the ring fencing guideline apply if the TNSP is not able to distort market outcomes?
- Utility scale ESDs may look very “network” in the future

Commercial framework

Commercial framework

- Review of options for commercial frameworks
  - Facilitated by Greg Thorpe – Oakley Greenwood
  - Lead to a number of options which are to be further progressed
  - Considered a wide range of benefits/services including:
    - Capex deferral (Generation, Transmission, Distribution)
    - Reduced losses (Transmission, Distribution)
    - Reduced generation opex (fuel etc) costs
    - Wholesale market FCAS
    - Voltage control (Distribution, Transmission)
    - Trading benefits (arbitrage is a contemporaneous trade)
  - It may allow planning assumptions to be less conservative wrt wind farms

Commercial frameworks

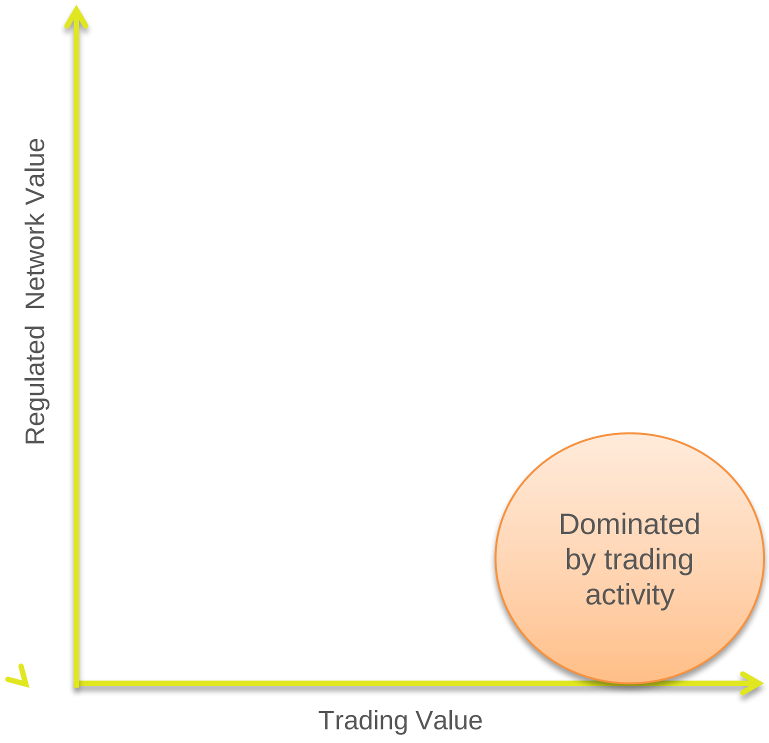
