



Energy Storage - developments, issues and considerations

APSE Energy and Walker Morris

Leeds





Introduction

Phil Brennan, Head of APSE Energy David Kilduff, Partner, Walker Morris



www.apse.org.uk



10:30 Strategic perspective -	Introduction
	Storage options – developments applications and the way forward - Ray Noble, APSE Associate
	Procurement and legals – options and issues - Kate Webster, Director, Walker Morris Solicitors
	Real Estate issues – Judith Pike, Partner Walker Morris Solicitors
11:40 Break	
	Investing in storage – what are investors looking for? - Chris Gartside, SDCL
	Energy, batteries and storage - a developer's perspective - Phil Roberts, GMI Energy
12:40 Lunch	
1:30 Operational Perspective -	Green Hedge - Tim Masters, Commercial Director - presentation/Q&A
	Camborne Energy - Harry Vickers, Business Development Manager- presentation/Q&A
	Green Acorn - Keith Hounsell, Managing Director - presentation/Q&A
2:30 Break	
2:45 Issues for LAs to consider when investing in batteries, grid connectivity and capacity - Ray Noble, APSE Associate	
	Discussion and debate
3:30 (Approx) Summary and Close	



Introduction

- Dynamic agenda
- Use your assets
- Use your powers

Have a strategy – energy, investment, asset management, carbon reduction...





Ray Noble, APSE Associate

Leeds

Storage Options – Developments, Applications and The Way Forward

Ray Noble – APSE Advisor



Government's Energy issues (1)

- Years of no investment in energy
- Many power stations reaching end of life
- Grid requires upgrading

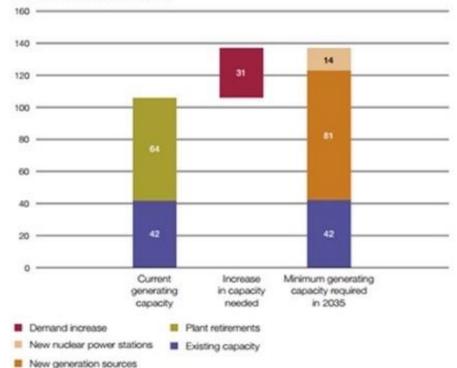
DENEWARIE ENERGY ASSOCI

• Demand for electricity increasing

The UK's energy challenge up to 2035

The Department projects that electricity demand may increase at the same time that a large proportion of existing generating capacity retires

Installed capacity (Gigawatts, GW)



Notes

- 1 The Department projects a range of scenarios for the future of electricity generation. This figure uses the scenario based on its central estimate of economic growth and fossil-fuel prices and shows the generating capacity required to meet the Department's security of electricity supply and decarbonisation objectives.
- 2 The figure shows total installed capacity the maximum electrical output that power generators can produce unadjusted for plant availability and outages.
- 3 New generation sources includes 17 GW from European electricity interconnectors.

Source: National Audit Office analysis of Department of Energy & Climate Change energy and emissions projections data

Government's Energy issues (2)

- Environmental rules have killed Coal
- Renewables now making a big impact, many being connected at the distribution end of grid
- Nuclear is expensive, few want to invest
- Biomass coming from Canada!
- Gas supply not guaranteed beyond 2035
- Government need an Energy Strategy







Government and Energy issues (3)

- Money and support funding is running out
- Market will have to decide lowest price wins!
- Distributed Generation is happening
- What is the future value of a National grid
- Air Source heat pumps need
 electricity
- Transport now needs electricity (EV's & Rail)
- Cities are struggling with pollution
 issues







Industrial Strategy

- Security of Supply is vital (particularly with Brexit)
- Must be competitive with other Countries on energy
- Wind (Onshore) and Solar will soon be the cheapest form of energy generation across the World
- Solar / Wind with Storage is a game changer
- Air Source, Ground Source Heat Pumps together with UK grown Biomass and AD all have a major part to play
- Government must have a planned TRANSITION
- Will Nuclear ever be built? Can we wait?
- What happens if Energy suppliers go bankrupt!
- What investment should be made in the Grid or Distribution System
- Storage allows off grid solutions to become a reality



