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Scottish & Southern  
Electricity Networks



# HYDRO CONFERENCE & EXHIBITION

6 JUNE 2017 PERTH

**GILKES**  
Hydro

 **TEXO Drone**  
Survey & Inspection Ltd



# **HYDRO'S PLACE IN SCOTLAND'S ENERGY SYSTEM**

**CHAIR:**

**JENNY HOGAN**

**SCOTTISH RENEWABLES**






**ALEX READING**  
**DEVELOPMENT DIRECTOR**  
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**DIRECTOR**  
**HIGHLAND ECO DESIGN**



**SUE KEARNS**  
**DEPUTY DIRECTOR, ENERGY DEPLOYMENT**  
**SCOTTISH GOVERNMENT**



**SEAN KELLY**  
**PROJECT MANAGER**  
**SSE**

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**INCOME AND EXPENDITURE: NAVIGATING PROJECT  
COSTS AND ASSESSING REVENUE OPPORTUNITIES**

**CHAIR:**

**MICHAEL RIELEY**

**SCOTTISH RENEWABLES**





**SARAH-JANE MCARTHUR**

**PARTNER**

**BRODIES**





# Hydro – Future Opportunities

Sarah-Jane McArthur | 06 June 2017

## Important Disclaimer

**This presentation has not been independently audited or adjusted for the presenter's optimism bias.**

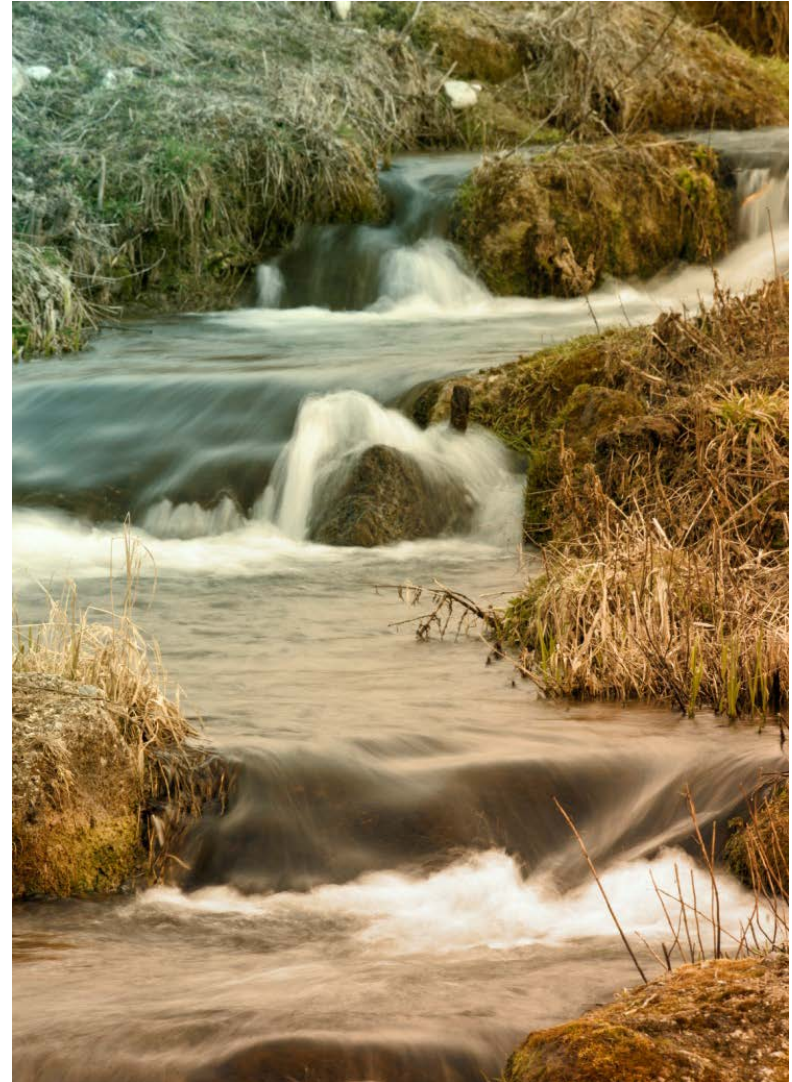
# Outline

- Scene setting
- Cost reduction opportunities
- Revenue increase opportunities
- Final thoughts



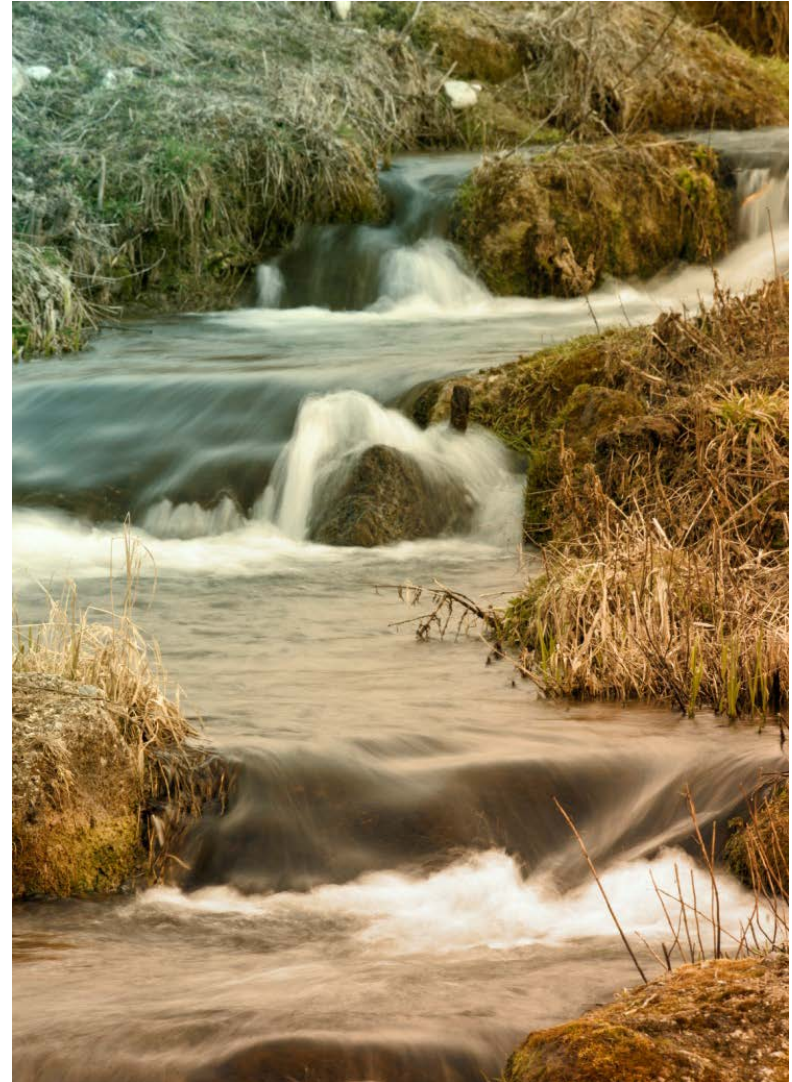
# The hydro landscape

- Previous FIT support = unprecedented number of small scale hydro schemes
- Bulk of pre-accredited schemes now completed.
- FIT review has led to large tariff cuts
- Current tariffs do not appear to be supporting new schemes
- Can projects still work? Can we maintain deployment above pre-FIT level.



# Policy Backdrop

- Energy Strategy
  - hydro v hydrogen
  - “local energy”
  - storage
- Manifesto Watch
- Energy Policy – Big Picture



# Finance Options

- 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
  - Bank lenders – with the right structure
  - Renewable Energy Bonds?
- What about communities?



# Grid

- Grid sharing arrangements – reducing overall grid costs
  - Accessing existing spare capacity
  - New private networks with other developers
  - Structuring
  - Control and access Issues
  - Impact on PPA and metering arrangements
- Off-grid private wire options
- ICP for contestable works

# Communities

- Shared Ownership options
  - Joint Venture – Community holding shares in the project vehicle
  - Split Ownership – Project split into two independent parts
  - Shared Revenue – Community buys a share of profit
- Potential for increased upfront costs to put structure in place.
- Community finance options
- Business Rates Relief - Up to 100% reduction available if community has a right to:
  - At least 15% of the annual profit; or
  - Annual profit attributable to 1MW of installed capacity (or more)

# Scale and Co-location

- Can we go bigger?
  - Were schemes artificially restricted?
  - Can you extend?
- 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

# Revenues

- Corporate PPAs
- Government PPA?
- Private wire connection to local demand – community or business
- Peer to Peer Energy

# Final thoughts

- I am an eternal optimist
- “I ATE’NT DEAD”
- Projects still have options to explore
- Working with communities may bring wider benefits
- Alternative revenue structures may be possible
- What does a sustainable future look like?





**NICHOLAS BLAIR**  
**CONTRACTS MANAGER**  
**NATIONAL GRID**

# Ancillary Services Markets and Opportunities nationalgrid

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Nick Blair – Contracts Manager, Commercial - Electricity

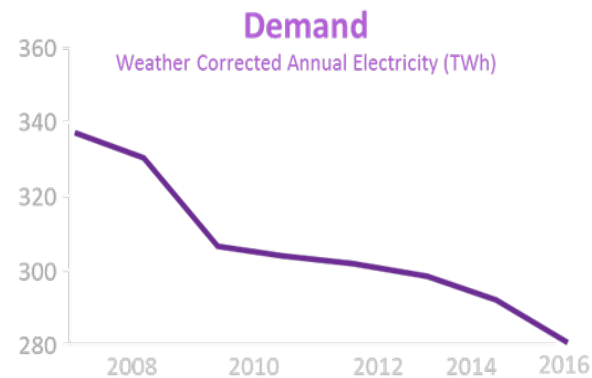
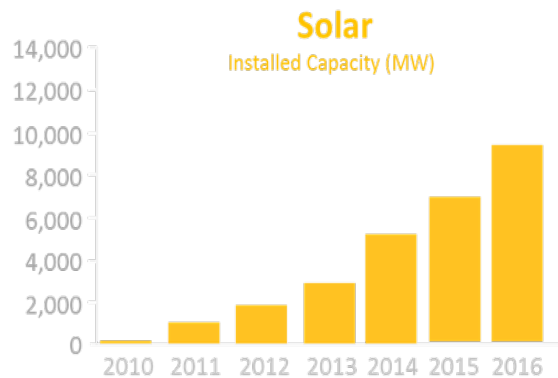
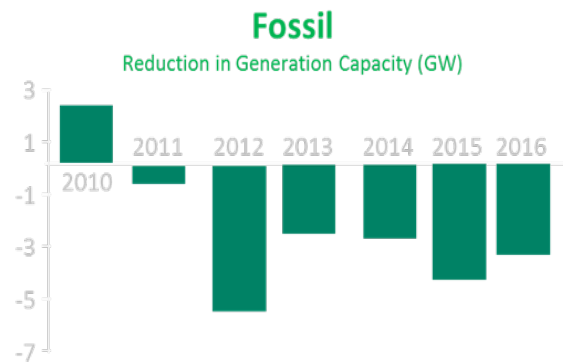
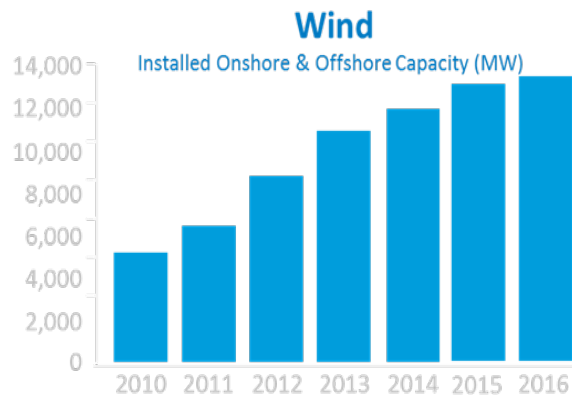
# Contents

- Changing Landscape
- Technology Solutions
- Opportunities
- NG Initiatives
- Contact Details