> Location to suit market outcomes

> Size optimised to market outcome

> Owned by generator, gentailer, specialist 3rd party

> Dispatch rights focused on trading

> Limited economic benefit at this stage



Commercial frameworks

> Location optimised to network limitation

> Size optimised to network limitation

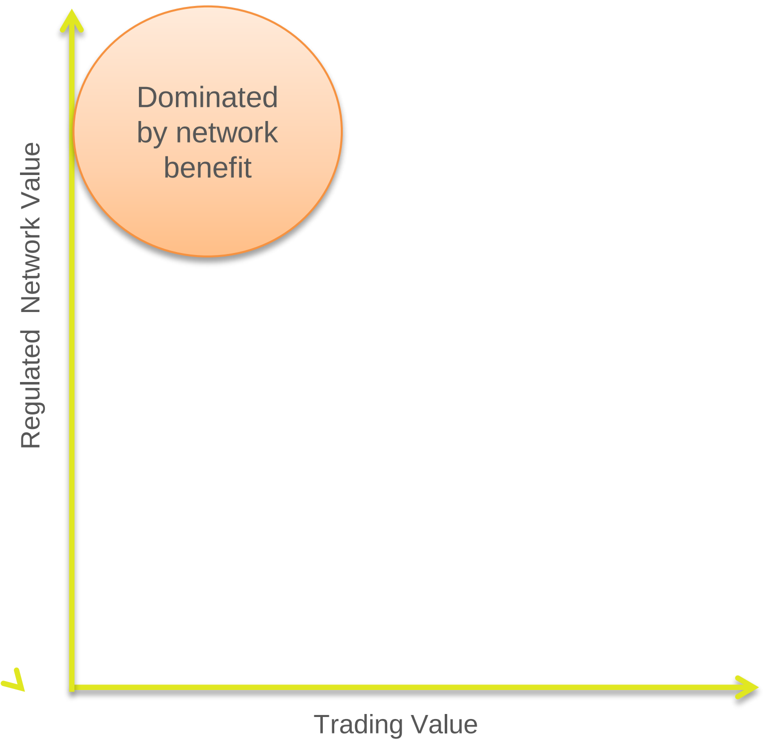
> Owned by TNSP

> Subject to RIT-T – in RAB

> Dispatch rights focused on network

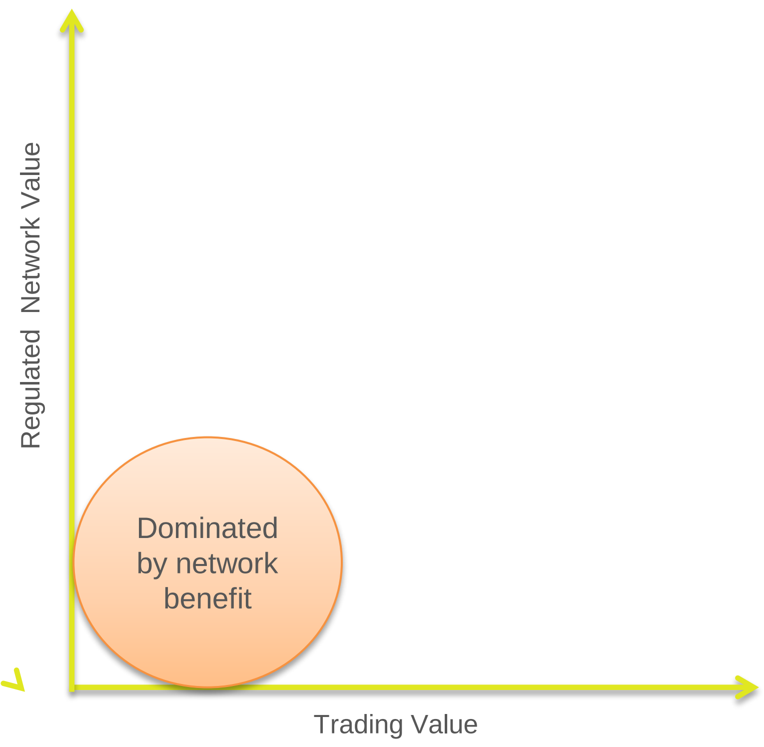
> Limited economic benefit at this stage

> Trading component TBA



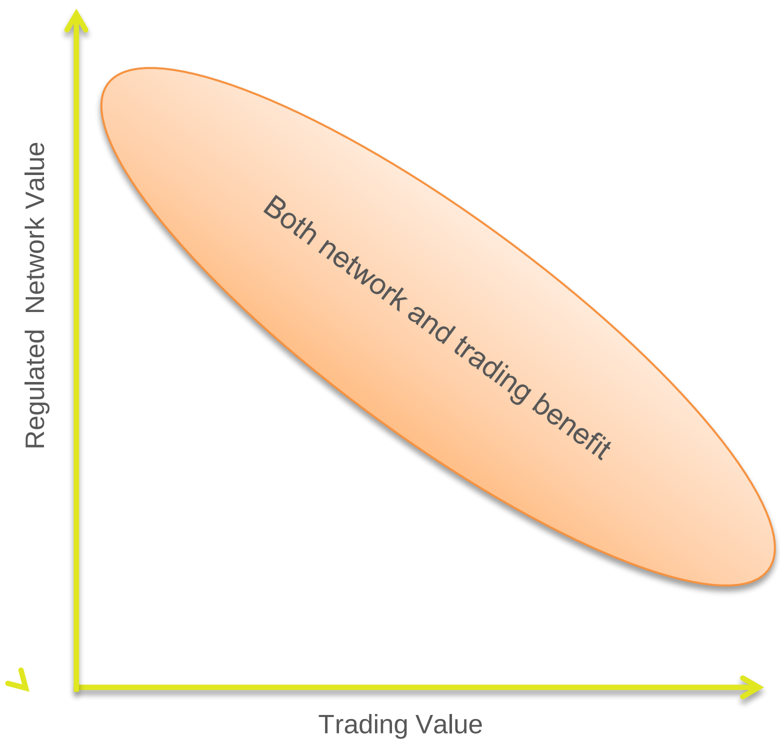
Commercial frameworks

- Location optimised to network limitation
- Size optimised to network limitation
- Owned by generator, gentailer or 3rd party
- Dispatch rights focused on network
- Network support passthrough for TNSP
- Would result from RIT-T outcome



