



HYDRO CONFERENCE

28 MAY 2020 **ONLINE**

Hydro's place in net-zero

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Director of Communications and Strategy, Scottish Renewables

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Director of Operations, SSE Renewables

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COMFORT BREAK 1200 - 1215

Exploring new opportunities: finance, innovation and grid

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Gavin Stewart

Flexible Solutions Delivery Manager
Scottish & Southern Electricity Networks

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CMZ Flexible Services

SR Hydro Conference

May 2020



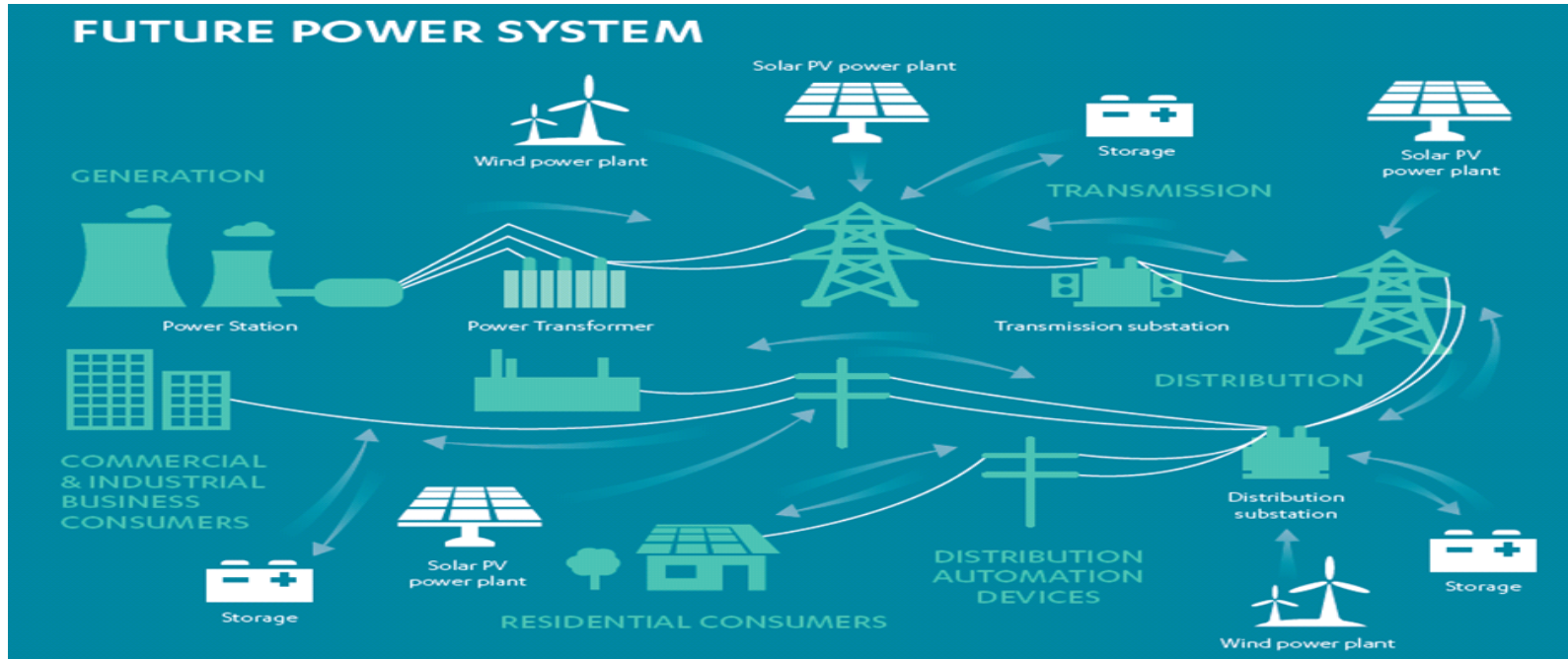
Scottish & Southern
Electricity Networks

Introduction

- The Network
- Flexible Solutions Team Overview
- Services Types & Case Studies
- CMZ Benefits
- Progress to Date
- CMZ Procurement Process
- Verification & Settlement
- Questions



The Network



Flexible Solutions Team Overview

Design

Delivery

Support

ANM

Timed
Export

Flexible Connections

3rd Party
ANM

G100

Sustain

Secure

Flexible Services

Dynamic

Restore



CMZ Service Types

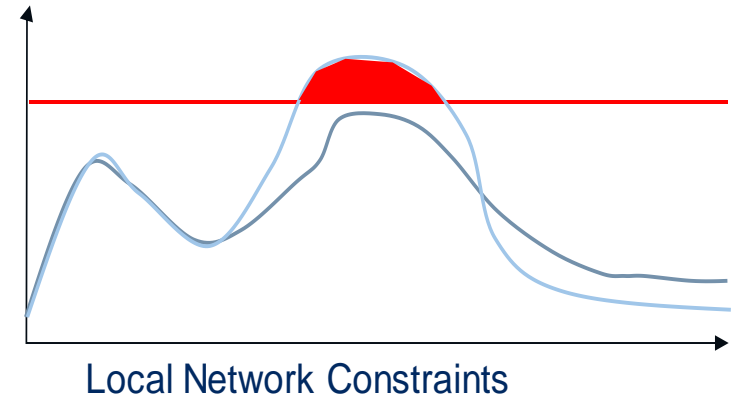
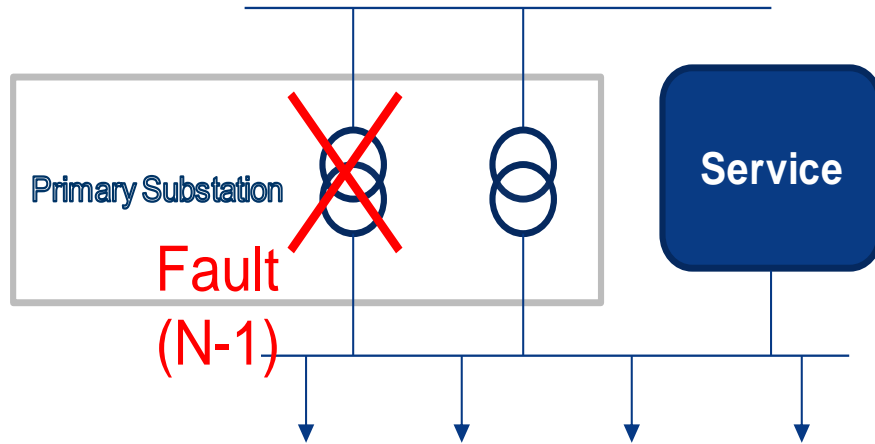
- **Sustain (Prevent) – Utilisation and Availability**
Reinforcement avoidance or deferral based on peak lopping forecasted demand.
- **Secure (Prepare) – Utilisation and Availability**
Required to support the network during planned maintenance work.
- **Dynamic (Respond) - Utilisation**
Required to support the network during fault conditions while there are planned outages.
- **Restore- Utilisation**
Needed to support the network during networks faults.