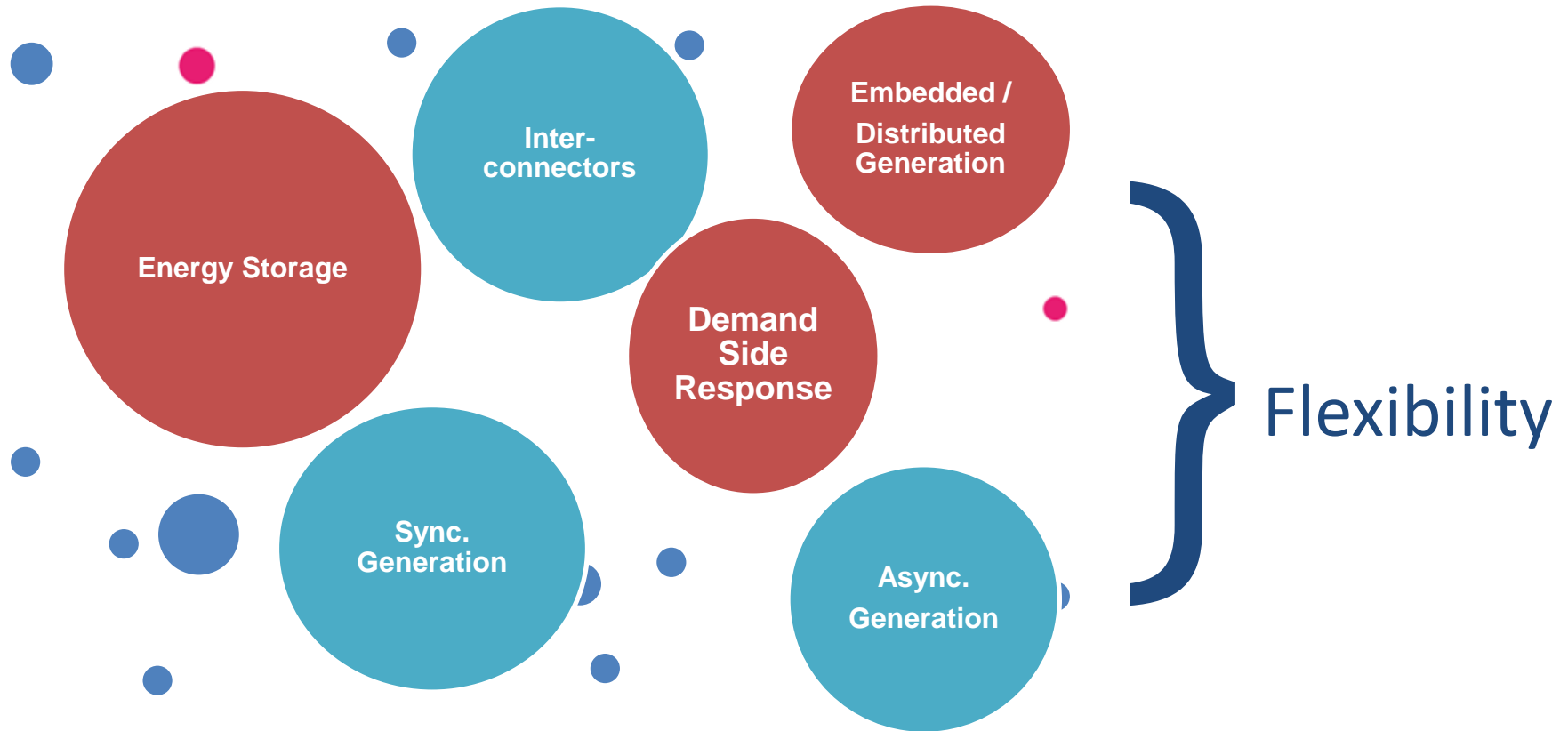




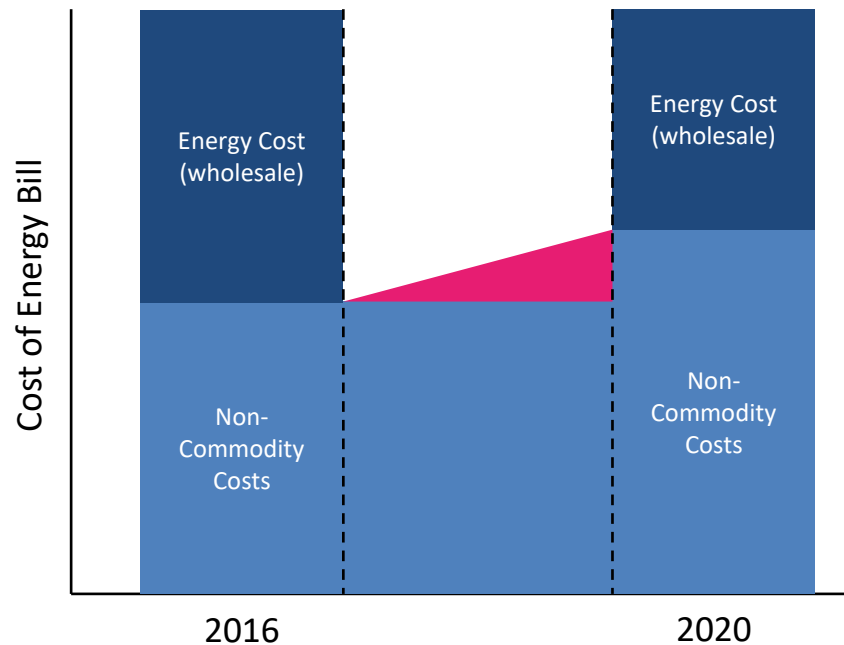
# Changing GB Electricity Landscape



# A range of technologies contribute to the solution



# What is the hydro perspective?



## Potential Benefits



**Cost Savings** – optimisation pumping profiles to times of low cost.



**Revenue Potential** - Schemes to reduce, increase, shift usage to a given signal have revenue available to earn



**Low Carbon System** - Offering flexibility of existing assets helps manage a low-carbon, majority renewable energy system

# What are the opportunities?

Wholesale/Energy

Triad Avoidance

Red Zone Management

Wholesale/Energy Market

Balancing

Frequency Response

Firm Frequency Response (FFR)/Bridging  
Enhanced Frequency Response (EFR)  
FCDM

Reserve

Short Term Operating Reserve  
Demand Turn-up (DTU)  
Fast Reserve

Local DNO trials ongoing

Capacity

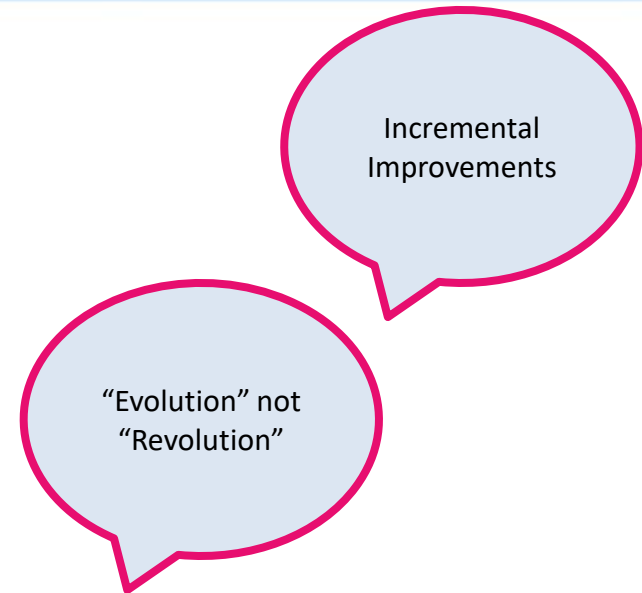
Capacity Mechanism

Transitional Arrangements  
Capacity Market





1	Customer Engagement: Raising Awareness & Clarity
2	Increasing Confidence in Flexibility
3	Evolution of Flexibility Markets



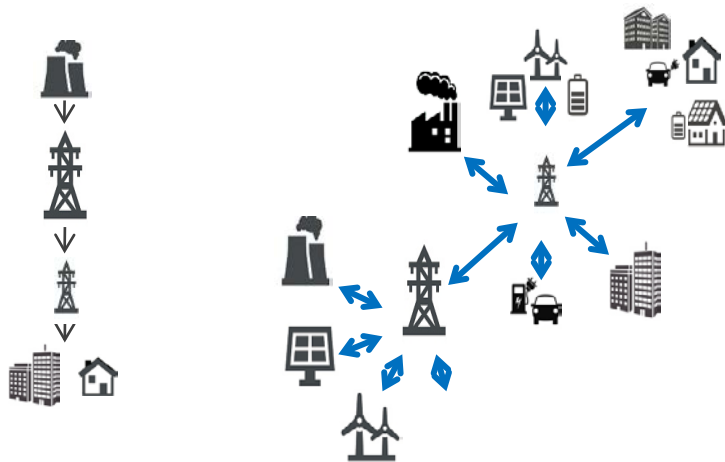
Improving Market Information

Simplifying Services

# Flexibility Programme (Future Role of SO)

Yesterday

Future System – increased interactions



- **Key outcome: Contributes to the creation of markets which allow all participants to effectively purchase what they need at minimum cost and deliver social welfare equilibrium**

Four areas of delivery

Information Provision

Shared services framework

Simplify product

Structural market change

# Contacts

- **Power Responsive Programme:**  
[www.powerresponsive.com](http://www.powerresponsive.com)

**LinkedIn:**  
Power Responsive

**For National Grid service opportunities:**  
[commercial.operation@nationalgrid.com](mailto:commercial.operation@nationalgrid.com)





**MARC SMEED**  
**PRINCIPAL CONSULTANT**  
**XERO ENERGY**



# GRID CHARGING

MARC SMEED



## AGENDA

Developing themes

TLMs – P350 impact

Embedded benefits

NGET wider review

Ofgem TCR / CCG

ENA TSO/DSO workstream

## Usual sorts of issues...

- Capacity!!! **Where is it?**
- Queue management
- Grid costs
- Underwriting
- Programme
- Grid costs (again).
- Technical req's

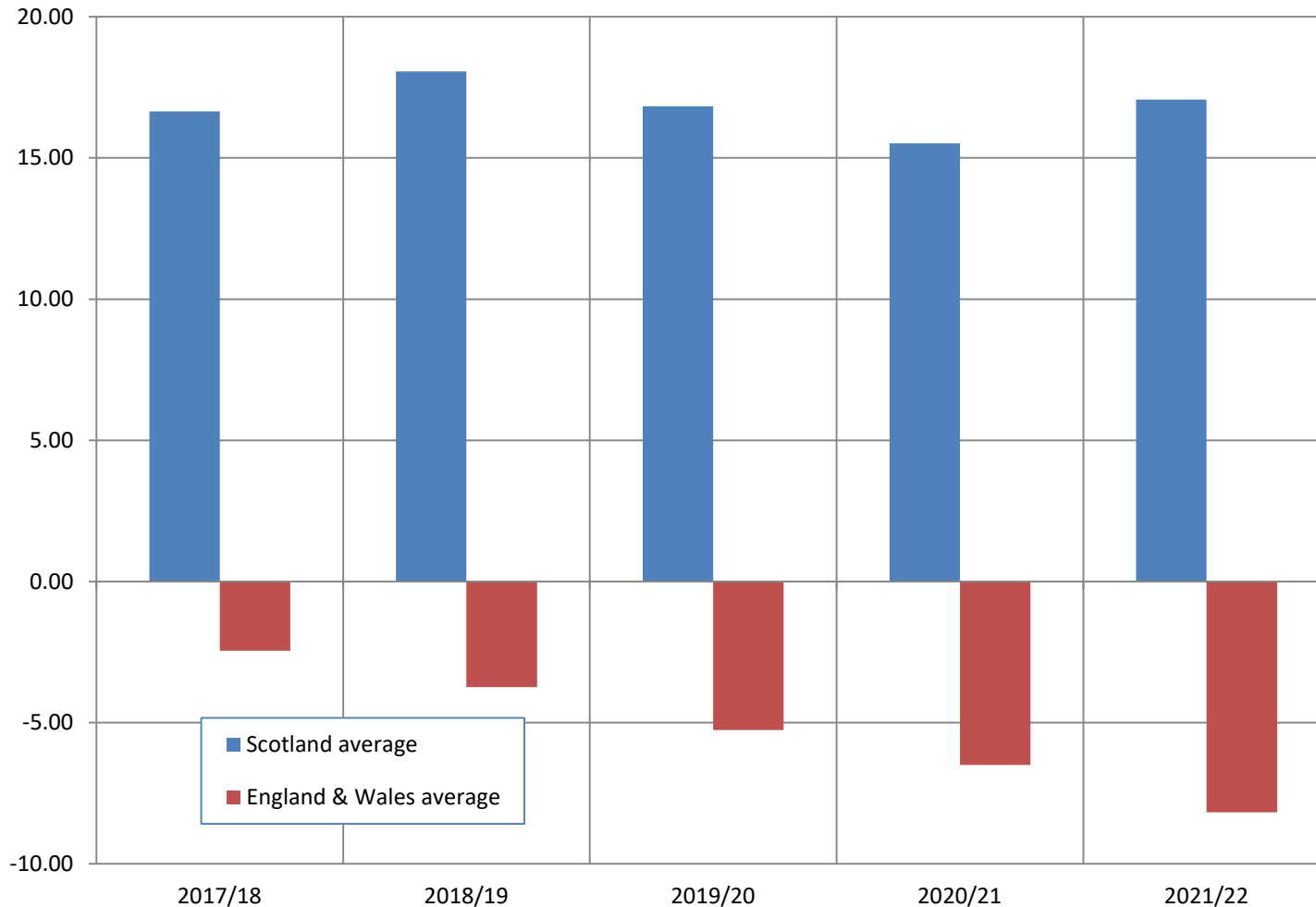
## But also a few new ones...