Speed of Technology advancements

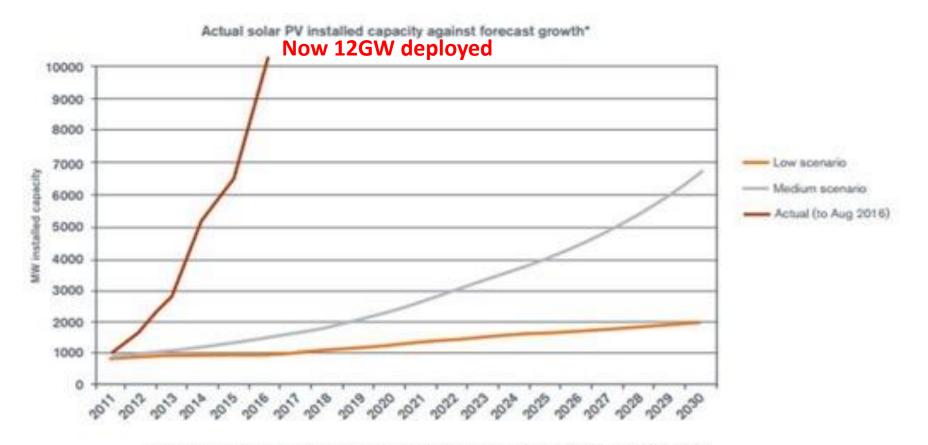
- Electronics Industry lead development for Phones and Computers developing smaller but more powerful batteries
- Motor Industry now developing the same technology to power Electric Vehicles
- This same technology is now entering the power industry at all levels, including buildings.
- All based around Lithium Ion battery technology







Global mass production drives down cost rapidly



* Low and Medium Scenarios come from the EA Technology 2012 report "Assessing the Impact of Low Carbon Technologies on Great Britain's Power Distribution Networks". Actual installed capacity is from DECC solar photovoltaics deployment data.



Storage price drop faster than Solar

Motor Industry flat out on EV's

- Nissan Leaf was first but had short range (85miles) and created "range anxiety"
- Tesla delivered a 260mile range and supercar performance
- Now all Car Manufacturers are introducing EV's across their full range by 2019
- Dieselgate has caused VW to rethink and strategy now is to be a market leader in EV's
- Motor Industry also working on Hydrogen Fuel Cell power









Motor Industry feels threatened!

- Tech Companies Google, Apple, Amazon, etc – all looking at making cars
- Apple tried to buy McLaren!
- Saw Tesla come from no where to shares worth more that General Motors
- All involved in self driving car development
- Could either compete with Motor Industry or be part of the supply chain – as Intel did in computers cars could be powered by "Apple"







EV's are solutions to Pollution

- Ranges of 200 to 350miles are now possible (range anxiety will be dead!)- 500mile being a target
- Some talking of the end of new fossil fuel cars sales by 2025
- Charging of EV's now 30mins puts stress on the grid - 5min charge time is target - how can the grid cope!
- Talk of a ban on diesels and a scrappage scheme
- All delivery vans will soon all be electric







Emissions and Pollution solutions

- All City transport can be clean
- Fossil fueled City transport is on the way out
- Electric buses even double decker's are now running
- Hydrogen Fuel Cell buses are also being developed
- Island ferry boats can now be powered by electric
- However we need a plentiful supply of clean electricity for transport to be "clean"







Fossil Fuels on their way out

- Charging EV's at home or locally (Supermarkets & Offices) with long runs topped up at Service Areas
- Grid will not cope with fast chargers and need Storage as an interface
- Increased supply of Solar and Wind electricity is essential
- Solar canopies over surface parking linked with Storage provides "clean" electricity







Smart Transport and Housing





Thank You

Ray Noble rn.solarbipv@gmail.com









Kate Webster, Director, Walker Morris

Leeds



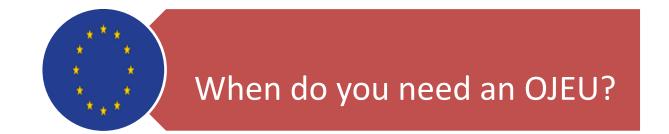
Procurement and Legal – Options and Issues

16 June 2017

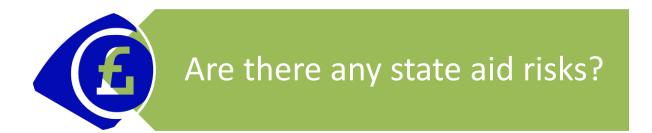
David Kilduff, Partner, Energy, Infrastructure & Government Kate Webster, Director, Energy, Infrastructure & Government



Key Questions









Option 1: Supply to the Authority

OJEU compliant procedure

Framework or DPS Open or Restricted Procedure

Competitive Procedure



Option 2: Investment Opportunity

Purchase of shares in a power project

Procurement – Securities transactions are exempt
Powers – General Power of Competence (Localism Act)
State Aid - Purchase at an overvalue could be state aid (so get an independent assessment if it is not publicly traded).