Commercial frameworks

- Location optimised to network limitation or co-optimised to network and provider
- Ownership by Generator, Gentailer, 3rd party or TNSP
- Dispatch rights: complex combination of TNSP and energy trader. (Ownership may dictate the relative priority)
- A number of ways to abstract the TNSP from the market



Close

- Utility scale ESD <u>will be</u> economic (just not yet)
- It may look a lot like network
  - A slow version of an SVC, Capacitor, Reactor, FACT etc.
  - A long term alternative to duplicated network elements
  - It may allow planning assumptions to be less conservative wrt wind farms
- The ring fencing guidelines are a potential impediment
- There are mechanisms that can abstract a TNSP owner from the market

Questions?

Thank you

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SUNVERGE

Renewable Made Reliable

Australian Energy Markets Commission
Public Forum on Integration of Storage
Sydney, 18 June 2015

Customers, Networks and Markets: Integrating the benefits of Customer Sited Energy Storage

Customers, Networks and Markets: Integrating the benefits of Customer Sited Energy Storage

1. **Background to Sunverge - Platform Solution**
2. **The benefits - Customer, Network and Market**
3. **Business Model 1 - DNSP led deployment**
4. **Business Model 2 - Retailer led deployment**
5. **Business Model 3 - Energy Services Company**
6. **Business Model 4 -Developer led Company**

Our Differentiation

- Access to integrated value streams
- Performance, reliability, safety
- Compliance with the highest utility and consumer standards and certifications
- Applications for consumers, grid operators, and market traders
- Integration points to consumer, utility, and retailer applications and systems
- Operational experience and empirical proof points