- Co-location
- Capacity sharing
- DSOs
- Flexibility market
- Behind the meter
- Micro grids

- Balancing and ancillary services only part of the picture.
- Market for new energy projects will be based on a cord of 3 strands
  - Energy
  - Capacity
  - **Flexibility**
- Current system – the energy market dominates.
- Case for future investment are likely to be more balanced across all three.



### Wider Tariffs for an Intermittent 40% Generator (£/kW)



What about 2022+?

XE long term forecast out to 2040

DNO region	Average UoS for 10MW generator (£/yr)
South West	4,546.97
South Wales	3,679.72
West Midlands	3,538.42
Eastern Power Network	2,872.44
London Power Network	1,664.99
Southern Power Network	2,138.57
Electricity Northwest	12,212.89
SP Manweb	8,620.89
SP Distribution	46,789.96
Southern Electricity Power Distribution	4,734.90
Scottish Hydro Electricity Power Distribution	12,120.36
Northeast	9,558.51
Yorkshire	8,902.39
East Midlands	3,522.45

## AGENDA

Developing themes

TLMs – P350 impact

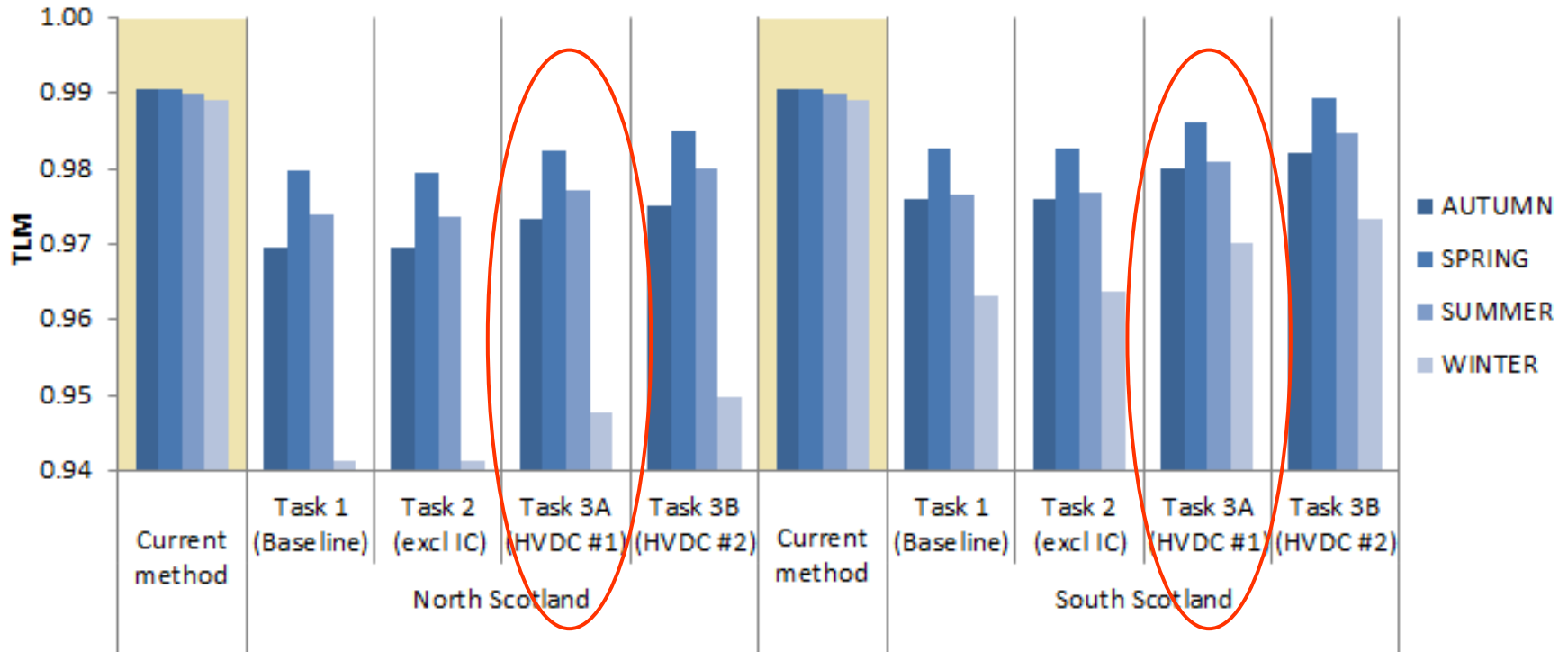
Embedded benefits

NGET wider review

Ofgem TCR / CCG

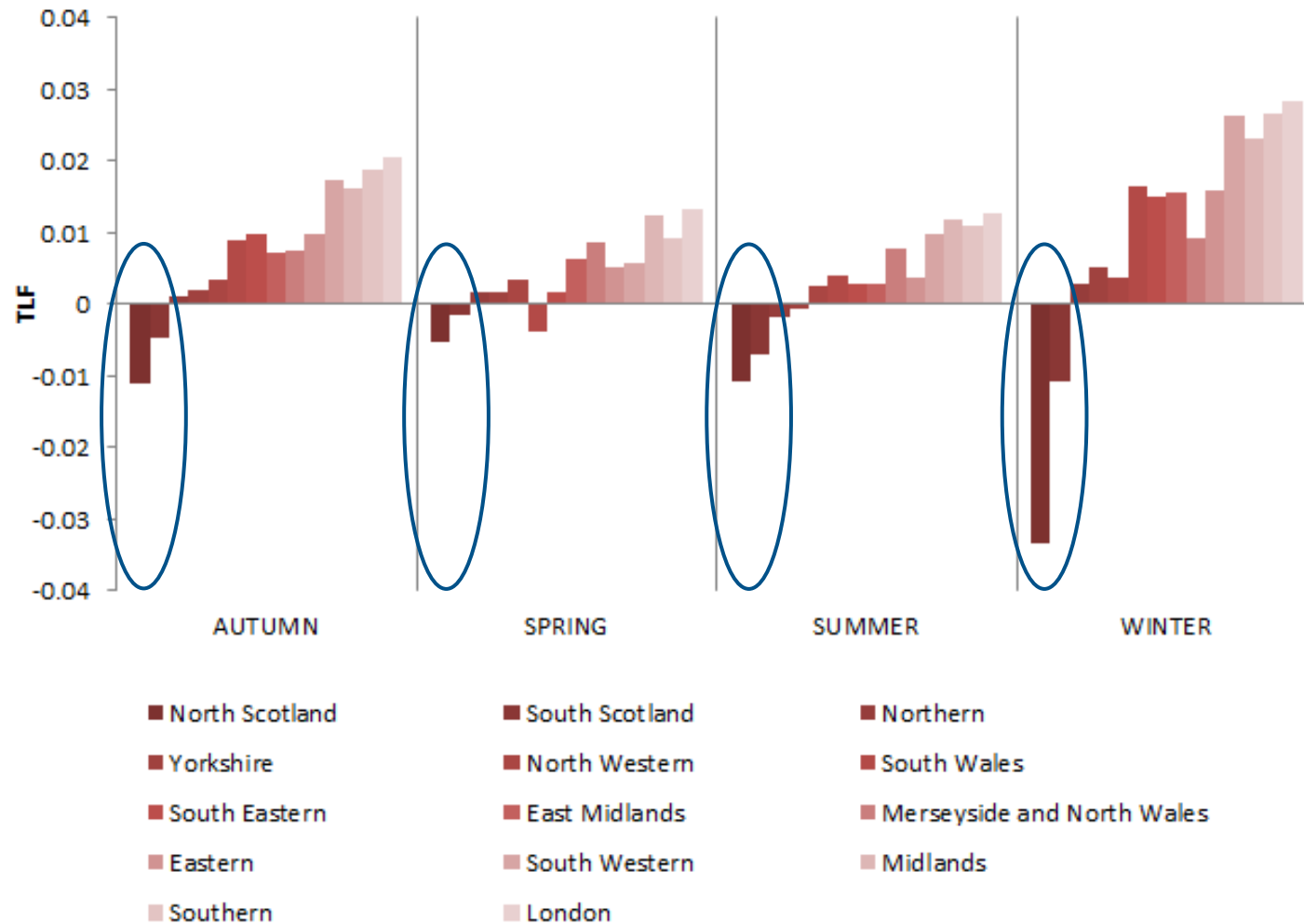
ENA TSO/DSO workstream

Average TLM (01Jun15 - 31May16)

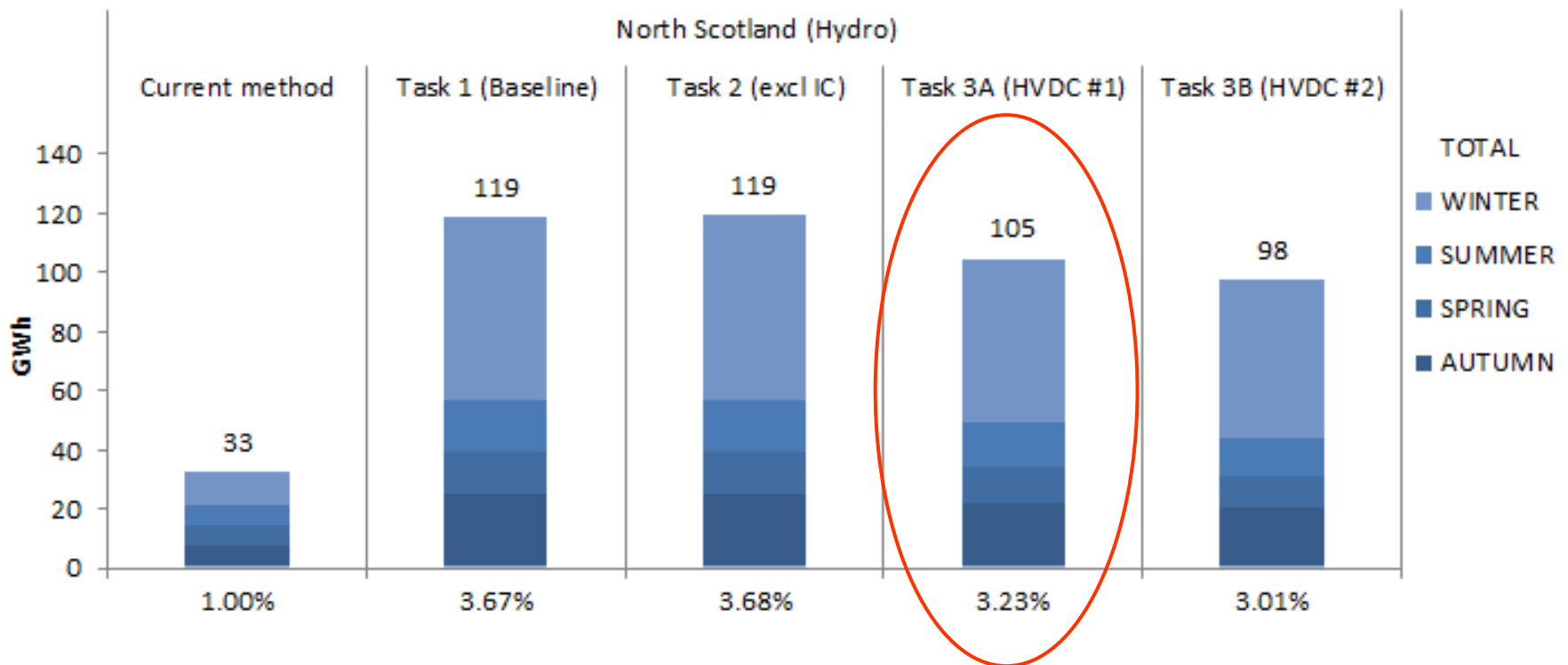




Calculated TLF values, Task 3A (01Jun15 - 31Mar16)