<https://www.ssen.co.uk/1connections/Flexible/>

<https://www.energynetworks.org/electricity/futures/open-networks-project/workstream-products-2020/ws1a-flexibility-services.html>



Constraint Managed Zones - Example



CMZ Benefit's



Cost savings achieved by deferring or avoidance of network re-enforcement capital expenditure.



Increases market liquidity, encourages more generators to connect and increase market capacity.



Alternative cleaner option - reduction in reliance on traditional mobile or temporary generation with the added benefit of a cost reduction per MWhr utilised.



By engaging with DER's from a renewable source this will lead to a potential reduction in CO₂, NO_x and particulate pollution when compared to traditional methods.



By contracting with DER's we are demonstrating SSEN's commitment to open networks and our transition towards DSO.



Progress to Date

- In the region of 450MW of flexible generation has been connected
- 6MW of Flexible Services procured on our North network
- 5GWh of services utilised on our North network
- Potential for an additional 140MW of Services in the next 6 months
- 7 Reinforcement deferral CMZ submissions made for review



Constraint Managed Zones - Dispatch

- **Automated Dispatch**
- **Manual Process**

E-mail or Phone Call, further clarification will be provided during the tender/contract discussions.

- Service Instruction
- Availability Notification
- Unavailability Notification
- Cease Instruction



Verification and Settlement

- Service provider submits a performance report and application for payment
- SSEN verifies and raises Purchase Order (PO)
- Service provider submits invoice with PO and SSEN receipts
- PO is raised against the planned job or fault number
- Utilisation = MWh x £/MWh
- Availability = £/MW/day
- Storage Compensation = 10% of potential utilisation



CMZ Procurement Process

There are two phases to the CMZ procurement process:

Phase 1: Pre-Qualification (PQQ)

- Potential providers are invited to pre-qualify for the tender event. This ensures that only those with suitable assets are invited to tender. Generally open for four weeks.
- Notification of PQQ events are posted in the following places:
 1. Piclo website (<https://www.piclo.energy/>) – potential providers are encouraged to register their assets here to receive notification when a PQQ event is issued.
 2. SSE website (<https://sse.com/potential-suppliers/>) – PQQ documents available to download here
 3. OJEU Contract Notice publishing's
- All three provide details on the CMZ event and who to contact in order to participate

Phase 2: Invitation to Tender (ITT)

- Companies that pass the PQQ stage will be invited to tender
- Price will generally determine the order and frequency in which assets are utilised.



Visibility of Future CMZ

- Register on Piclo
- Connect on social media (Facebook, Twitter, LinkedIn)
- Visit our Website for further details

<https://www.ssen.co.uk/1connections/Flexible/>



Scottish & Southern
Electricity Networks 19

Islay CMZ

Inver Hydro

- 2MW installed capacity with 1 million m³ of storage capacity in reservoir
- Designed, owned and operated by Inver Hydro Ltd based in Argyll
- Inver Hydro supplied just under 5 GWh under the contract.
- Inver Hydro met approximately 2/5ths of the combined Islands' load when running at full power (2MW)



John Lithgow (Managing Director Inver Hydro Limited)

“The CMZ has certainly been a success. Of course there were some operational issues along the way but nothing to take the shine of what was a successful collaboration between Inver Hydro and SSEN, which ensured that together we kept the islands' lights on over the winter.”



Mark Wilson

Chief Executive Officer Intelligent Land Investments

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Intelligent Land Investments Group



Mark Wilson

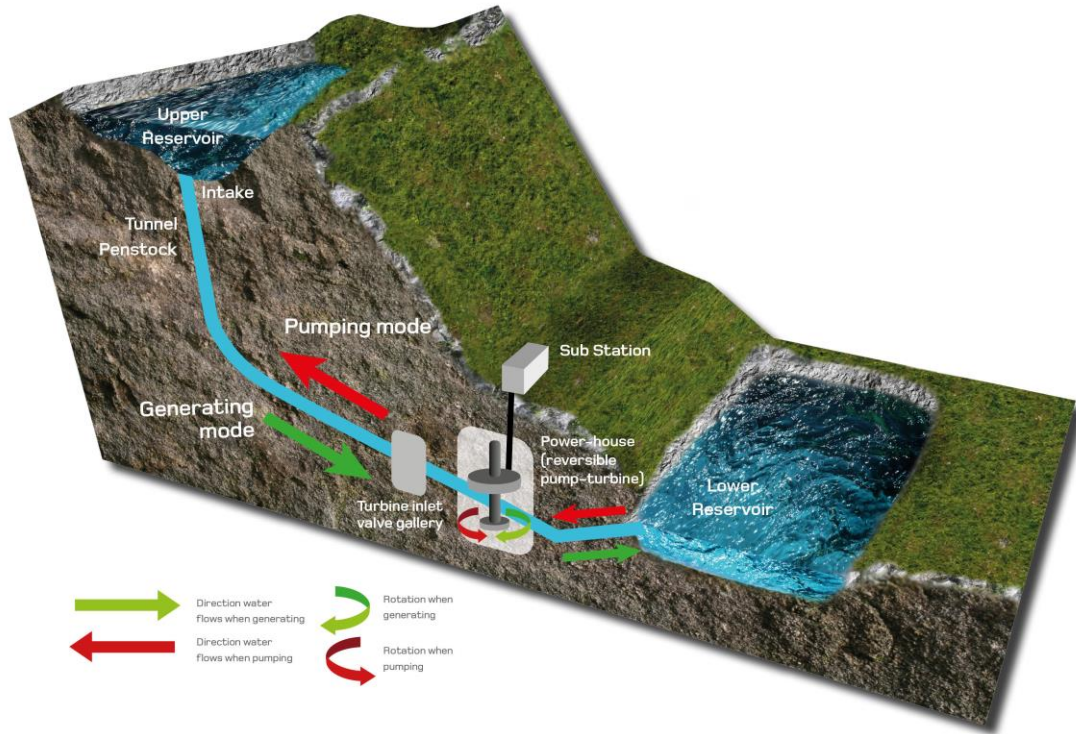
CEO

Presenting to

Scottish Renewables Hydro Conference

Thursday 28th of May 2020

What is Pump Storage Hydro?