400+ Units in Operation

1.5 MW PV Under Management

4.2 MWh Under Management

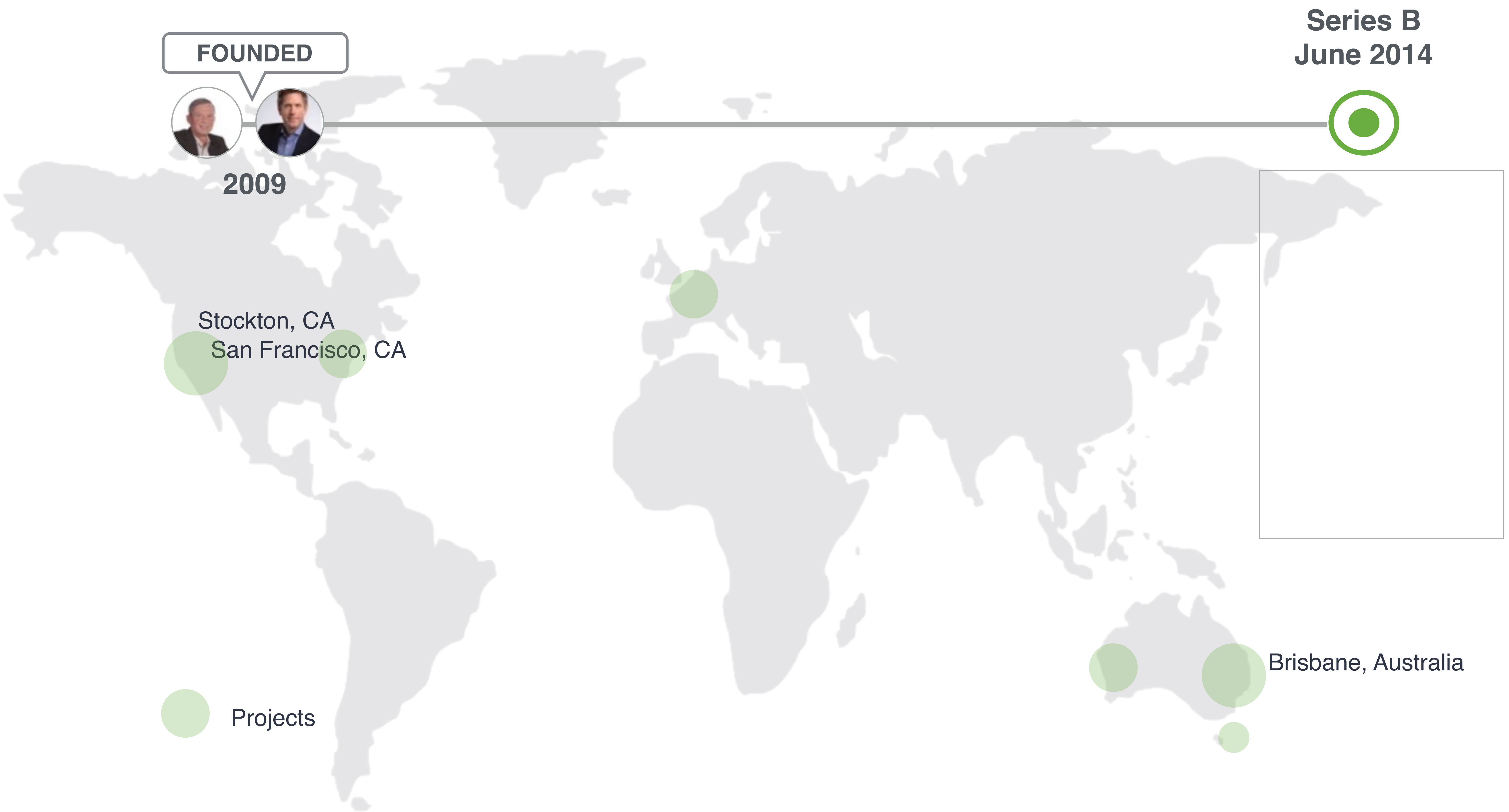
193 MWh of Peak Load Reduction

7,451 Over 7,451 of Backup Power

330 Households Served

98% Fleet Uptime (%)

19+ World Wide Projects



Company Mission

Enabling the transition to a zero-emission grid by:

- Deploying storage and controls required to **integrate renewables into the grid**
- **Maximizing the value of distributed energy** resources with customer-sited solutions
- Sharing, and harmonizing, this **value between energy consumers, providers, utilities, and society as a whole**

Key Strategic Commercial Partnerships:

Kokam — Great Power for Everyone

Schneider Electric

SUNPOWER

SIEMENS

Our Solution: Distributed Energy Storage System

The Sunverge Solar Integration System (SIS) is an intelligent distributed energy storage system that:

- captures solar power and delivers it when needed most
- combines batteries, power electronics, and multiple energy inputs in a UL-certified appliance controlled by software running locally and in the cloud
- is a utility-grade product designed for the residential and commercial markets.

Storage Appliance

Software as a Service

Renewable Generation

The benefits

An intelligent integrated platform uses on-board computing, power electronics and a powerful software platform to aggregate multiple storage units into a Virtual Power Plant and provide benefits to customers, networks and the wholesale energy market.

Customer benefits

- Bill reduction
- Bill certainty
- Reliability and islanding
- Added control

Network benefits

- Avoided network augmentation
- Avoided voltage correction
- Reduced opex - power quality investigations
- Remote trouble-shooting for local network issues
- Demand management
- Access to data

Wholesale and Market benefits

- Avoided generation costs
- Avoided energy losses
- Demand response
- Avoided wholesale caps
- Efficient market operation (peak-shifting)
- Ancillary services
  - power factor correction
  - frequency keeping
  - voltage support
  - over-frequency reserve

Durable Utility Grade Grid Asset for Designed for Safety and Performance

Fleet-wide capacity forecast, reservation, scheduling, and dispatch for local grid stability

Simplifies grid operation and provides operation and maintenance benefits

Covered by long-life product and Installation warranty

Case Study: Distribution Network Service Provider

Vector

Key features

Customers pay an upfront and monthly lease payments to the utility network provider

Customer installs the solar and network invests in storage on the customer premises, behind the meter, but as a network asset. Opportunities for regulated and non-regulated revenues