A JV to sell power through the grid or private wire •Procurement – OJEU not necessary if it is for a commercial purpose and uses a holding company.

• Procurement – if the project needs the council to offtake then an OJEU will be required

• Powers – General Power of Competence (Localism Act) and requirement to exercise right through a company.

Developing a power project to sell through the grid or private wire Procurement – OJEU not necessary if done through a company with a commercial purpose

• Procurement – if the project needs the council to offtake then an OJEU will be required

• Powers – General Power of Competence (Localism Act) and requirement to exercise right through a company



What is State Aid?





What is the risk and can it be managed?

Claw-back from the Beneficiary

Block Exemption – the "Safe Harbour"



Walker Morris Contacts



Kate Webster, Director, Energy Infrastructure & Government

+44 (0)113 283 2572 kate.webster@walkermorris.co.uk



David Kilduff, Partner, Energy Infrastructure & Government

+44 (0)113 283 2643 david.kilduff@walkermorris.co.uk

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Judith Pike, Partner, Walker Morris

Leeds

APSE Energy Storage - developments, issues and considerations



APSE Battery Storage - Real Estate Issues

Issues for the Landowner

- Grid Connection
- SPV vehicle/Funder issues
- Rent
- Exclusivity requirement
- Maintenance of Private Network
- Termination Rights



APSE Battery Storage - Real Estate Issues

Issues for the Operator

- Upfront costs
- Title due diligence
- Maintenance of capacity
- Complexities of embedded power
- Funder v. Landlord
- Threat of termination



Contact

Judith Pike, Partner, Real Estate

+44 (0)113 283 2508 judith.pike@walkermorris.co.uk



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Break

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Chris Garside, SDCL

Leeds





Phil Roberts, GMI Energy

Leeds





Lunch

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Tim Masters, Commercial Director, Green Hedge

Leeds





Harry Vickers, Business Development Manager, Camborne Energy

Leeds

Camborne Energy Storage Limited

CAMBORNE CAPITAL

About Camborne Energy Storage

- Camborne Capital is a privately-owned parent company to Camborne Energy Storage Ltd (CES) and Camborne Land Investments Ltd. The CES team has a significant level of experience and skills in the energy sector, having developed and accredited over 500 MW of large-scale assets across the UK.
- CES has positioned itself to be market-leaders in the emerging energy storage market through the commercialisation of battery storage technologies. CES is poised to begin work on its expansive 800+ MW pipeline of energy storage projects, and, due to CES's background in the industry, maintain a strong network with market-leading battery suppliers, legal advisers, technical advisers, land agencies, ancillary services, investors, and more.
- CES is led by Dan Taylor, who was appointed having recently closed with Project FALCON, a £17m project with Western Power Distribution looking at alternative intervention techniques on the 11kV network, including battery storage.
- CES has installed the very first grid scale Tesla Powerpack in Europe at a site in Somerset, which has been co-located with a ground mounted solar PV site.
- CES has recently been granted planning consent for over 40MW of battery energy storage facilities to be constructed in 2017.



entification, sourcing and screening for three reen belts sited ground mounted solar PV in-Ilations totaling 17MW across the Lees Estate



Identification, sourcing and screening for the development of a grid tied Lithium Ion attery installation, alongside a solar PV farm ir Somerset, currently under construction



Portfolio and Pipeline

Live Portfolio

CES has a number of sites that have already been submitted into the Local Planning Authority for full planning permission. These sites all have an Option and draft Lease agreed and signed with valid import/export grid offers.

Pipeline and Status

CES also has a considerable number of sites that have a grid offer and land secured, or are at grid application stage. Once a project has been awarded a grid offer, a full appraisal of the site is undertaken.