## Volumes netted from Transmission connected hydro (01Jun15 - 31May16)



## AGENDA

Developing themes

TLMs – P350 impact

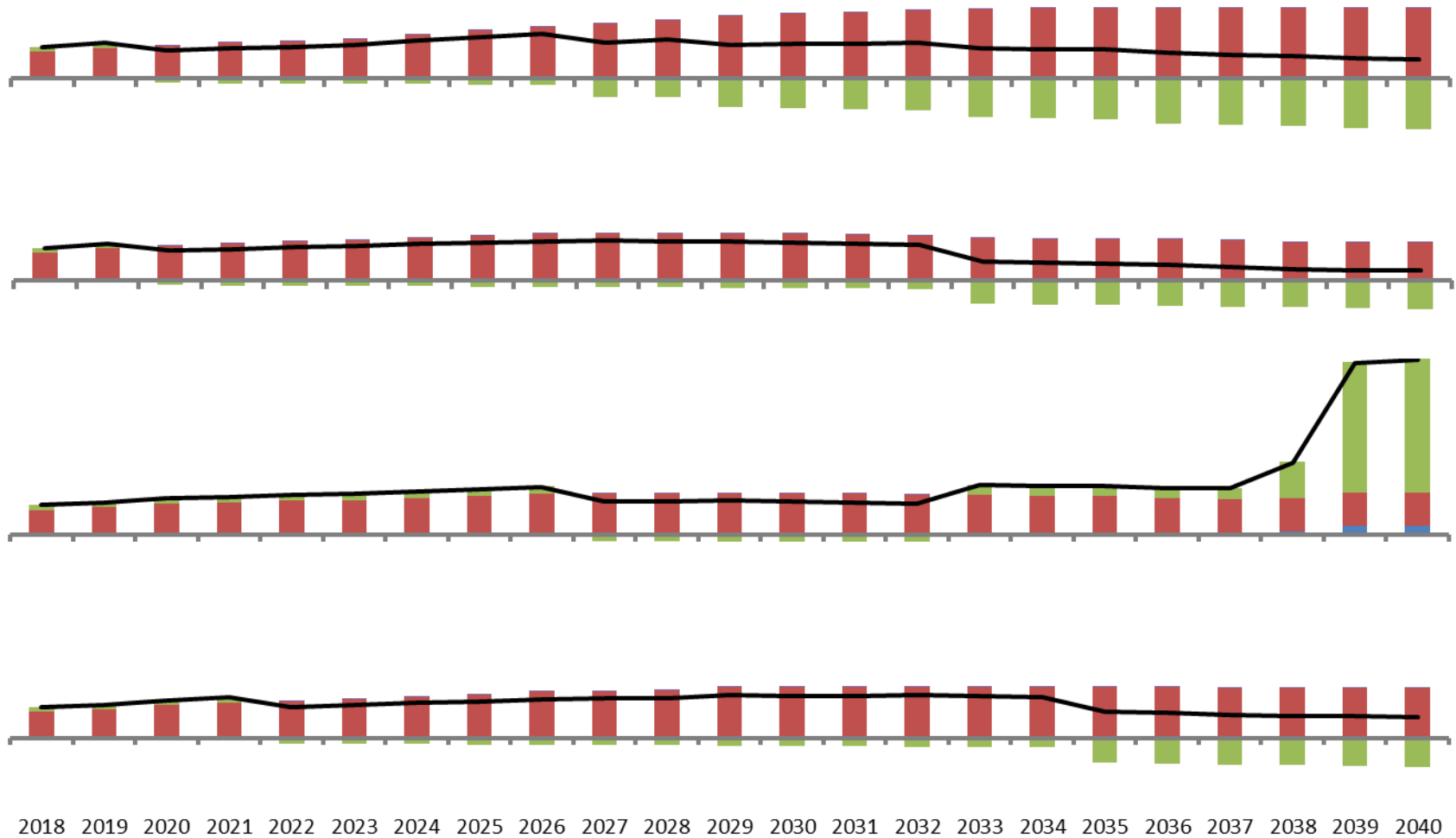
**Embedded benefits**

NGET wider review

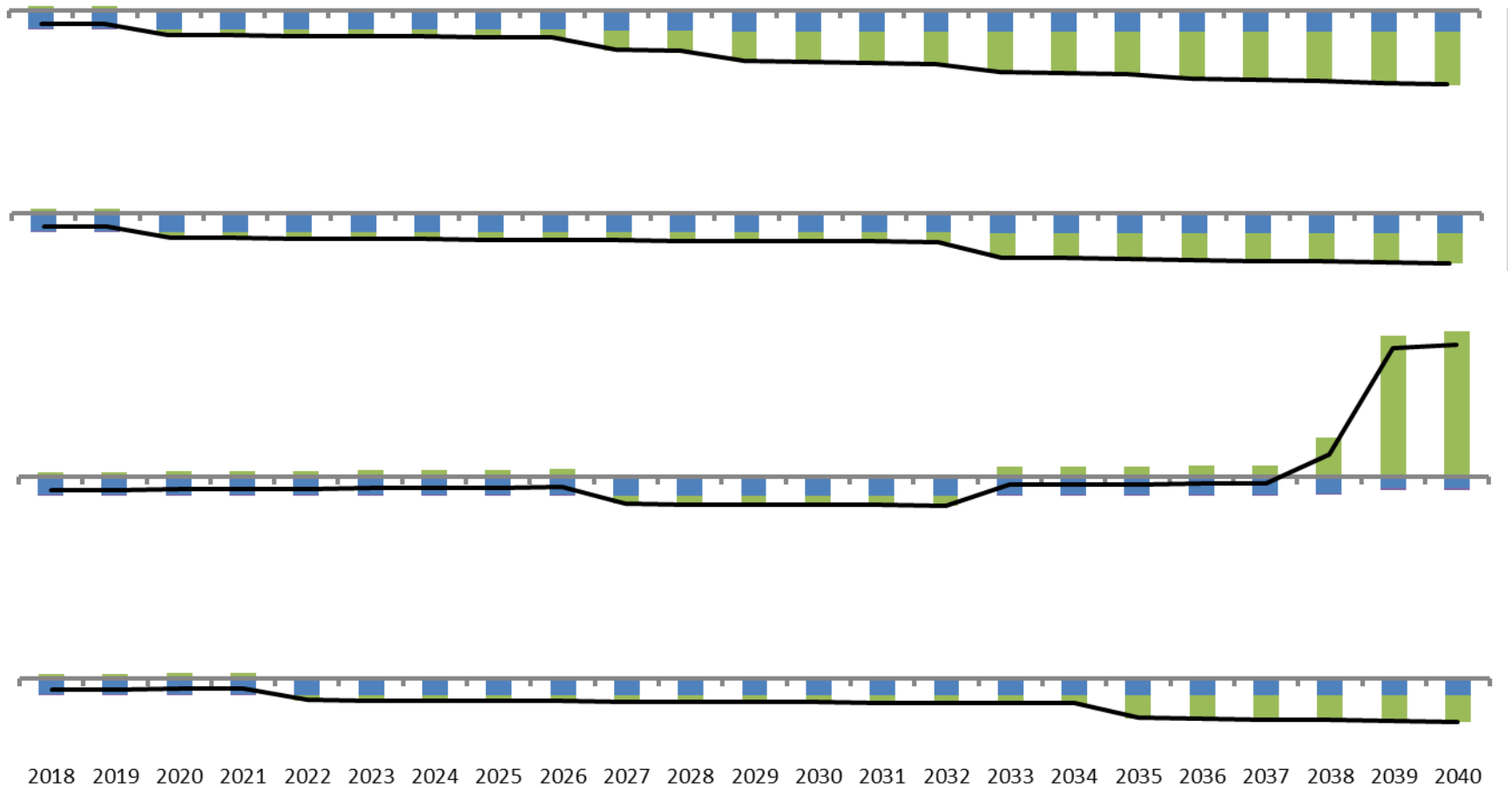
Ofgem TCR / CCG

ENA TSO/DSO workstream

# Embedded benefits



# Embedded benefits



## AGENDA

Developing themes

TLMs – P350 impact

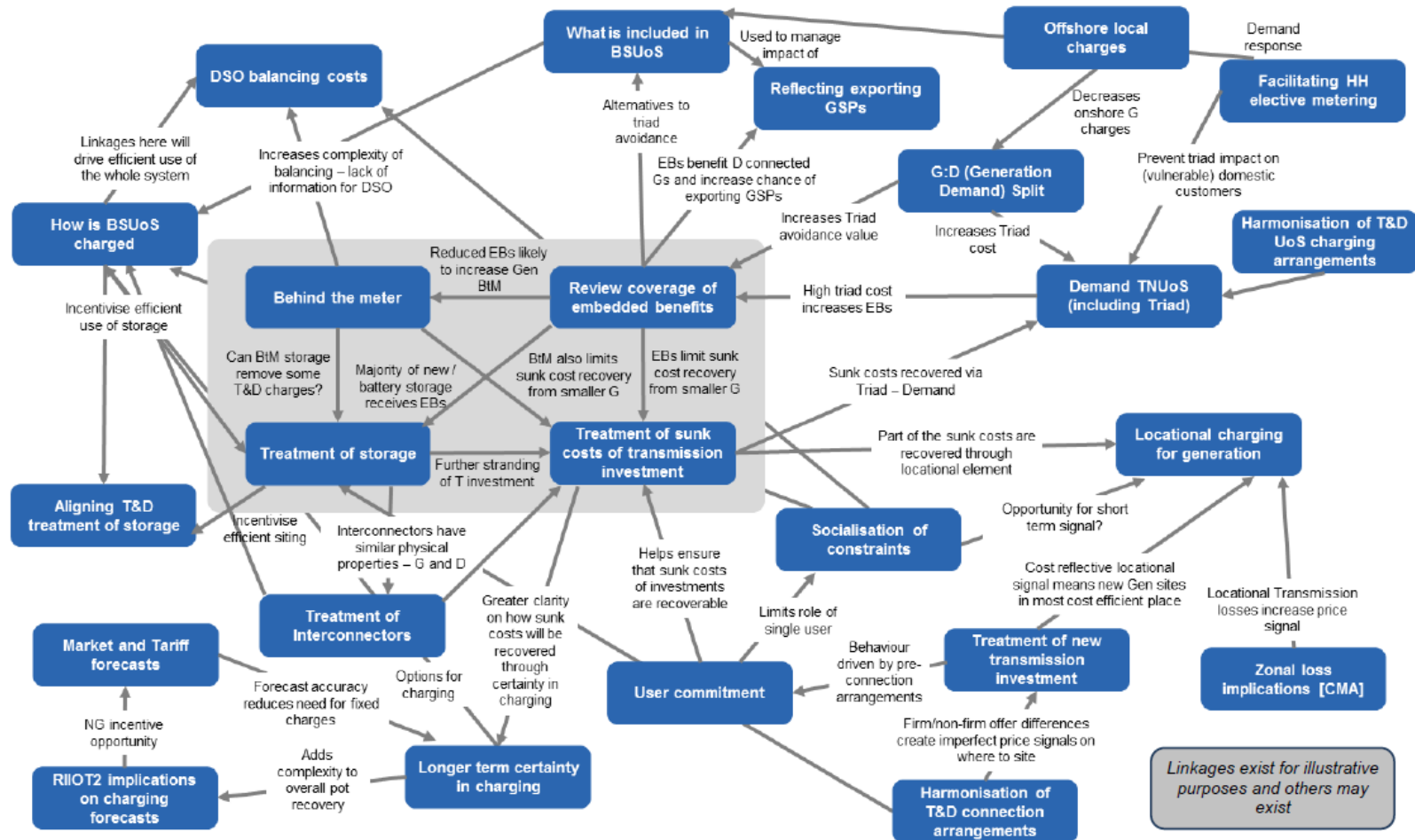
Embedded benefits

**NGET wider review**

Ofgem TCR / CCG

ENA TSO/DSO workstream

# Charging interdependencies



Source: NGET

## AGENDA

Developing themes

TLMs – P350 impact

Embedded benefits

NGET wider review

**Ofgem TCR / CCG**

ENA TSO/DSO workstream



- Significant code review – cross code issues
- How do we charge **fairly** for the system going forward?
- Demand residual charges – charging per kWh (what about microgen?)
- Charging for storage (double charging issues, etc)
- Triad avoidance activity – system still fit for purpose? Already minded-to decision made for exporters, what about simply avoidance activity?
- Negative generation residual.