PSH Background

- Over 46GW of renewables are now installed in the UK
- Increased demand for flexible capacity
- The most developed and largest capacity form of grid energy storage
- 95% of the world's energy storage provided by PSH
- 4.1GW of PSH capacity in the UK planning and development pipeline
- National Grid forecast up to 9GW of energy storage capacity required by 2030, and new 2050 NetZero targets will increase this need

Carbon Trust - Imperial College

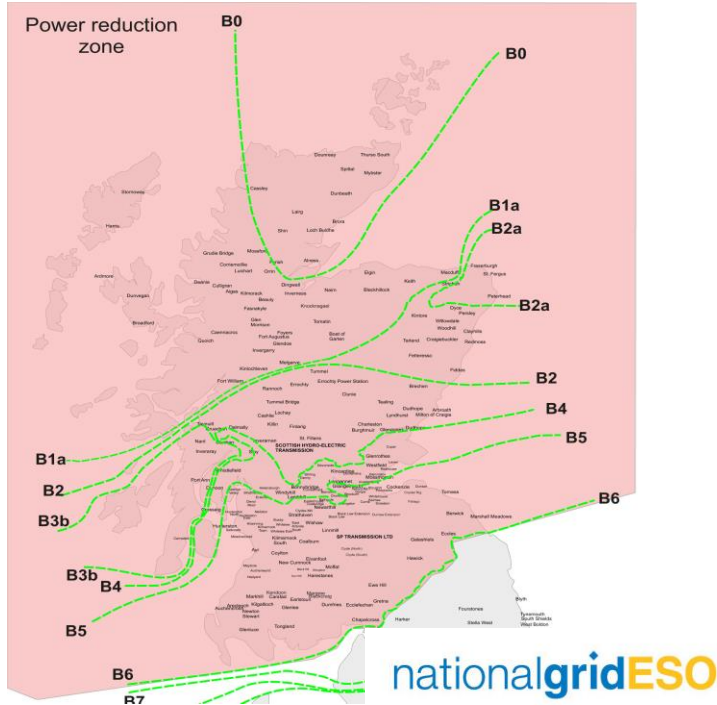
- Potential savings of up to £2.4 billion per annum by installing around 6GW of additional storage capacity
- Consumers could save an estimated £100 per year
- An additional £5 billion per annum could be saved by better optimisation of the power system utilising storage

Benefits of PSH

- It is a proven, reliable technology, available at large scale, with an asset life of 100+ years
- Cheapest cost option for longer term storage (>4hrs). Recent analysis shows; Strategy for Long-Term Energy Storage in the UK, notes a cost per MWh of £64 (Hydrogen, £102; Liquid Air, £128, LI Battery, £192)
- Analysis also notes that combining 10GW of PSH by 2050 with Hydrogen can provide necessary long-term storage at cheapest cost option to meet net zero
- Biggest projects can provide power back-up for several days
- It will provide long-term energy security for the UK and reduce reliance on interconnectors
- 70% of PSH Capex is construction. Several hundred jobs created. Money stays in the UK economy
- Provides a suite of balancing services to the system operator, including: black start, inertia, frequency response, reserve and reactive power and reducing network constraints



Scotland Transmission System Boundaries of Focus

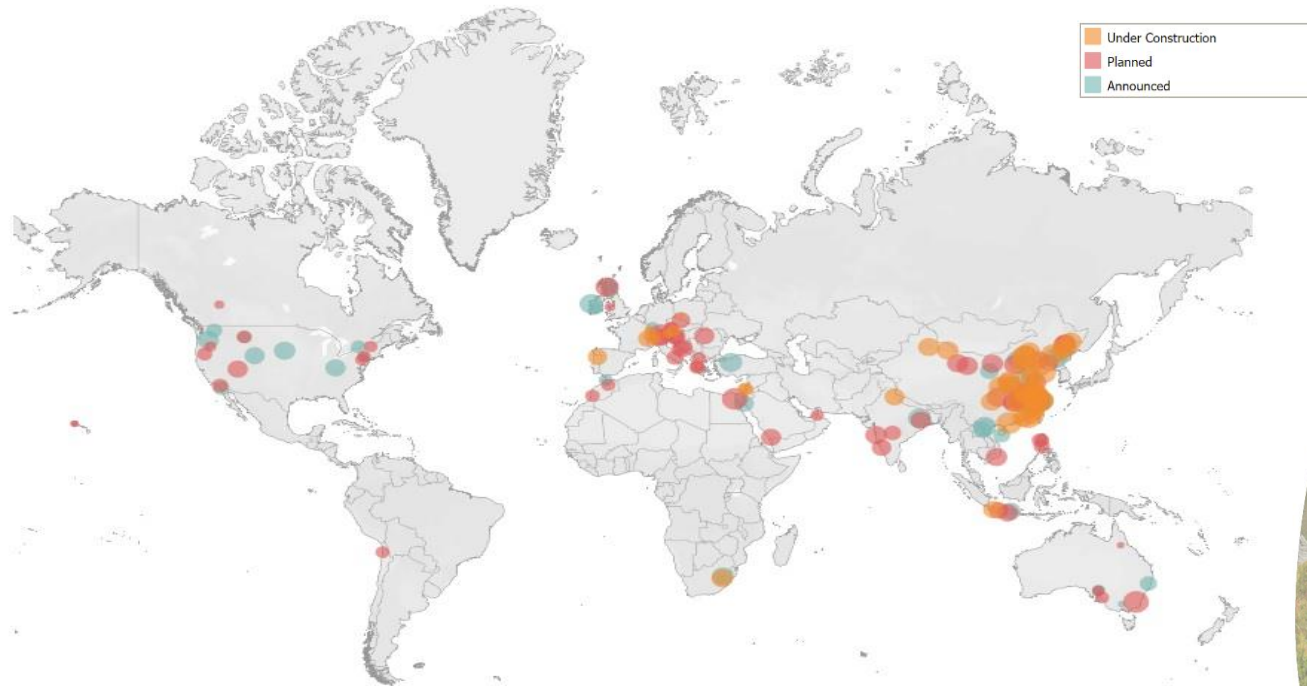


- Due to high penetration of wind, the Scottish transmission system has significant power flow and stability constraints
- The Electricity System Operator is looking for solutions.
- PSH in Scotland is well placed to provide ancillary services to address these constraints.