Development Process and Expertise

CES has a number of key relationships, partnerships and agreements with large land agents and land owners. This includes exclusive access to the largest single landowner in the UK, managing 650,000 acres of land throughout the UK. With such key land partners, we are able to target areas of the grid network that we have identified and analysed as optimum for both export and import capacity, which no competitor can access. As part of this analysis, we investigate the viability of connecting sub-second response technology onto specific areas of the network. Once a valid grid offer has been provided, CES manages the securing of land rights along with ensuring the site is capable of achieving planning permission. This is done by running a number of feasibility checks before progressing the development.

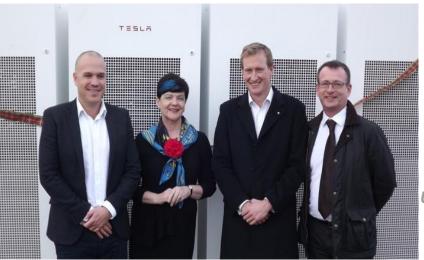
Portfolio Overview				
MWs with Planning Approval	43			
MWs in Planning	159			
MWs with Grid Offers & Land	250			
MWs at Grid Application Stage	348			

Case Study

- CES' first site was commissioned in November 2016 and was officially unveiled by Baroness Neville-Rolfe, who was the Energy Minister at the time.
- This is a market leading, European first, installation for the battery provider, Tesla.
- It has attracted significant coverage for CES and further raised our profile as a leader in the UK energy storage sector.
- This system is tied directly to a ground mounted solar installation in South West England.







L to R: Dan Taylor – Managing Director, Camborne Energy Storage; Baroness Lucy Neville-Rolfe – Energy Minister; Edward Sargent – Manager, Tesla UK; Chris Roberts – Managing Director, Poweri

"

We welcome this exciting project from Tesla and Camborne. Innovation in storage technologies will help manage our electricity grid more efficiently, support greater energy security and, crucially, drive down consumer bills.

UK Energy Minister, Baroness Neville-Rolfe, 07 December 2016



CES's Battery Energy Storage project, utilising Tesla's Powerpack solution, alongside existing Solar PV site.

Camborne's offering

- Grid-connected energy storage facilities (Landlord approach):
 - Leasing land over 15-20 years
 - RPI-linked
 - Fully managed asset.
 - Decommissioning.
- Behind-the-meter energy storage facilities (High energy users approach):
 - Energy Storage facility will provide services behind-the-meter to reduce bills by, amongst other things:
 - Triad Avoidance
 - Red Tariff Avoidance
 - Capacity firming for renewable assets.
 - Peak shaving.
 - Can be funded by client or fully funded by Camborne as an off-balance sheet asset with ownership being handed to the client after 10 years.
- Electrical vehicle infrastructure:
 - Camborne are heavily involved in facilitating the development of EV charging infrastructure.
 - Happy to run over slides on this if requested.
- Solar Co-Location
 - Co-location with existing solar PV generation Help to alleviate curtailment issues and utilise all clean energy; use solar as a tool to charge energy storage.

EV Charging: Camborne's Offering

By Partnering with CES, companies will benefit from CES's energy storage development experience as we:

- Identify viable opportunities for EV charge points to be co-located with battery storage facilities.
- Carry out a full feasibility study of each opportunity presented.
- Offer a development and financing proposal for each opportunity.
- Identify the most appropriate storage technology and supplier to deliver an optimised solution
- Have the capability to identify prime site locations, secure grid connections, carry out planning and construct and operate facilities.

CES is already working closely with an EV manufacturer to increase the number of charging points in the UK, by co-locating energy storage projects to ensure the required capacity is available. Furthermore, our approach reduces the client's direct capital expenditure for grid connections and other project costs as a result of CES's project financing capabilities.

CES Preferred Site Characteristics

- Onsite Offtake:
 - An onsite offtake requirement, preferably for a minimum of 20% of the storage capacity.
 - Where there is an onsite offtake requirement, CES will require information pertaining to the following:
 - Current load profile (average, peak, minimum) and demand.
 - Hours of operation.
 - Shutdown times throughout the year.
 - Any existing generation on site type and size.
 - Fuel cost of existing sources.
- Stand Alone:
 - Feasible for a stand alone, grid connected development.
 - Availability of both grid import and export, preferably symmetrical, however asymmetrical can be considered.
 - A minimum of 5MW of available grid capacity.
 - A feasible grid point of connection, ideally within 1km of the site.
 - Preference for connecting at 132kV or under.
 - Access to a minimum of 0.5 acres of land on which to locate an energy storage site.
 - Viable access route into site for construction.
 - Clear probability of securing planning approval. (Preferably industrial/brownfield, greenfield is possible).