## AGENDA

Developing themes

TLMs – P350 impact

Embedded benefits

NGET wider review

Ofgem TCR / CCG

ENA TSO/DSO workstream

# What is a DSO (and why should I care?)

*“To consider the charging requirements of an enduring electricity transmission/distribution system, whose purpose is to facilitate a market place between producers and consumers. Consequently, understanding the drivers of cost and benefits in delivering those requirements. The overall aim is to develop the appropriate whole-system price signals for the TSO-DSO transition.”*

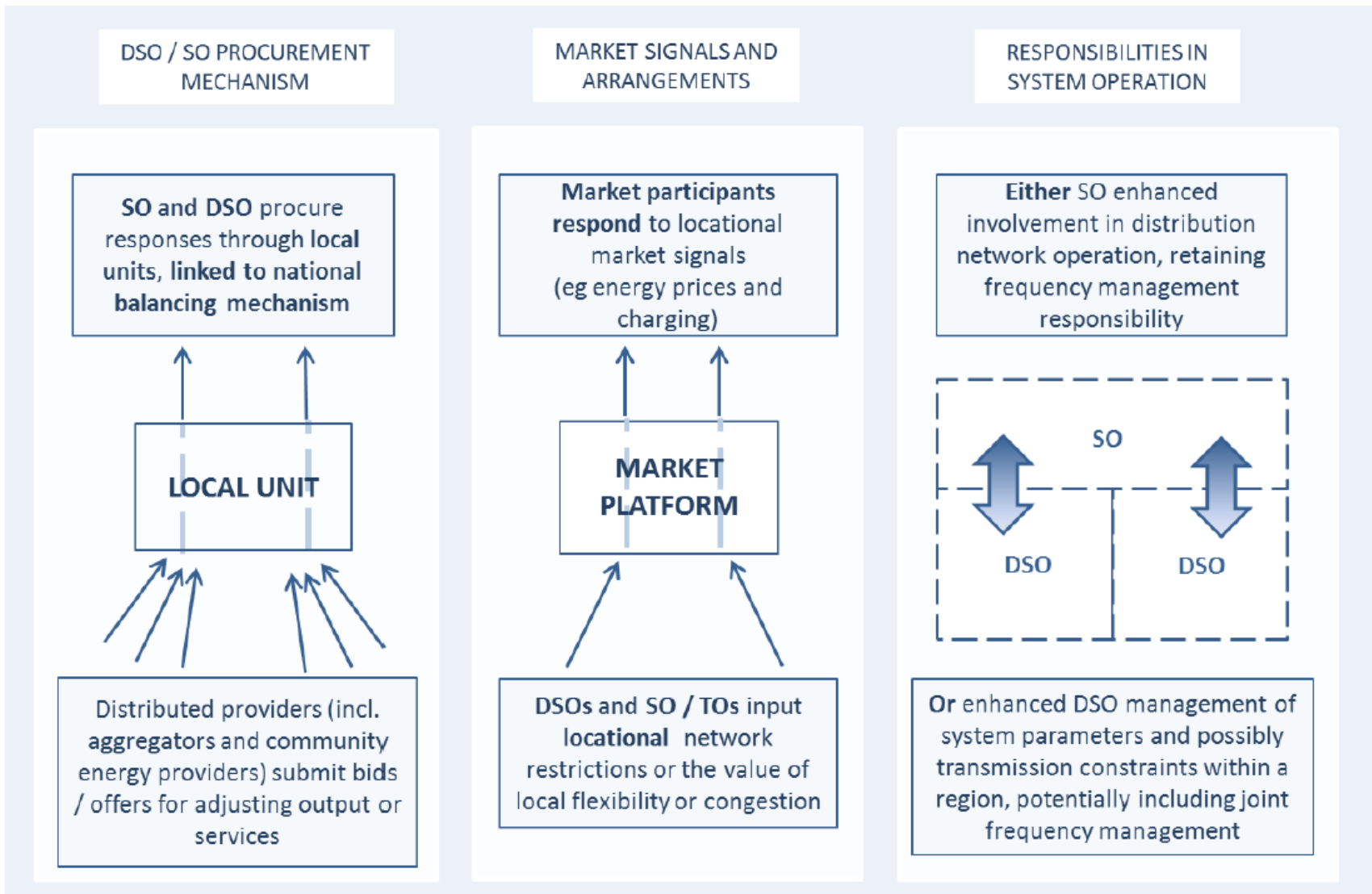
## DNO

Build and maintain a network to accommodate all generation and demand, all of the time.

## DSO

Use ICT to deliver an optimised network.  
Actively manage power flows.  
Regional constraint management.  
Broker balancing and ancillary services  
Coordinate with SO  
Become a platform to provide visibility of network congestion to facilitate optimal DG/DSR activity

- Faster connections
- Cheaper connections
- Lower use of system costs
- **New market**



Source: Ofgem

## Options for Increasing Commonality of Approach in T&D Charging

Option 1	Align T connection boundary with D – deeper T boundary
	<ul style="list-style-type: none"><li>• Unlikely to have major impact on removing distortions?</li><li>• Significant implementation issues</li></ul>
Option 2	Align D connection boundary with T – shallower D boundary
	<ul style="list-style-type: none"><li>• Unlikely to have major impact on removing distortions?</li><li>• Significant implementation issues</li></ul>
Option 3	Agree common cost drivers / scenarios for cost modelling
	<ul style="list-style-type: none"><li>• Harmonisation of diverse cost drivers essential for development of whole system approach?</li></ul>
Option 4	Harmonise modelling approaches
	<ul style="list-style-type: none"><li>• Questionable benefits</li></ul>
Option 5	Harmonisation of residual charges / scaling approaches
	<ul style="list-style-type: none"><li>• Focus of Targeted Charging Review</li></ul>

Costs for getting connected at distribution are very different to transmission – different philosophical approaches to charging.



## Transmission (shallow charging boundary)

The network owner brings the system to your project.

Only pay capital costs for assets specifically for your project

The rest of the network investment is recovered through use of system charges.

## Distribution (less shallow charging boundary)

Pay all capital costs to extend the network.

Pay share of capital costs to reinforce the network.

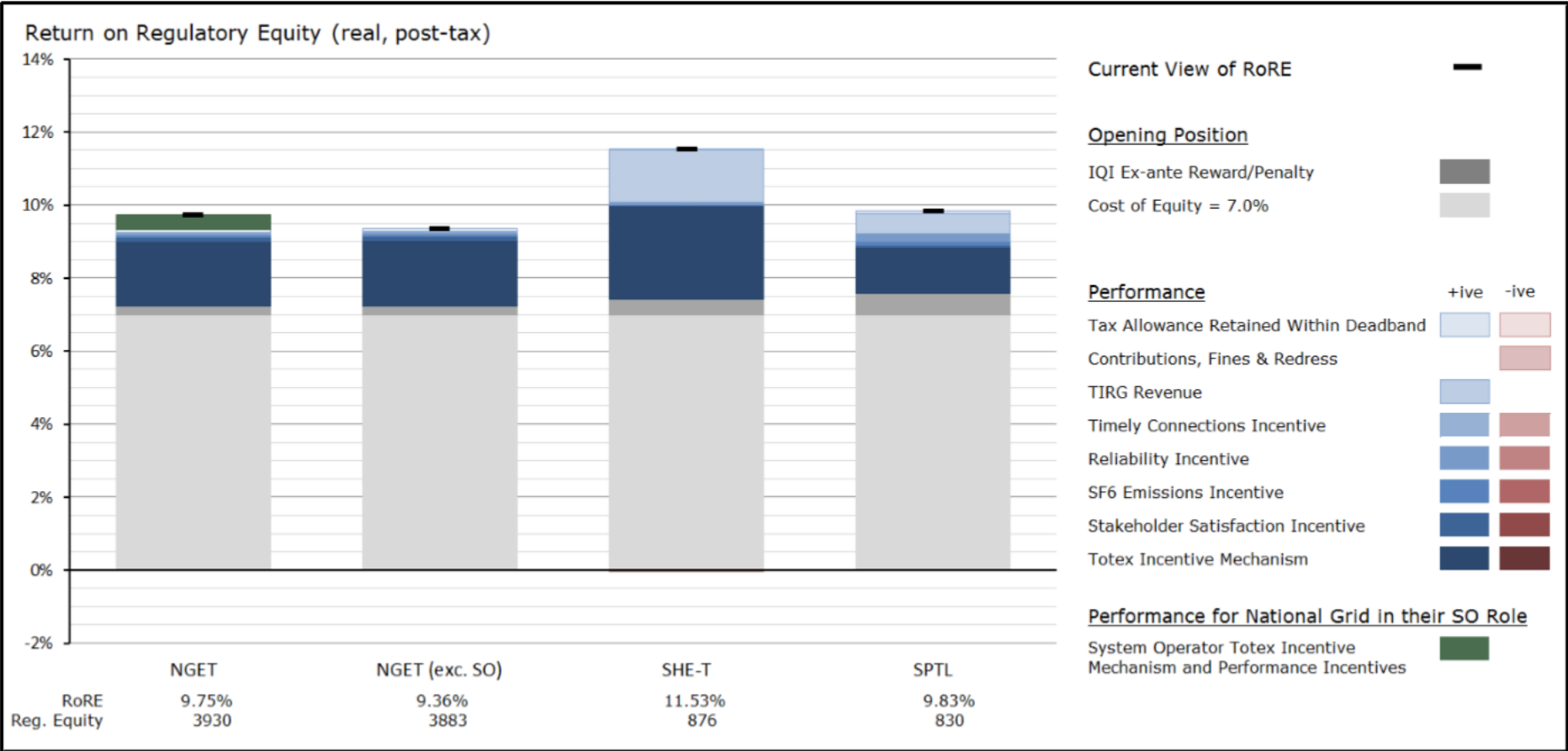
Use of system charges to recover operating/asset renewal costs.



Costs aren't like-for-like



	Transmission	Distribution
<b>Application fees</b>	Yes	None (soon)
<b>Capital costs (and other pre-connection costs)</b>	Connection Charges* One Off Works Underwriting	Connection costs Reinforcement costs Transmission pass-through
<b>Operational costs</b>	TNUoS BSUoS Connection Charges* Transmission losses	GDUoS Embedded benefits LLFs





Let's discuss!

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**KENNY HUNTER**  
**BUSINESS DEVELOPMENT MANAGER**  
**MEG RENEWABLES**

From FIT degression to the 2017  
Revaluation of business rates....

...the good news just keeps on coming!