Policy Reform

- **The key for PSH is some form of guaranteed revenue stream to secure lower cost financing**
- PSH revenues will come from markets for wholesale electricity, ancillary services and capacity.
- These markets are becoming more focused on short--term price signals rather than longer term signals needed for large scale new infrastructure
- This could include longer term ancillary market contract, such as Constraints management (say 10 years)
- For interconnector projects, a cap and floor model is available. This could therefore be applied to technologies that can offer long term storage like PSH.

International Hydro Association PSH Map



The current need for PSH

- the current lockdown and low electricity demand is giving us a glimpse into the future, where the electricity production is dominated by renewables
- on Sunday afternoon May 24th we saw carbon emissions from electricity fall to 18g/kWh, a new low and record for the UK
- at the same time electricity prices fell to -£60/MWh because there was little flexible generation
- low cost renewable generators were paid not to run in order to secure system stability, incurring additional balancing costs
- additional flexible pumped storage generation would have allowed more renewable generation to run and reduced the costs of balancing

Thank you

Mark Wilson
CEO

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Intelligent
Land Investments
GROUP



Alastair Martin

Founder and CSO
Flexitricity

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Flexing small hydro

Fantastic new revenue opportunities
and how to actually find them

Flexitricity 

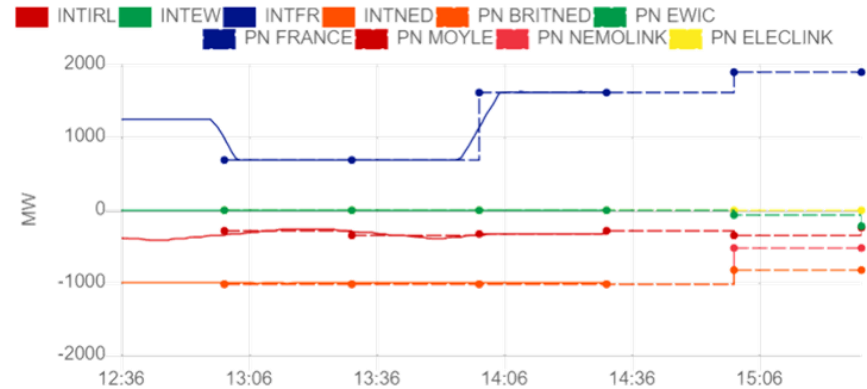
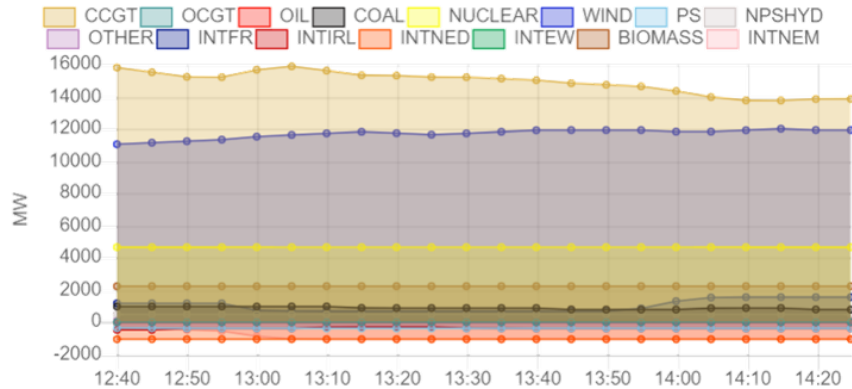
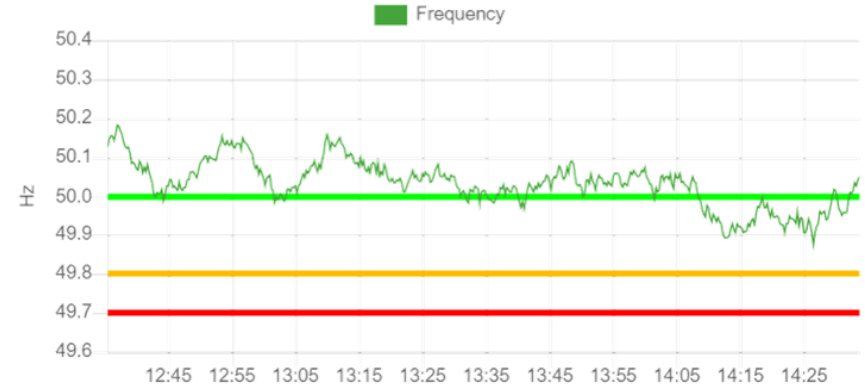
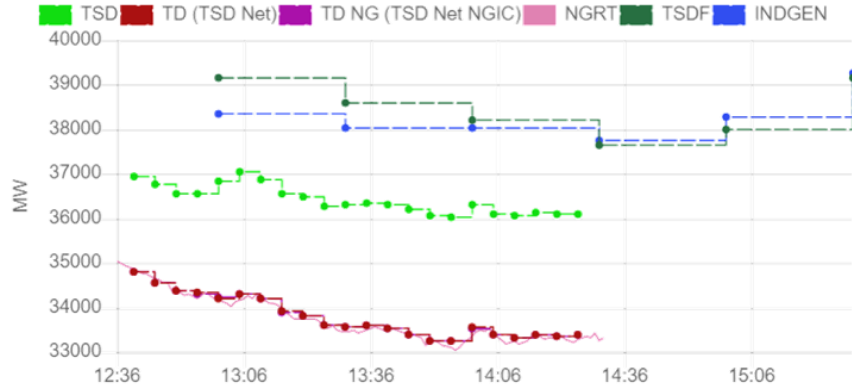
Flexitricity in a nutshell

- First, largest and most diverse **demand response aggregator**
- First energy supplier to bring a DSR asset into the **Balancing Mechanism**
- **11,000+** demand response events
- **24-hour** operations
- Fully **automated**
- <1s to 30m response
- Flexible load, CHP, hydro, energy storage, UPS, standby
- **Positive and negative reserve**
- Industrial, commercial, public sector