Harry Vickers- Business Development Manager hvickers@cambornecapital.co.uk Mobile: 07796178500

> Head Office 48 Dover Street, Mayfair, London, W1S 4FF | T. 020 7151 4122 www.cambornecapital.co.uk





Keith Hounsell, Managing Director, Green Acorn

Leeds



APSE, June, Leeds Energy Storage

Keith Hounsell Green Acorn Energy Solutions



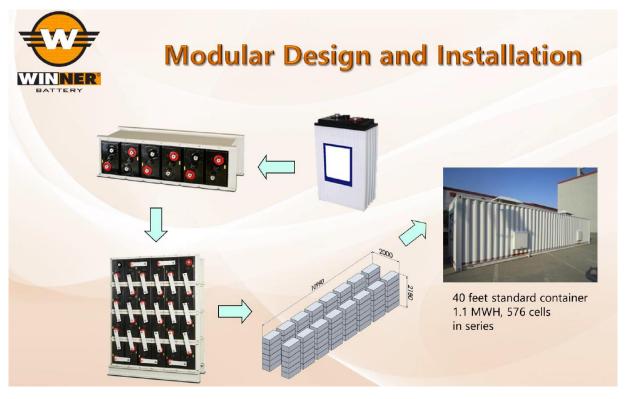
CREDIBILITY OF OUR PROPOSITION

- We have been in the renewable space for 10 years and 4 years in the UK Energy Storage, in which time we have modelled out over 300 sites, advised on grid / planning and the future on 217 sites
- Our site security side of Green Acorn is well developed and works with some large corporations to understand the short, medium, long term availability on their sites and the best technology to use
- We have our first 1mw site coming on line in September this year and depending on Grid installation and trading patterns being awarded a further 7 mw sites, we have a further 27 sites in progression
- Our 2 aggregators Limejump & Kiwi Power are leaders in the UK supply and power aggregation market space, both work in harmony with the client to deliver a clear end to end power provision with detailed modelling and both own / operate their own sites
- We have well healed finance options available for our clients and this ranges from Scottish Equity Partners, Lancea Partners, Energy Saving Finance & the Funding Portal which see Local Authorities as a excellent partner to fund projects
- Currently as we know amendments are coming through on the energy storage space and this means models are changing, so there is a need for robust forward planning in line with DNO, National Grid and being awarded contracts and obtaining the battery equipment.



Typical System Costs

- Standard Lead Acid per Mw cost is £425,000, yearly maintenance and monitoring £12,500, 4 5 year life
- Lead Carbon per Mw cost £550,000, yearly maintenance and monitoring £11,250, 6-8 year life
- Lithium Ion, LifePo5 per Mw cost £595,000, yearly maintenance and monitoring £11,250, 8-10 year life





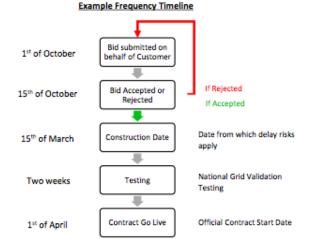
REVENUES – OPERATIONAL REQUIREMENTS

Portfolio Frequency Response

- 24 month contract maximum
- 5 month maximum build from awarded contract
- Delays to build time risk contract termination and liquidated damages. Any delays that are accepted will net off the initial term

Capacity Market

- 15 year maximum term
- Requires Prequalification in August of each year
 - o Must be a new build asset (not energised)
 - Must have Grid connection, planning and legal right to use the land
- Price confirmed in December of that prequalification year in an open tender
- 15 year term starts on 4th year out
- 1 year contracts available for October of the following year from the December Auction
- 18 year contract maximum (3 rolling years and 15 year fixed)