Kenny Hunter  
MEG Hydro Services

# Pessimism warning!



**Kenny Hunter**



**Sarah-Jane McArthur**

# MEG Renewables – hydro scheme developers

## Merk Hydro

- 1mW run of river scheme with storage at Loch Fyne, in conjunction with CRF and Here We Are. Commissioned August 2015

## Farr Hydro

- 500kW run of river scheme on FCS land south of Inverness. Commissioned December 2015

## Glenkiln Hydro

- 500kW run of river scheme at Lamlash, Isle of Arran. Commissioned July 2016



# MEG Hydro Services – O & M support for hydro

## Technical

- servicing, pigging, remote monitoring

## Commercial

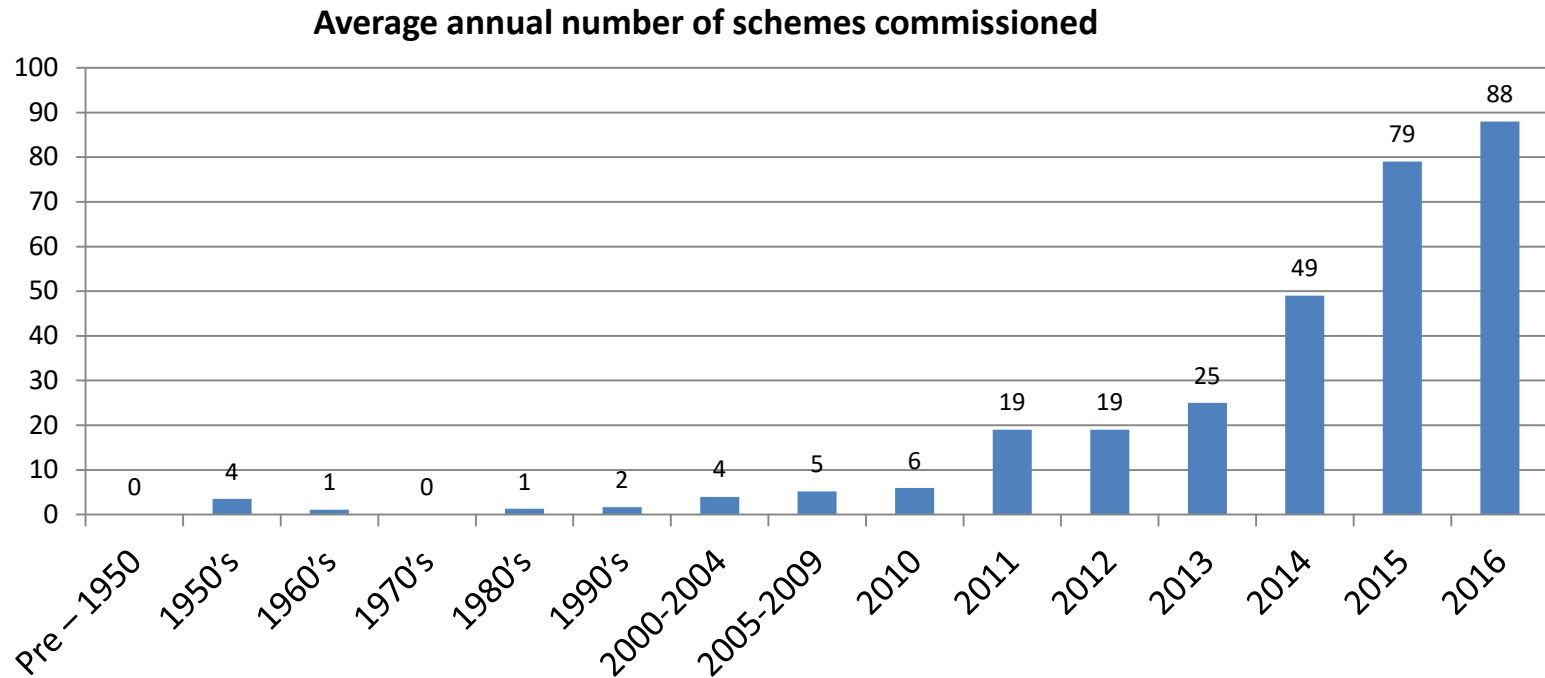
- performance reporting, revenue maximisation

## Optimisation

- scheme enhancement, downtime limitation

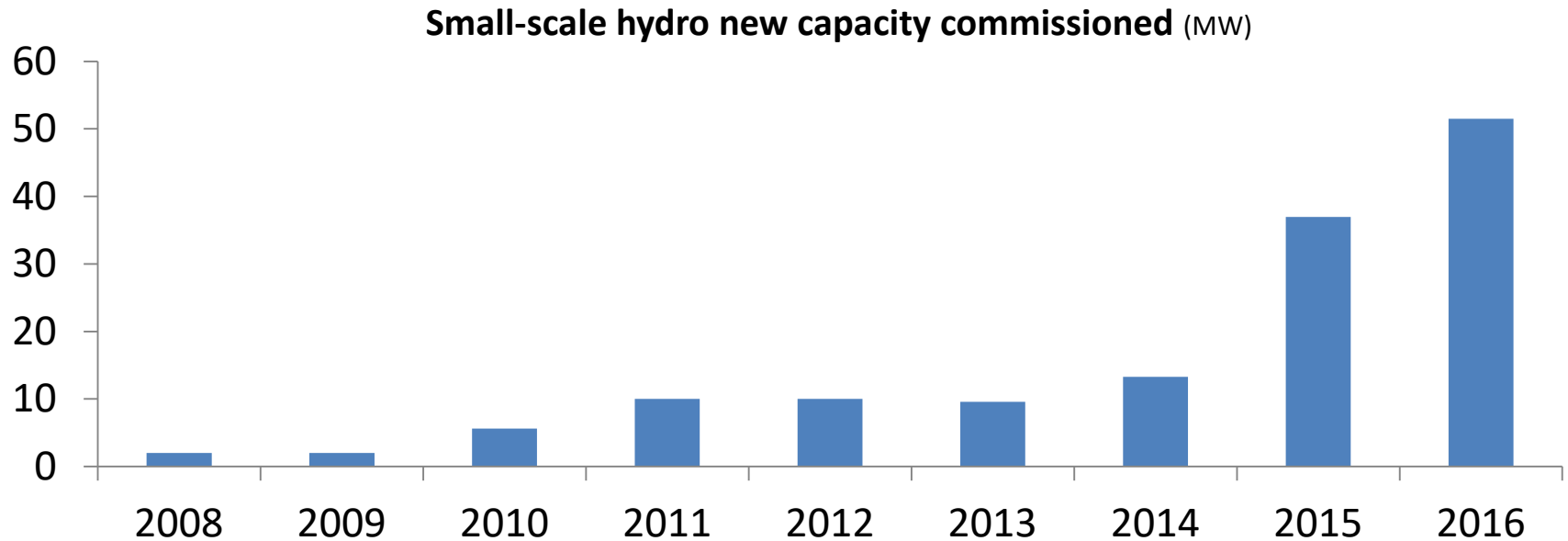


# Small-scale hydro; a recent phenomenon



- Schemes built in 1950's and 1960's averaging 1.5 MW
- ROC schemes from 2000 to 2010 typically 900 kW
- FIT schemes after 2010 concentrated around 500 kW

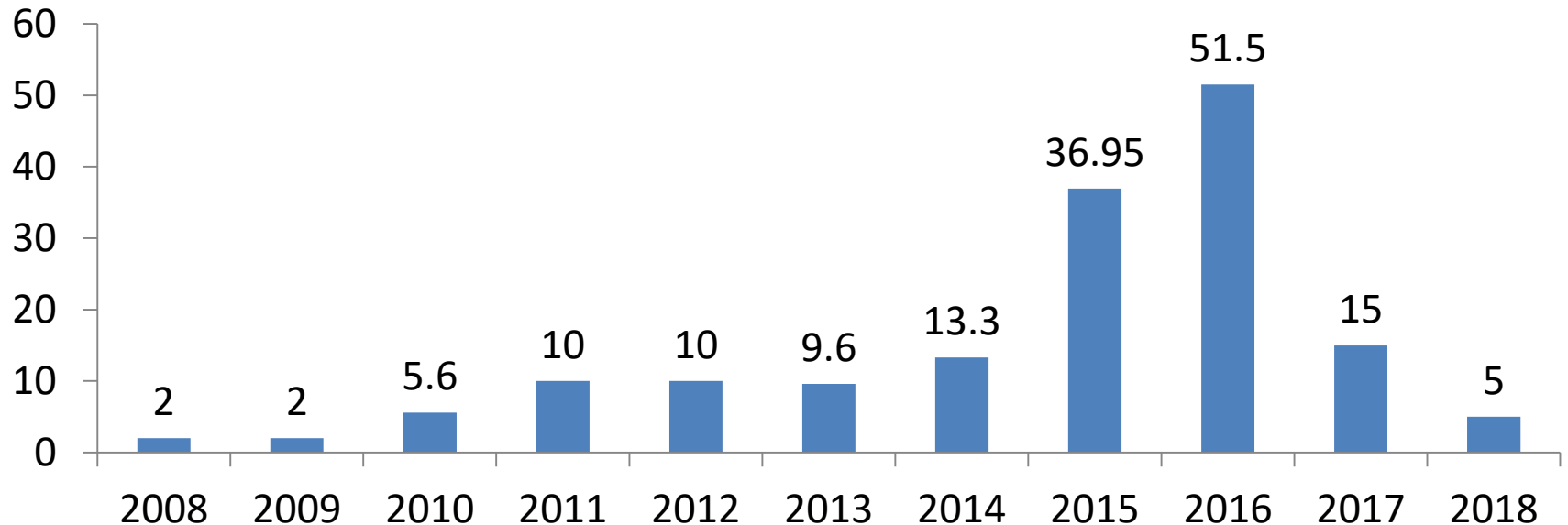
# Feed in Tariffs have been good for hydro..



- **C. 410 operational small-scale hydro schemes in Scotland**
- **70% constructed during FITs era**
- **50% of <5MW schemes less than 3 years old**

# .....but hydro is now at the cliff edge

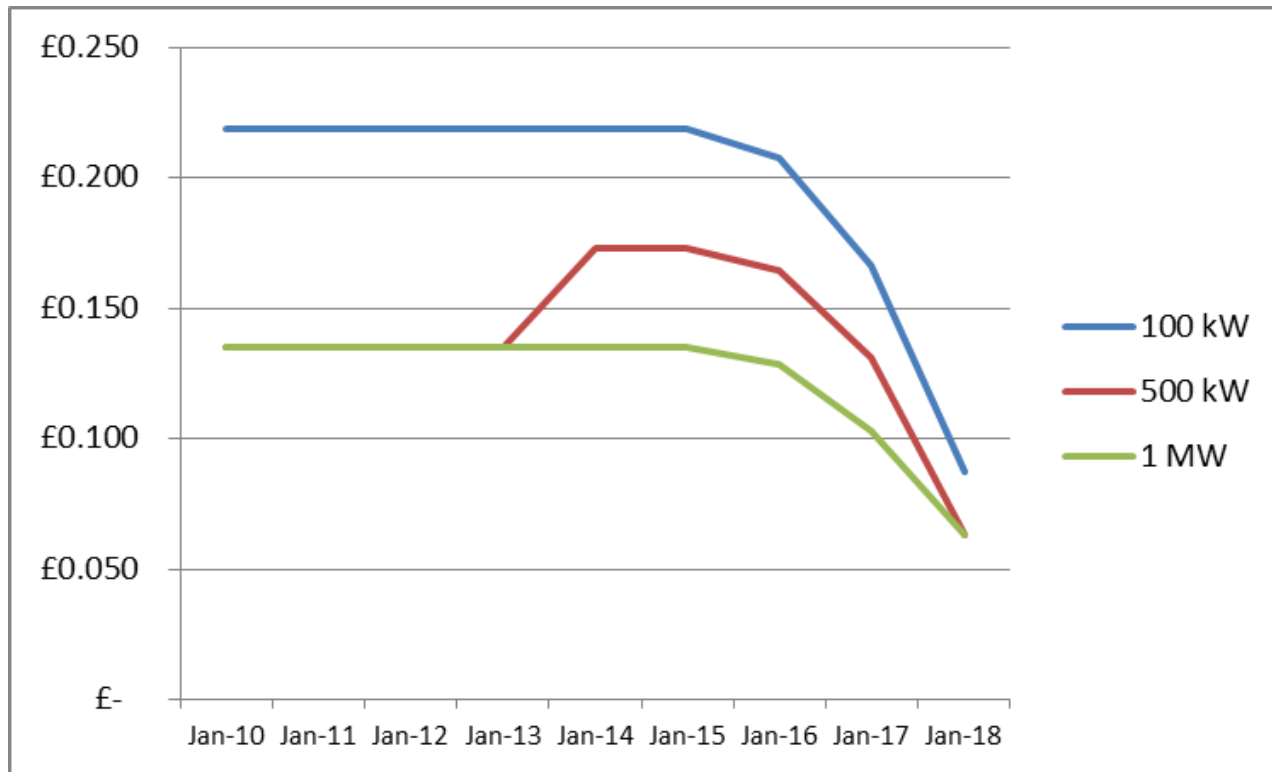
Small-scale hydro commissioned (MW)



- Last of the schemes pre-accredited before the big depression hit of late 2015 being built out in 2017
- Construction now polarised between <100 kW and >1 MW