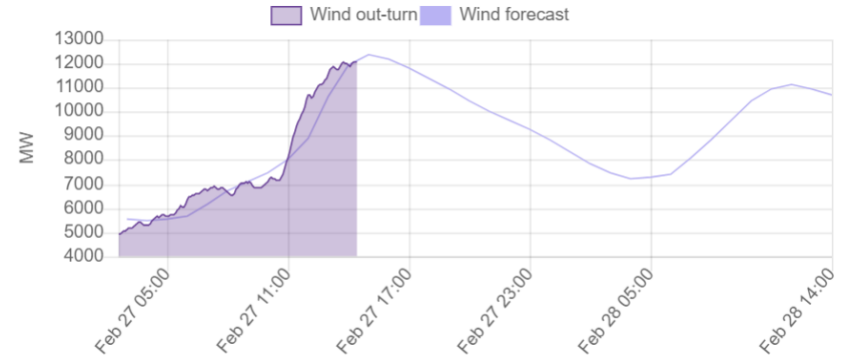
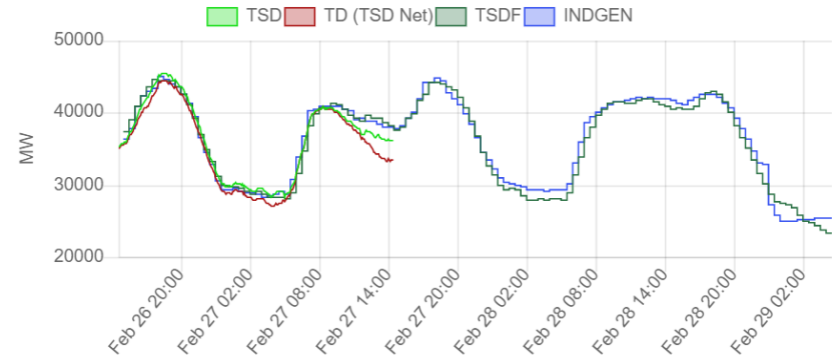
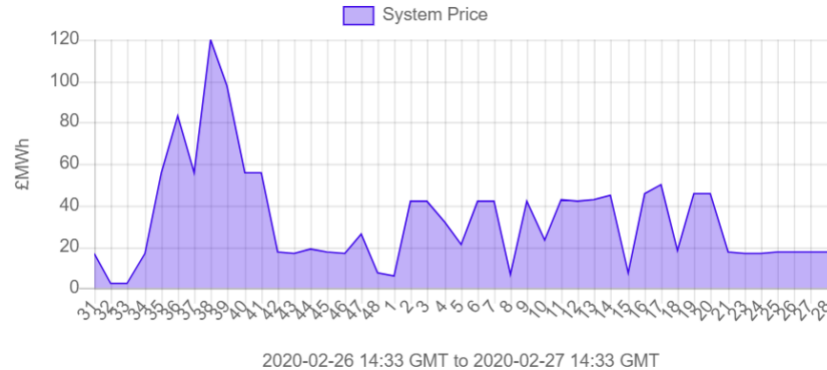
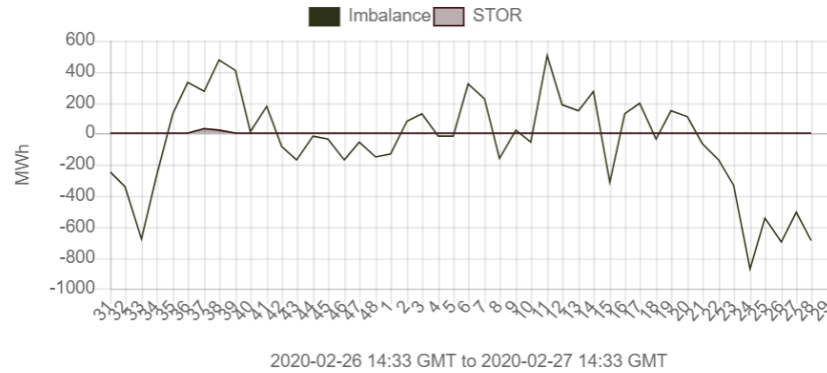