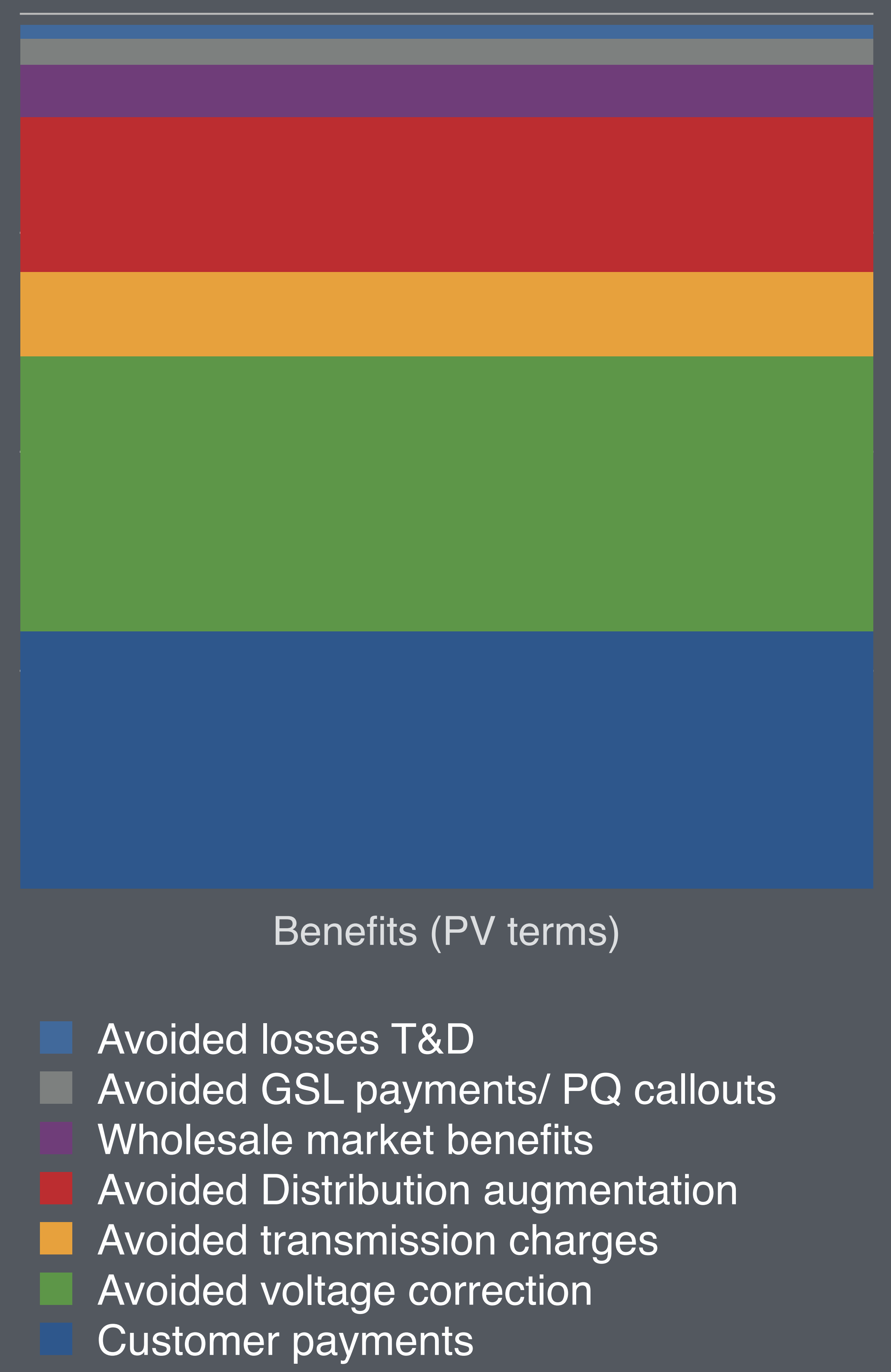
Through communications and software rules, units are aggregated across the network to provide optimised benefits across all value streams

Fleet based SIS units operate in an orchestrated fashion to provide the benefits of a virtual power plant as well as localised network solutions

Value is shared between customer (through bill savings) and utility (through efficiencies, utilisation, avoided augmentations and corrections and wholesale market improvements)

Hardware and software provide a localised solution to network problems where the costs and benefits are shared by customers who would otherwise act in their own interest alone

Summary of typical value stack (low scenario)