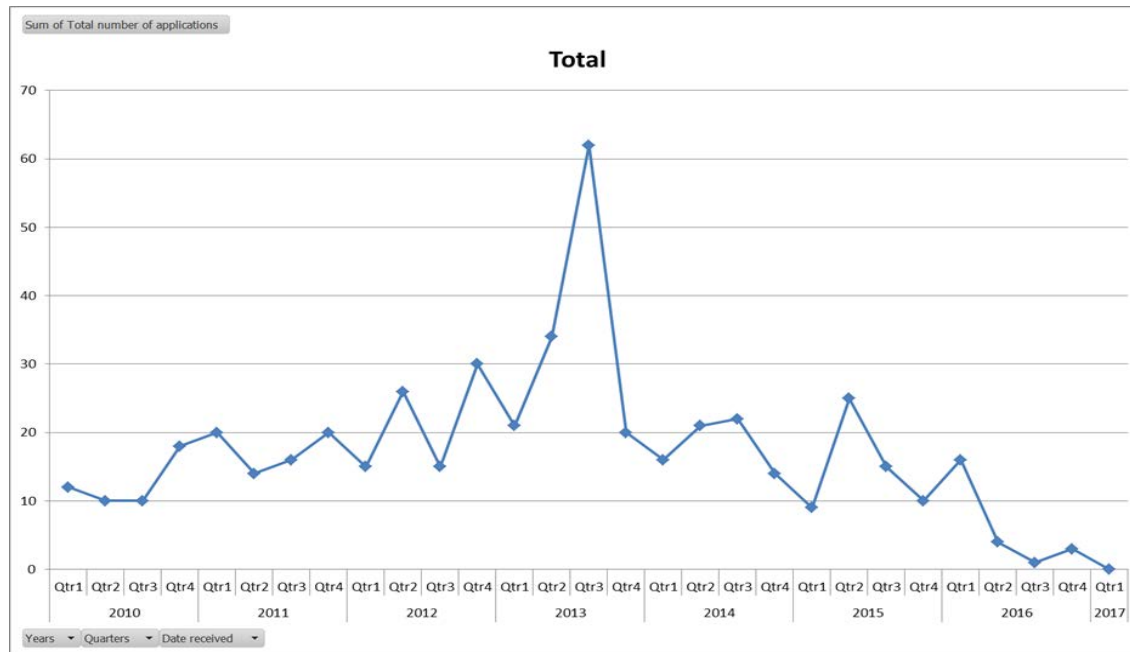


# FIT Generation Tariffs 2010 - 2018



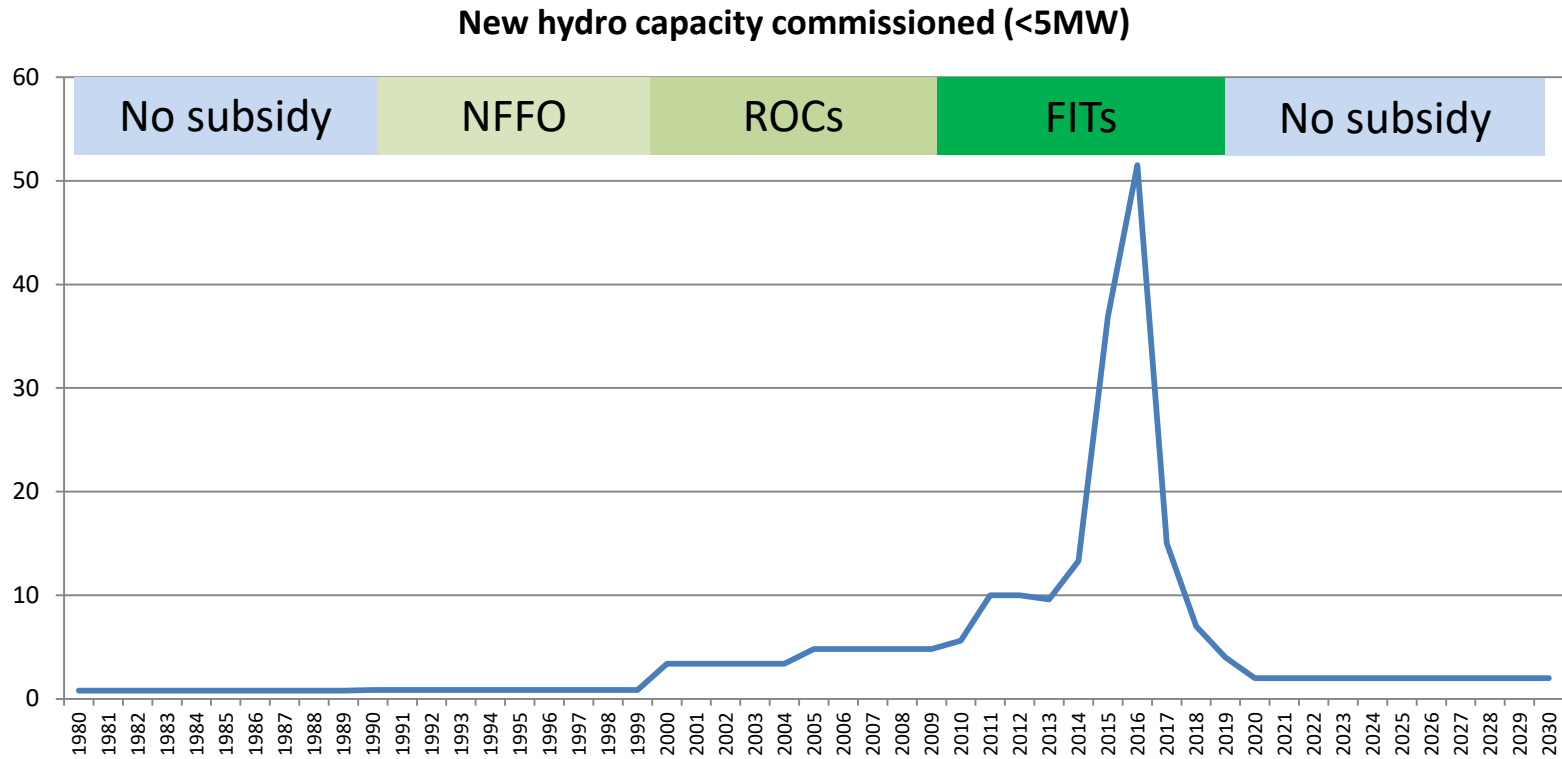
- **Chart shows tariffs at commissioning date**
- **Assumes pre-accreditation utilised**
- **FITs set to be withdrawn in March 2019**

# CAR licence applications peaked in 2013



- 2-3 year lead time from CAR application to commissioning
- Little prospect of development revival this side of 2020

# A 50 year view of hydro in Scotland?



- How much political will to stop this happening – Holyrood/Westminster?
- Will 2030 targets make a difference?

# So how is the future looking?



## FEED-IN TARIFF (FiT)



# A shift of focus to O & M

- Minimising outlays/maximising revenues
  - Fixed/unavoidable costs
  - Variable/optional costs
  - New/rising costs
- The risk of false economies
- The stance of lenders and insurers
- How much to budget?

# Business Rates – our latest big issue

- Prior to April 2016 – not a huge problem, thanks to 100% relief
- April 2016 – rates relief for small-scale renewables withdrawn
- December 2016 – draft revaluations published; average increases of 150-200% for small hydro
- Jan- Mar 2017 – BHA/Alba/SR engagement with Scottish Government, resulting in hydro up to 1MW being included in 2017/18 transitional relief scheme
- April 2017 – Final values confirmed; appeals process opens
- April-June 2017 – further engagement with Assessors and Scottish Government to seek revision to methodology utilised for 2017 Revaluation, or some other form of permanent fix

# Why are the 2017 Rateable Values so high?

- Plant & Machinery Order
  - 90%+ of typical hydro scheme deemed to be rateable
- ‘Need’ to resort to Receipts and Expenditure method of valuation
  - Absence of acceptable rental evidence
- From turnover to rateable value
  - Turnover
  - Less allowance for opex costs (c. £150k per MW)
  - Less tenant’s depreciation (45% x 3.3% x capital cost of scheme)
  - Divisible Balance
  - Less tenant’s share (39.81% of divisible balance)
  - Landlord’s share (rent + rates)
  - Rateable value (= landlord’s share x 67.6%)

# Avenues being pursued; outcomes sought

- Multi-track approach
  - Scottish Government/Assessors
  - Barclay Review
  - Appeal to Lands Tribunal
- Key strands to our case
  - Hydro RV versus Wind RVs
  - Negative cash flow
  - Risk of debt default – local impact
- Outcomes sought
  - Revision to Plant & Machinery Order
  - Parity with other renewable energy categories, notably wind
  - Rateable Values to reflect actual rental levels
  - RVs not to exceed 10% of turnover



**The future may not be bright....but it is orange**



# Thank You

Kenny Hunter

MEG Hydro Services

[ken@meg-renewables.co.uk](mailto:ken@meg-renewables.co.uk)

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Electricity Networks



# HYDRO CONFERENCE & EXHIBITION

6 JUNE 2017 PERTH

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**EXPLORING NEW MARKETS: HYDRO AND PUMPED  
STORAGE ACROSS THE GLOBE**

**CHAIR:**

**RACHELLE MONEY**

**SCOTTISH RENEWABLES**





**GARETH MCMANN**  
**HYDRO SALES ENGINEER**  
**GILBERT GILKES & GORDON LTD**

# GILKES

HYDROPOWER SYSTEMS



**GILKES**

ORDER NO. 200103

TURBINE NO. 56736 DATE 2016

ELECTRICAL OUTPUT 1333 kW

RATED NET HEAD 124.5 m

RATED FLOW 1369 l/sec

SPEED 1000 rpm

GILBERT GILKES & GORDON LTD.  
KENDAL LA9 7BZ ENGLAND

DESIGNED & BUILT IN THE UK 



# Gilkes Export Experience

Gareth McMann  
*Hydro Sales Engineer*

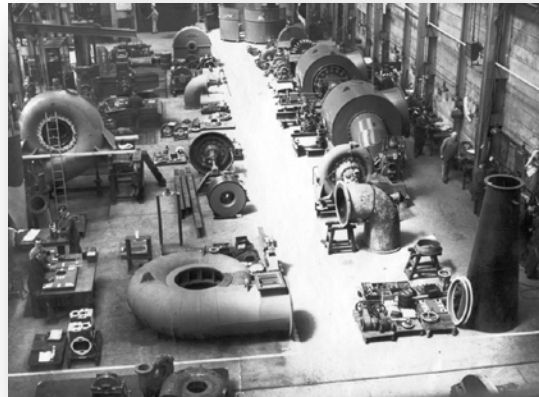
# Objectives

- Introduction to Gilkes
- Gilkes export experience
- Case studies
- Challenges faced with export



## History

- British Manufacturer based in Kendal, Lake District, UK
- Company founded 1853
- Royal Warrant Holders
- Turgo Turbine designed by Eric Crewdson in 1919



## Gilkes Today

- Still family run business (over 160 years)
- Over 6800 turbines worldwide
- Exporting to over 80 Countries
- Offices in UK, USA & Japan
- 200+ Employees
- £40m Turnover
- 50% Export



## Myself

- Gained Masters in Sustainable Engineering from Lancaster University in 2011
- Joined Gilkes in 2011 as a Hydro Sales Engineer
- Focused on the UK market for 5 years
- Moved to support International sales team 12 months ago

# Gilkes Around The World

## **GILKES** EXPORTS



# Active Markets

- Africa
  - Kenya
  - Tanzania
  - Zimbabwe
  - Malawi
- South east Asia
  - Malaysia
- USA
- South America
- Turkey

## Case Study 1

Long Banga – Sarawak, Malaysia

- 2 x 160kW Twin Jet Turgo turbines
- Rural electrification project
- Mini grid network
- Second stage project underway



## Case Study 2

### Dereici HEPP – Turkey

- 7MW 5 Jet Vertical Pelton
- Privately funded developer
- Turbine package supplied by Gilkes Turkey



## Gilkes Turkey

- Joint Venture between Gilbert Gilkes & Gordon and Marbeyaz Makina Sanayi A.S. – Part of the Yapitek Group.
- Turbine engineering and design undertaken by GGG.
- Purchasing and manufacture undertaken Marbeyaz.
- Achieve 100% domestic production in Turkey
  - Access increased Feed in Tariff from Turkish Government.