Per Mw revenue stream

Battery Size – 1000kw/1000kwh Constraint - 0% Limejump Portfolio Benefit - Yes

Full Stack 10 year average £/MW - £156,194 Net Frequency Price £/MWh - £18.43

	Y1	Y2	Y3	¥4	Y5	Y6	¥7	Y8	Y9	Y10
VPP Frequency	£155,548	£155,548	£139,993	£125,994	£119,694	£113,709	£108,024	£102,623	£97,492	£92,617
Capacity Market	£15,000	£15,300	£15,606	£25,000	£25,500	£26,010	£26,530	£27,061	£27,602	£28,154
CM Avoidance	-	-	-	-	-	-	-	-	-	-
GDUoS	-	-	-	-	-	-	-	-	-	-
Triad	£51,430	£58,770	£38,788	£19,394	£2,600	£2,652	£2,705	£2,759	£2,814	£2,871
Running Costs	-£6,014	-£6,134	-£6,257	-£6,382	-£6,510	-£6,640	-£6,773	-£6,908	-£7,046	-£7,187
Total	£215,964	£223,484	£188,131	£164,006	£141,285	£135,732	£130,487	£125,535	£120,862	£116,455
	Rolling Contract			Market	£1,561,938					
	Fixed Contract			Contracted	£542,859					



10 year financial overview per MW

£312,385 (31,238pa)	£782,220 (£78,222pa)	£1,564,440 (£156,444pa)	Trading Revenue Stream
£159,000 (can be land value)	£397,500	£795,000	Development Costs
£42,500 (4,250pa)	£106,250 (10,625pa)	£212,500 (21,250pa)	Yearly Opex (ave 10yrs)
£55,690 (£5,569pa)	£278,470 (£27,847pa)	£556,940 (£55,694pa)	Net Diference
1.96p	<i>4.9</i> p	9.8p	Private Wire per kw
3.64р	9.1p	18.2p	EV Charging per kw
	£159,000 (can be land value) £42,500 (4,250pa) £55,690 (£5,569pa) 1.96p	£397,500 £159,000 (can be land value) £106,250 (10,625pa) £42,500 (4,250pa) £278,470 (£27,847pa) £55,690 (£5,569pa) 4.9p 1.96p	£795,000 £397,500 £159,000 (can be land value) £212,500 (21,250pa) £106,250 (10,625pa) £42,500 (4,250pa) £556,940 (£55,694pa) £278,470 (£27,847pa) £55,690 (£5,569pa) 9.8p 4.9p 1.96p



Exclusivity contract	Both	Both	Both	Both
Complete Grid Offer	Either	Both	Green Acorn	Green Acorn
Complete Initial Model	Local Authority	Both	Green Acorn	Green Acorn
Identify Land & Survey	Local Authority	Both	Green Acorn	Green Acorn
On Board Aggregator	Local Authority	Both	Green Acorn	Green Acorn
Planning Consent	Local Authority	Both	Green Acorn	Green Acorn
All Legals	Local Authority	Both	Green Acorn	Green Acorn
Technology & Installation	Local Authority	Both	Green Acorn	Green Acorn
Complete Final Model	Local Authority	Both	Green Acorn	Green Acorn
Complete Final Contracts	Local Authority	Both	Green Acorn	Green Acorn
Sign Up Aggregator	Local Authority	Both	Green Acorn	Green Acorn
Complete Time Line Plan	Local Authority	Both	Green Acorn	Green Acorn
On Board EPC	Local Authority	Both	Green Acorn	Green Acorn
Complete O&M Contacts	Local Authority	Both	Green Acorn	Green Acorn
Overview end to end	Local Authority	Both	Green Acorn	Green Acorn
Final sign off's	Local Authority	Both	Green Acorn	Green Acorn



Site options

- Identify all possible grid services including
 - Frequency response
 - Capacity Market (CM)
 - Energy arbitrage
 - TRIAD / STOR / DMR
 - Private Wire
 - Future revenue options
- Specify & design site layout with storage system
- Consider ownership options, O&M possibilities & finance options
- Complete the detailed site modelling to identify the best options to maximise the investment per project
- Group sites into A, B, C & D portfolios



Site Secure

View all possible sites now to evaluate what grid is available, prospects for the short, medium, long term.

Timeline can be 12months + to obtain Grid & Statement of Works via the DNO and planning before the site is progressed to development (not including aggregator timeline)

Due to the changes happening happening over the next couple years with regulation we look to future proof our sites and clients alike and for non stand alone sites, leisure centres, County Halls etc so therefore on these sites a "Availability Payment Plan" - "Net supply" - "Demand Response" all fit well going forward.

Monitoring the buildings asap ensures the site loads, generation, time of use and availability are understood so we can maximise the power throughout the year this may / will include battery storage to aid the profile.