Reference Customer: Single Family High Density Housing

2500 R MIDTOWN

34 Single-family homes.
Micro grid.
Net zero homes.

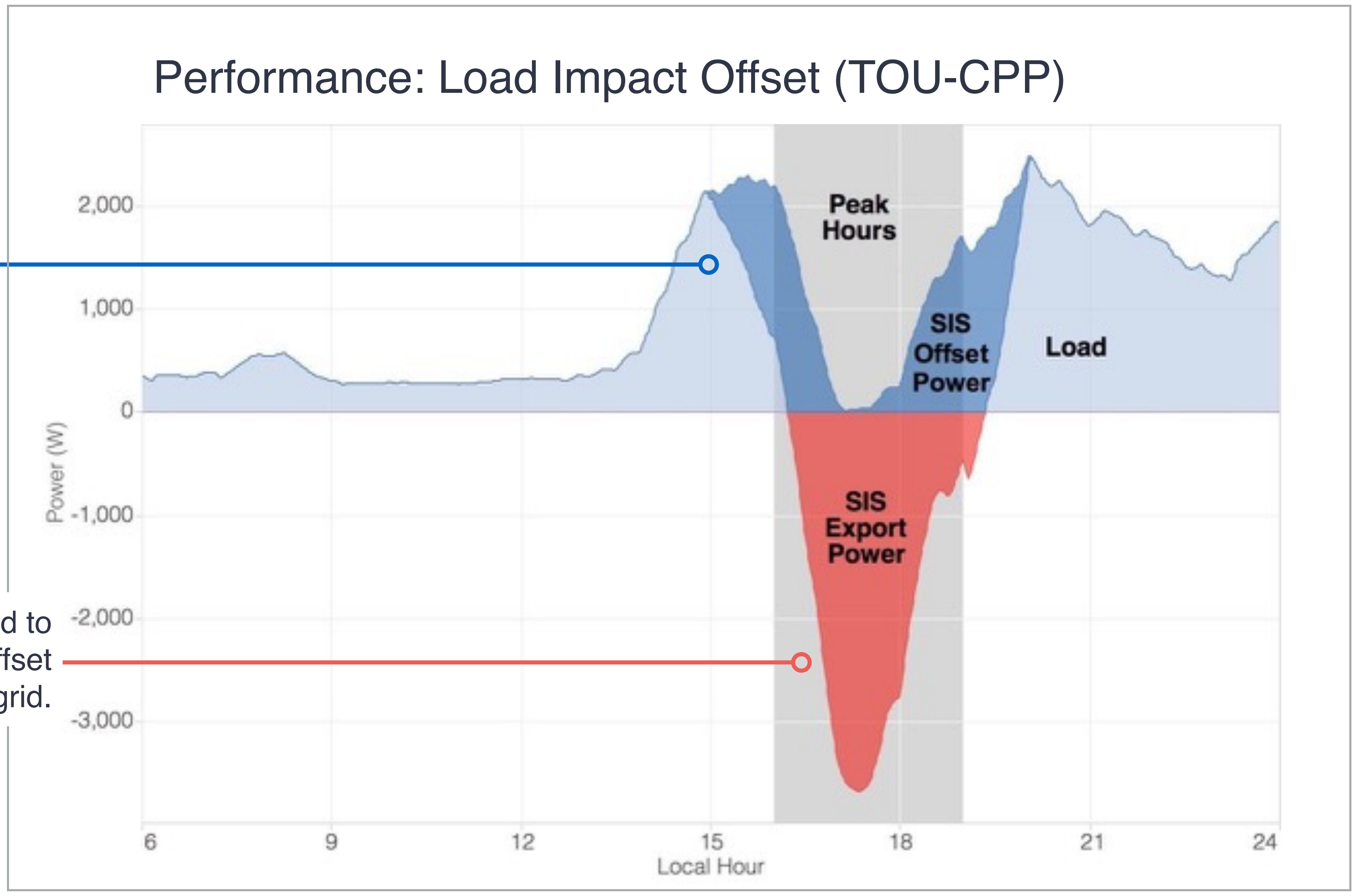
SMUD™
Powering forward. Together.

2500 R is the first Net Zero Energy community in Sacramento's midtown district. Net Zero Energy means that over the course of a year, each unit generates all the electricity you'll need and emit net zero carbon emissions. How is that even possible? 2500 R homes combine certified energy efficiency measures with a revolutionary built-in solar energy system.

Project name	: Microgrid, high density housing
Client	: Pacific Housing, Inc., SMUD
Project tags	: PV + Storage, Residential, Behind-the-Meter
Location	: Sacramento, CA
System	: 11.65kWh, 4.5kW, + 3Kw PV, Automated PCT

Chart is average load impact of 2500R units participating in Time of Use - Critical Peak Period (TOU-CPP) rate during Sept 12th 2014 Conservation Day.