**Flexitricity**

Life in the Flexitricity control room



Life in the Flexitricity control room



Horticulture – Rainbow Growers



CHP – Thamesway Central Milton Keynes



Flexible load – Norish



Standby generation – Rotherham MBC



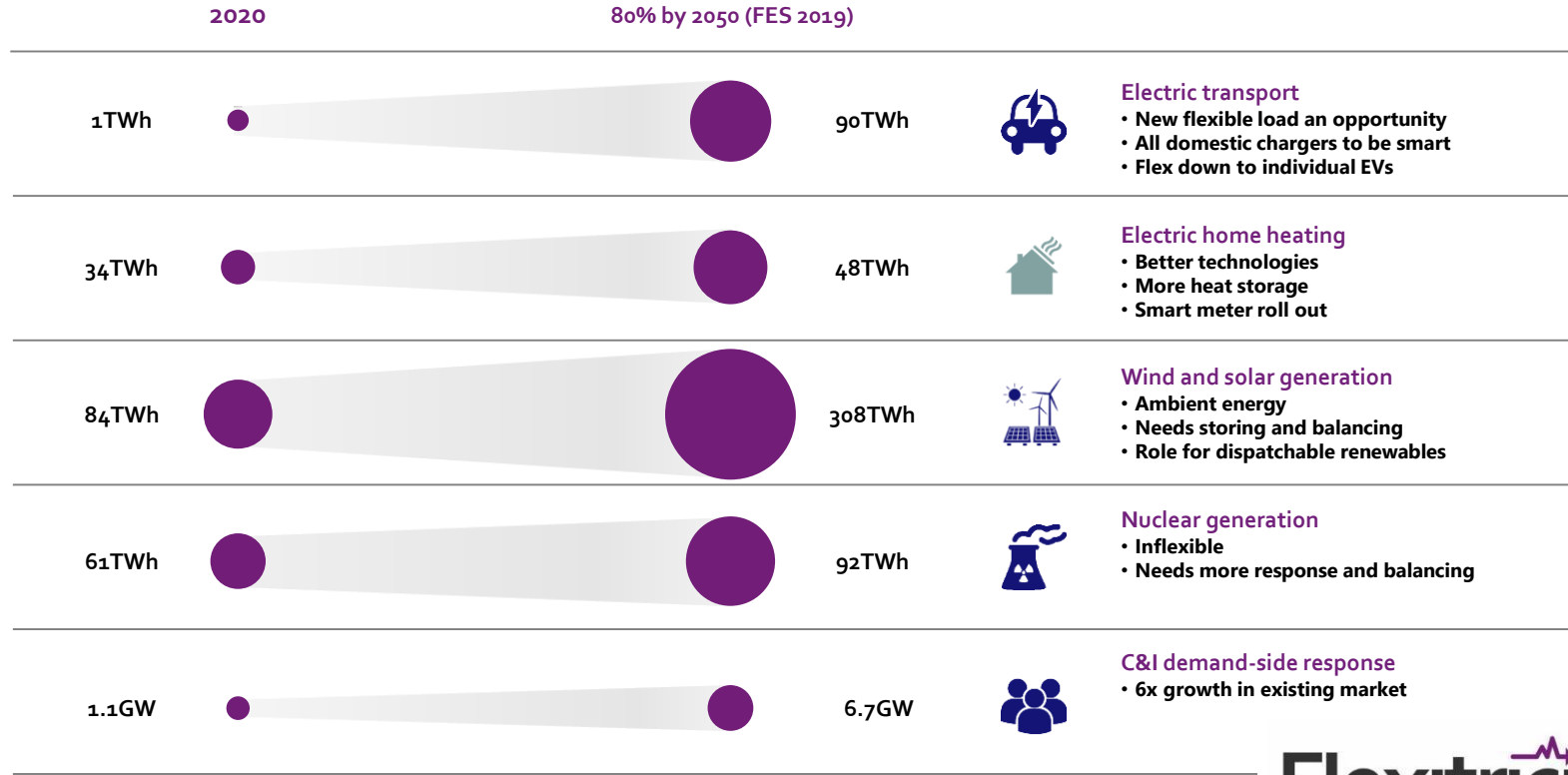
CHP – The University of Edinburgh



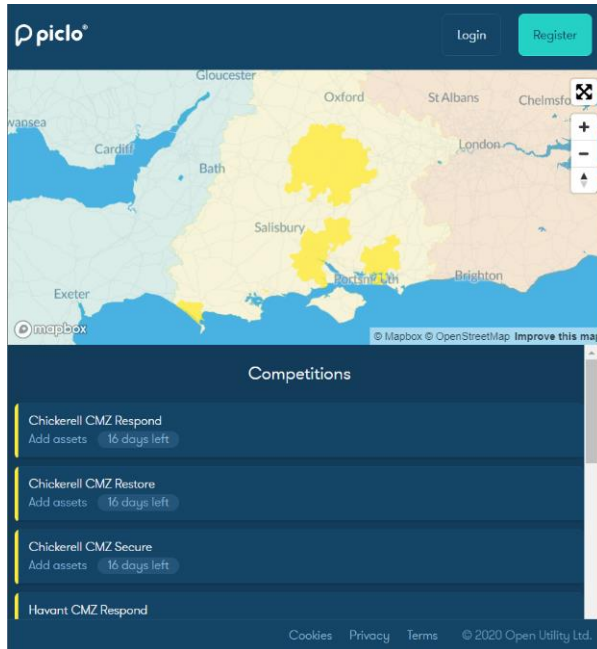
CHP – Aberdeen Heat & Power



Flexibility is the pathway to zero carbon



Source: Great Britain market - National Grid ESO, Future Energy Scenario, 2019



Distribution (local)

- Regional monopolies
- Several platforms
- Becoming more active



System Balancing, Transmission

- One GB system operator
- Well-established markets
- Constantly evolving



Interconnectors (transnational)