Consider technologies like CHP, lighting systems, heating & ventilation, load optimisation & others possibilities

Considering the ability to Private Wire and adding EV / Hybrid charging as the sector expands.

Park & Rides are a key area for us and EV's as we all know are gaining ground quickly now and this is expanding with excellent medium term expectations which means these sites will have medium to long term income stream viability, which we have partnered with EO vehicle charging to be able to offer a turn key possibility.

Therefore now is the time to be securing grid if nothing else and we are able to offer "site secure" to understand each & every site, we are also able to offer an insurance policy that covers pre development expenses if the site fails to be developed due to planning, grid retraction.









www.greenacornenergy.co.uk







Break

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Ray Noble, APSE Associate

Leeds

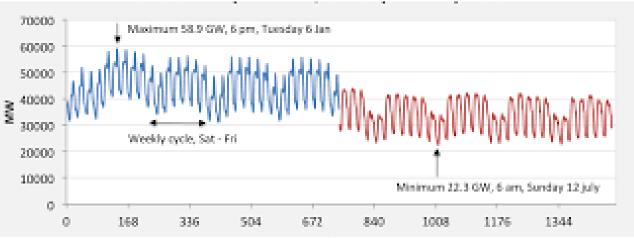
Issues for LA's to consider when investing in batteries, grid connectivity and capacity

Ray Noble – APSE Advisor



Energy Industry is changing fast

- Large amounts of Storage allows the variations between Winter and Summer demand to be levelled out
- At times in Summer we have to much electricity
- At times at night we have to much electricity
- DNO's and NG on learning curve!





Time of use tariffs & Smart meters are coming

- Time of use tariffs are going to be standard across all users, even domestic
- 4.00pm to 8.00pm is the highest charges (Red Zone)
- Using electric or charging EV's at this time should be avoided
- Storage provides a way of moving electricity and avoiding Red Zone costs
- Supply of electricity is getting smarter







"Fuel Poor"

- "Fuel Poor" will be hit by Smart Meters (time of use electricity)
- They tend to use lots of electricity at Red Zone times
- Government must prevent high bills to "Fuel Poor"
- Solar and Storage with Smart Controls in all Housing Association / Local Authority stock provides the answer
- Moving spare (cheap) electricity and store to when needed.





Provision for charging EV's

- New houses should be generators and provide EV charging points
- Retrofit program should be undertaken on existing houses with garages / drives
- Buildings should provide standard charging points for all parking spaces
- Fast chargers should be provided at Service areas and Filling stations



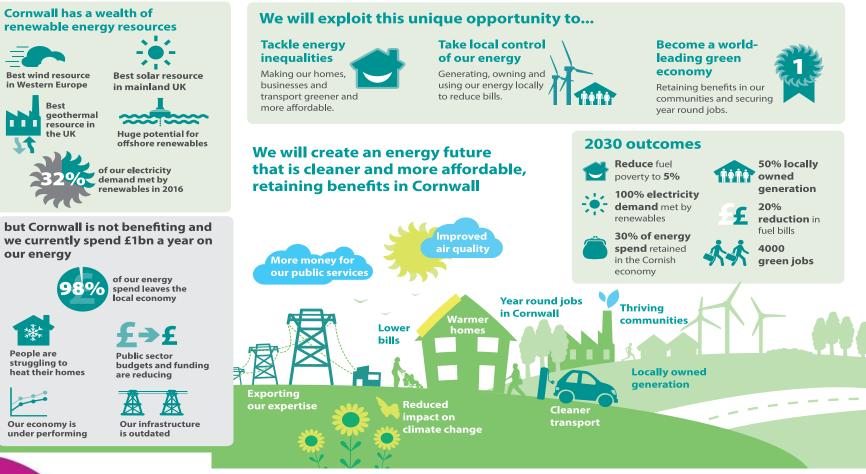




Start working out the opportunities

Cornwall's energy future

We will create an energy future that is cleaner and more affordable, retaining the social and economic benefits in Cornwall.



CORNWALL &

ISLES OF SCILLY

one and all

CORNWALL

COUNCIL

CIOS

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EA aos

DENEWARIE ENERGY ASSOUTH

Thank You

Ray Noble rn.solarbipv@gmail.com









Discussion and Summary

Leeds