70% of the day's solar generation was shifted to the peak period (4pm - 7pm) in order to offset load and export power to grid.



Reference Customer: Developer

new home construction couple with whole home automation

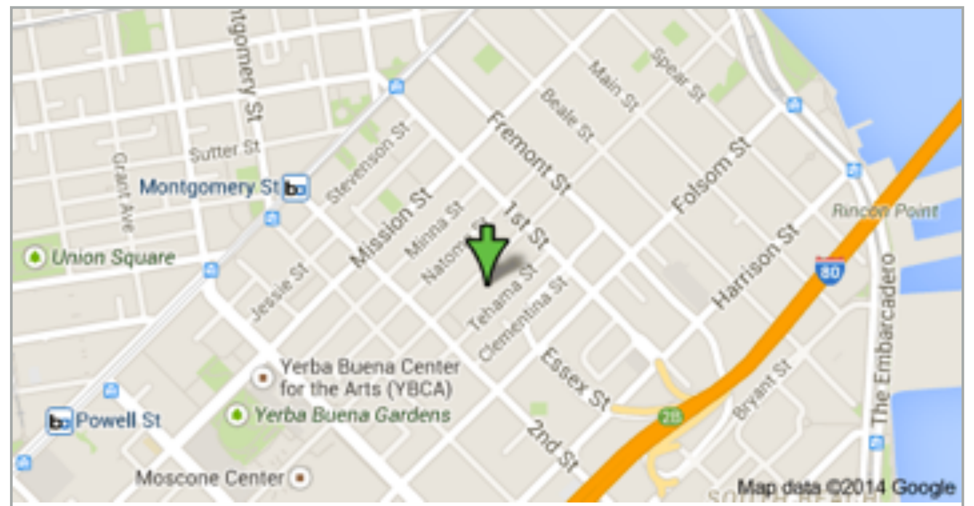
Double ZeroHouse 3.0 is designed to achieve net zero energy usage with a SunPower solar system and Sunverge energy storage, an advanced grey-water recycling system, and energy efficient appliances. Combined with a Ford C-MAX Energi plug-in hybrid, this home demonstrates the leading edge of smart, sustainable living.

Project name	: Double ZeroHouse 3.0
Client	: SunPower and KB Homes
Project tags	: PV + Storage, Residential, Behind-the-Meter
Location	: El Dorado Hills, CA
System	: 11.65kWh, 6kW, + 5Kw PV, Automated PCT

Contact us.

We look forward to hearing from you.

San Francisco, CA, USA



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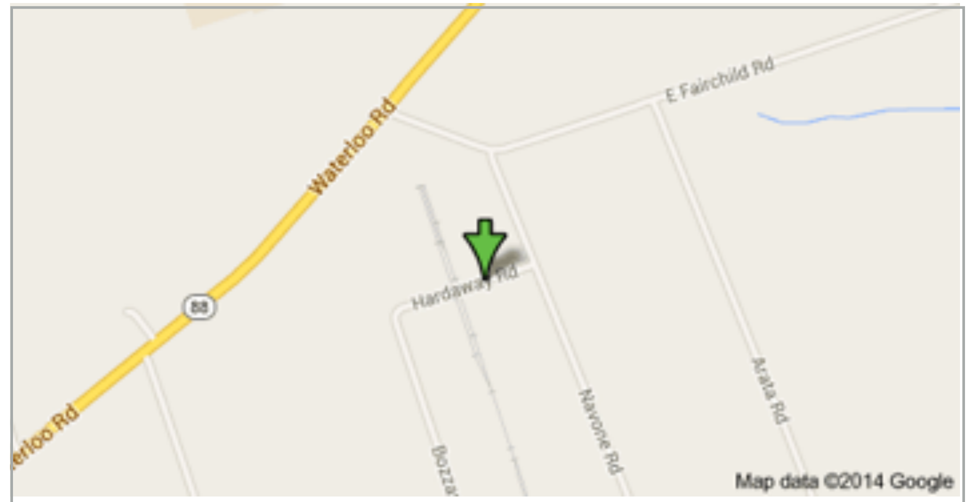

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SUNVERGE

Renewable Made Reliable