- Arrangements settled
- Implementation pending

Flexitricity

How electricity works

Forward trading

Day-ahead auctions

Intraday trading

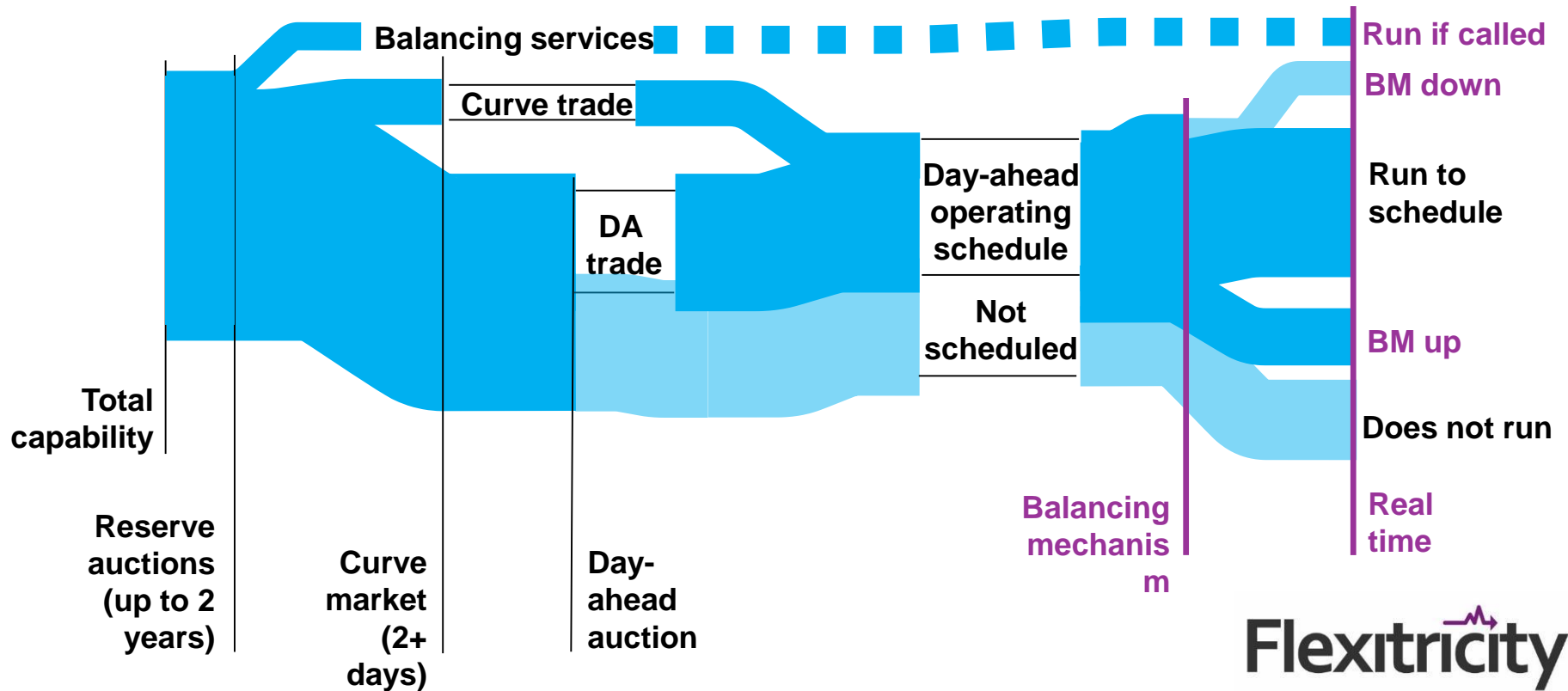
The Gate



Balancing Mechanism

**Flexitricity**

Flexibility: from forward planning to real time



BOA Stack

BETA

27-05-2020



24

Submit

Reset Form

Reset Sort

Bids Below FPN

BM Unit ID	Fuel Type	Zone	PN	SEL	BOP	Bid Price	Bid Level	Bid Volume
T_WBURB-1	CCGT	Z16	414	150	-1	5.26	-170	-22.0
T_WBURB-3	CCGT	Z16	405	197	-1	5.26	-170	-17.5
T_PEMB-21	CCGT	Z12	434	219	-1	5.05	-216	-67.0
T_SCCL-3	CCGT	Z11	380	250	-1	0.55	-140	-65.0
T_KEADGT-3	OCGT	Z11	0	20	-1	42.50	-100	
T_SEEL-1	OCGT	Z16	0	275	-1	40.00	-1	
2_BUKPR001	OTHER THERMAL		0	60	-1	30.00	-60	
E_MORFL-1	OTHER THERMAL		0	19	-1	25.00	-40	
E_SEVINGTN	OCGT	Z15	0	7	-1	20.00	-10	
E_LSTWY-1	OTHER THERMAL	Z12	0	6	-1	17.00	-20	
E_TDRVE-1	OTHER THERMAL	Z13	0	3	-1	17.00	-20	
E_TRFPK-1	OTHER THERMAL	Z17	0	7	-1	17.00	-20	
E_WTRLN-1	OTHER THERMAL	Z13	0	9	-1	17.00	-20	
2_LSTAT001	OTHER		0	2	-1	16.70	-20	
E_SUDME-1	OTHER THERMAL	Z12	0	20	-1	16.00	-40	
E_DBFM-1	OTHER THERMAL		0	19	-1	15.00	-20	
E_LCHWT-1	OTHER THERMAL	ZX	0	7	-1	15.00	-20	
E_RAKE-1	OTHER THERMAL		0	20	-1	15.00	-20	
E_RDFRD-1	OTHER THERMAL	Z16	0	10	-1	15.00	-40	

Offers Above FPN

BM Unit ID	Fuel Type	Zone	PN	MEL	BOP	Offer Price	Offer Level	Offer Volume
T_SVRP-10	CCGT	Z12	0	391	1	36.00	420	175
T_HUMR-1	CCGT	Z11	898	1,197	1	38.00	1	0.333
T_HUMR-1	CCGT	Z11	898	1,197	2	38.00	170	15.7
T_SEAB-1	CCGT	Z12	0	742	1	41.99	900	281
T_CARR-2	CCGT	Z8	0	434	1	42.00	405	141
V_LFLEX001	OTHER		-4	1	1	47.23	4	1.50
2_LSTAT001	OTHER		0	18	1	47.95	20	6.60
E_ALCOA-1	OTHER THERMAL	Z12	0	39	1	47.95	40	14.6
E_RDFRD-1	OTHER THERMAL	Z16	0	20	1	48.65	40	7.33
E_RDFRB-1	OTHER THERMAL	Z16	0	19	1	48.65	40	6.97
2_NANGE001	OTHER		0	12	1	49.00	12	3.10
2_MFLEX001	OTHER		2	4	1	49.50	2	0.350
2_FFLEX001	OTHER		1	3	1	49.50	2	0.383
2_AFLEX001	OTHER		1	3	1	49.50	3	0.383
2_EFLEX002	OTHER		0	11	1	49.50	11	2.57
T_COSO-1	CCGT	Z15	0	350	1	35.75	350	
T_SPLN-1	CCGT	Z16	0	400	1	35.75	400	
T_CARR-1	CCGT	Z8	0	434	1	40.00	405	
T_KEAD-1	CCGT	Z11	0	734	1	40.00	900	

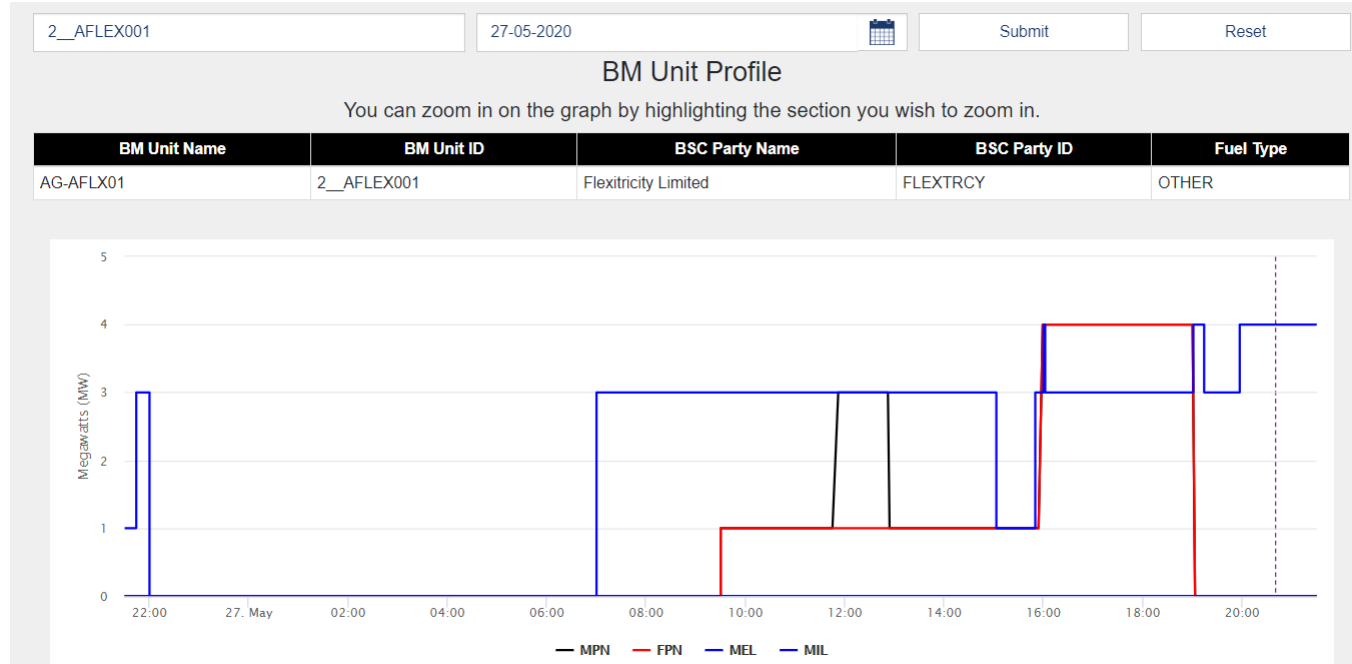
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Status:



Embedded generation in the BM



Renewables – can they participate in the BM?

Ambient renewables

- Wind turndown is well established
 - Solar also involved
- Price of turndown reflects lost ROC etc
- Deployed for:
 - Transmission system constraints
 - Low demand
 - Manual frequency balancing
- Not actually what we want to do!
 - Throwing away free energy
 - But it will be a valid tool in a zero-carbon system

Hydro with storage

- Positive and negative balancing
- Ad-hoc provision
 - Available flexibility revised every 30 minutes
- Preventing energy loss
 - Requires reservoir monitoring
 - Requires real-time optimisation
- PPA and BM are compatible
 - Virtual Lead Party
 - Supplier active in the BM
 - Both

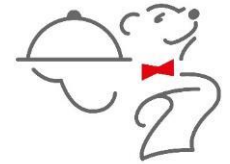


What on earth is a Virtual Lead Party?

- Balancing Mechanism Wider Access
 - Enter the BM without changing supplier / PPA provider
 - VLP manages the flexibility
- Assign the tasks to the right skillsets
 - PPAs closely tied to financing
 - Hedged suppliers often trade up to day-ahead
 - You need a control room to do flexibility
 - We've got one
- Collaboration is good
 - Best outcome when VLP and PPA provider co-operate
 - With collaboration, intraday market is also open

“This transformation is central to the way we balance the system today – particularly as we work to meet some of the challenges associated with balancing the system in lockdown conditions – and forms an important part of being able to operate carbon free by 2025.”

Roisin Quinn, Head of National Control at National Grid ESO



**PHILIP DENNIS
FOODSERVICE**

Feeding your passion



Flexitricity

The market has changed

- Flexibility options that protect yield
 - Better than STOR
 - More realistic than frequency response
 - Better designed than DTU
 - Firmly embedded in market structure
- Flexible flexibility
 - Can step out and in as required
- Future-proof
 - The five worlds of DSO
 - Interconnectors and TERRE
 - Central to net zero





Flexitricity overview

From our 24-hour control room in Edinburgh, Flexitricity runs the most complete set of demand response services in the industry.

Flexitricity brings revenue to British businesses, increase asset reliability, reduce national CO₂ emissions and helps to secure energy supplies.

We are Britain's demand-response leader.

Sarah-Jane McArthur
Partner
Brodies LLP

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HYDRO – EXPLORING OPPORTUNITIES

Sarah-Jane McArthur, Partner, Brodies LLP
28 May 2020



ENLIGHTENED THINKING

- **Context**
- **Cost reduction opportunities**
- **Revenue increase opportunities**
- **Final thoughts**

- Previous FIT support = unprecedented number of small scale hydro schemes
- FIT is now closed to new schemes and without subsidy deployment levels are likely to be low.
- Options to reduce costs/ improve revenues will only work for some schemes in some locations. We need to be realistic.
- Can we maintain deployment above pre-FIT level?



- Hydro is a long-term asset and therefore needs long-term investors.
- Reduced tariff levels may not achieve hurdle rates for some investors
- Who might be interested:
 - Institutional funds – but might need separate construction finance and likely to need aggregation
 - High net worth individuals and family offices – likely to need an investment vehicle
 - Landowner – access to cheaper secured debt
 - Community investment – but also potential to increase delivery cost
 - Scottish National Investment Bank?

- Grid sharing arrangements
 - can reduce overall grid costs
 - access existing spare capacity
 - share new infrastructure with other developers
- BUT
 - needs careful structuring considering control and access
 - increases complexity for PPA and metering arrangements
- ICP for contestable works

- If we don't sort this issue then the outlook is bleak even with subsidy.
- Current position: the lobbying continues
 - Currently 60% relief available for most schemes subject to state aid restrictions
 - Reliefs are not a viable long-term solution.
 - Tretton Review conclusion was not to change the rules but to continue reliefs.
 - Further engagement with Scottish Government is planned to explore potential solutions notwithstanding the outcome of the review.
- Note Community Business Rates Relief for renewables projects - Up to 100% reduction available if community has a right to:
 - At least 15% of the annual profit; or
 - Annual profit attributable to at least 0.5MW of installed capacity
- Note neither relief applies to pumped storage schemes.

- Can we go bigger?
 - Were schemes artificially restricted for FIT?
 - Can you extend?
 - Access to the CfD >5MW
- Co-location – storage or complementary technologies
 - Reduce proportionate infrastructure costs
 - Improve overall yields
 - Maximising export over constrained grid/ through downtime
 - Potential to access different types of revenue – ancillary services, capacity market

- Corporate PPAs
- Private wire connection to local demand – community or business
- Peer to Peer Energy
- Ancillary Services/ Capacity Market

FINAL THOUGHTS

- I am an eternal optimist but acknowledge the need to be realistic
- Projects still have options to explore
- BUT only available to some projects in some locations – won't work for all
- Still some fundamental hurdles to overcome
- We need to be clear on what a sustainable future for the sector looks like and how hydro fits in to a net zero landscape

HYDRO – EXPLORING OPPORTUNITIES

Sarah-Jane McArthur, Partner, Brodies LLP
28 May 2020



ENLIGHTENED THINKING



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