# Challenges Faced With Export

- Location
- Local cultures/language/time.
- Security
- Finance
- Procurement rules
- Regulation – abstraction, grid connection etc.
- Shipping and transport
- Site conditions
- Access to materials & labour
- Local support

# Rewards of Export

- Travel
- Higher value projects
- Providing power to rural communities
- Provide employment to local work force
- Promoting British export

Thank You



**JON BOYCE**  
**SENIOR EXPORT FINANCE MANAGER**  
**UK EXPORT FINANCE**



UK Export  
Finance



# Government Support to UK Exporters

## SR Hydro Conference, June 6<sup>th</sup> Perth

Developing for our customers





## Objectives

- How we support UK exporters and how we assist overseas buyers of UK capital goods/services
- How to contact us



## Who we are in UK

UK Export Finance is the UK's export credit agency formally the Export Credits Guarantee Department

We complement the private market by providing government assistance to UK exporters and investors, in the form of insurance policies and also guarantees on bank loans, performance bonds & confirmed Letters of Credit

Provide Political Risk Insurance on overseas investments



## Supporting UK Exporters

Deals done on bank guarantees such as bonds & working capital (no lower limit)

For Export credit insurance Min premium £250, no lower limit)

We cover all sectors, goods & services

Minimum UK content of 20%

UK Treasury Guarantee





## Export insurance policy (EXIP)

Insures exporter against risk of not being paid or of not being able to recover costs of performing export contract due to specified events

All sectors and up to 95% cover, No minimum contract value!

Can be introduced by a qualified credit insurance broker

Not for EU / rich OECD markets below 2 year risk horizon

Not whole turnover cover

It is conditional cover, so the terms of the policy must be met to have a valid claim

Exporter completes application form and sends to UKEF



## Case study: Export Credit Insurance



- ▶ BuroHappold Engineering provides integrated design, planning, project management and consultancy services for all aspects of building development, infrastructure and the environment.
- ▶ The business was offered a consultancy contract worth in excess of \$100,000 in Lesotho, a market which was new to the firm and perceived to be comparatively risky.
- ▶ When Buro Happold could not find cover in the private sector, UKEF was able to provide reinsurance in the form of export insurance, helping the company protect itself from any risk of non-payment.

“Given how well single-project export insurance cover worked for us, I can foresee further use of it. There are plenty of untapped markets in Africa where we can explore new projects.”

-- *Adrian McCarthy, Credit Manager, Buro Happold Engineering*



## Contract Bond Support Scheme

Where a participating bank issues a contract bond (or indemnifies another bank issuing the bond) for UK export contract

For advance payment, progress payment and all other performance bonds we normally guarantee up to 80% of the bond

Exporter and Bank complete application form and submit to UKEF along with:

- Last 3 years accounts



## Bond Case Study – BiFab Engineering

BiFab recently won a major contract +£100M with Dutch EPC contractor SHL to supply fabrication work for the Beatrice Offshore Wind Farm. The buyer required performance and warranty bonds from BiFab's bank which due to the size of the bonds required additional security

John Robertson, Managing Director at BurntIsland Fabrications, said:

This contract gave us a valuable opportunity to be part of a major renewable energy infrastructure project, as well as a significant boost to our revenue at a difficult time due to the low level of activity within the oil and gas sector. Working with UK Export Finance meant that we were able to realise this opportunity.



## Export Working Capital Scheme

We provide guarantees to banks to cover the credit risks associated with export working capital facilities in respect of specific export contracts.

UKEF formally guarantees up to 80% of risk

Useful where a UK exporter wins an overseas contract that is higher in value than is typical, or succeeds in winning more overseas contracts than it has done before.

Last 3 years accounts,, cash flow forecast and/or trade cycle details

Max term loan is 2 years, working capital facility to contract value is max 75%



## Working Capital & Bond Case Study

- ▶ Oil & gas equipment provider PCT Group won a US \$5 million contract with Samsung Heavy Industries
- ▶ UKEF provided guarantees to its bank for performance and warranty bonds. UKEF also guaranteed a working capital loan from PCT's bank
- ▶ The support helped PCT unlock the cash flow it needed to fulfil the order

“UKEF’s support was invaluable, helping us make sure we had the resources to benefit fully from the significant business win.... I’d recommend working with them to any company looking to realise opportunities abroad.”

-- Brian Lemond, Director, PCT Group





## Buyer/Supplier Credit, Direct Lending Facilities

UKEF provides a guarantee to Bank that makes a loan to an overseas buyer for capital goods and/or capital services

Value of export contract on buyer credit facility is min £5M and covers capital goods and services

Value of export contract on supplier credit facility is min £250K and covers capital goods and services. UKEF may cover up to 85% of contract value

We can also look at providing guarantees under Bills of Exchange and Promissory notes

Exporter makes application to UKEF

Direct Lending is where we give loan to buyer who then repays UKEF



## Buyer Credit Case Studies

UKEF approached by Forum Energy Technologies & we supported their Nigerian buyer Marine Platforms Ltd with a buyer credit facility worth £14.1M, allowing the exporter to secure the contract & deliver equipment

UKEF provided \$870M buyer credit to the \$19bn Sadara Petrochemical project in Saudi, supporting Foster Wheeler, Fluor & Jacobs

UKEF helped Carillion win \$110M contract in Dubai to build World Trade Centre, Hotel & Offices under our direct lending facility.





**Jon Boyce (07990 887852)**  
**jon.Boyce@ukexportfinance.gov.uk**

**Carol Harvey (07817 830833)**  
**carol.harvey@ukexportfinance.gov.uk**





**PAUL O'BRIEN**

**SPECIALIST, ENERGY AND LOW CARBON ENERGY TECHNOLOGIES**

**UK EXPORT FINANCE**





# **Small Scale Hydro**

## **Overview of international markets**

**Paul O'Brien**  
**Energy and Low Carbon**

# Overseas Regional Markets



## Europe

Mostly mature market with many of the global leaders in the industry. Pockets of opportunity for small scale



## Americas

USA and Canada have mature markets with growth of large scale in Brazil. Small scale opportunities across LAC area



## Asia

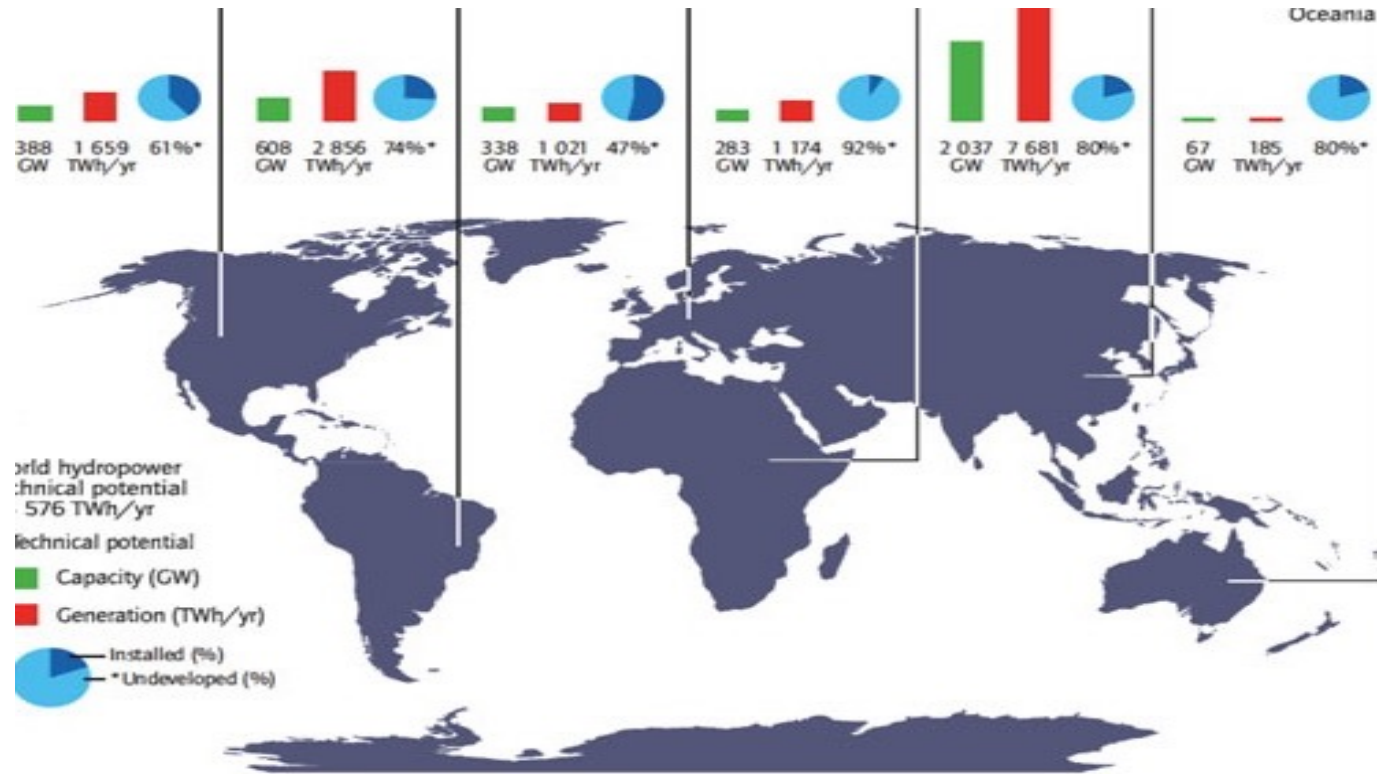
China is the market leader. Opportunities in India, Pakistan, Vietnam, Cambodia and across South East Asia



## Africa

Many fast growing economies with low penetration of electricity supplies e.g. Nigeria, Malawi and Ethiopia

# Untapped potential

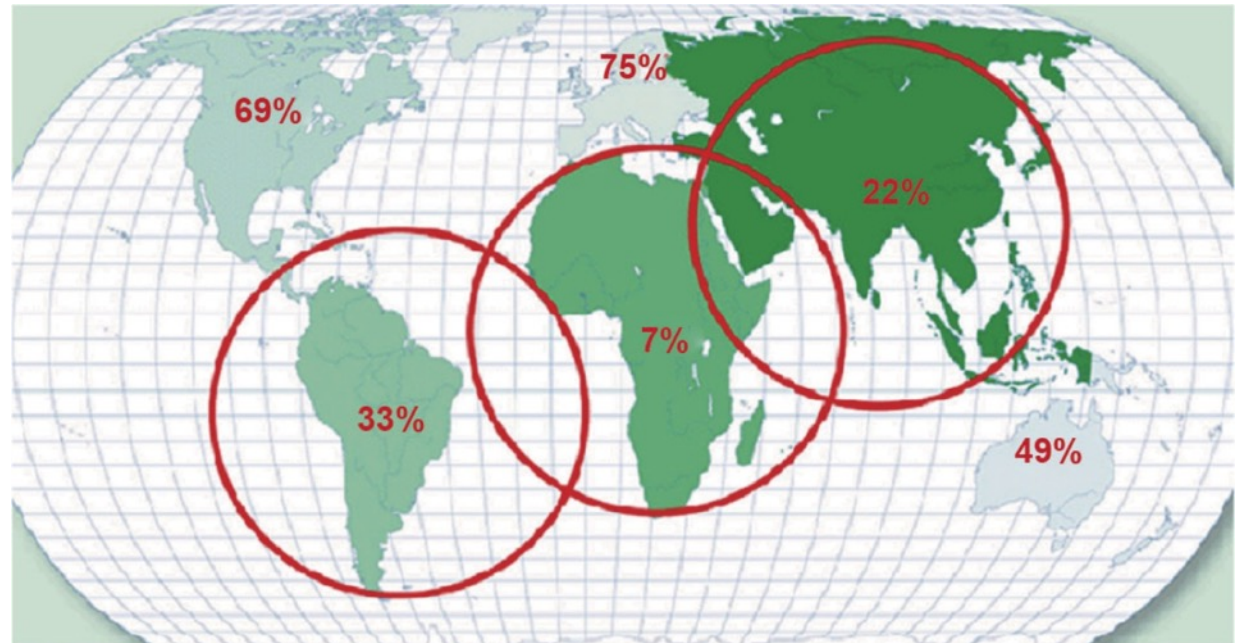


Source: IPCC, 2011, based on IJHD, 2010.

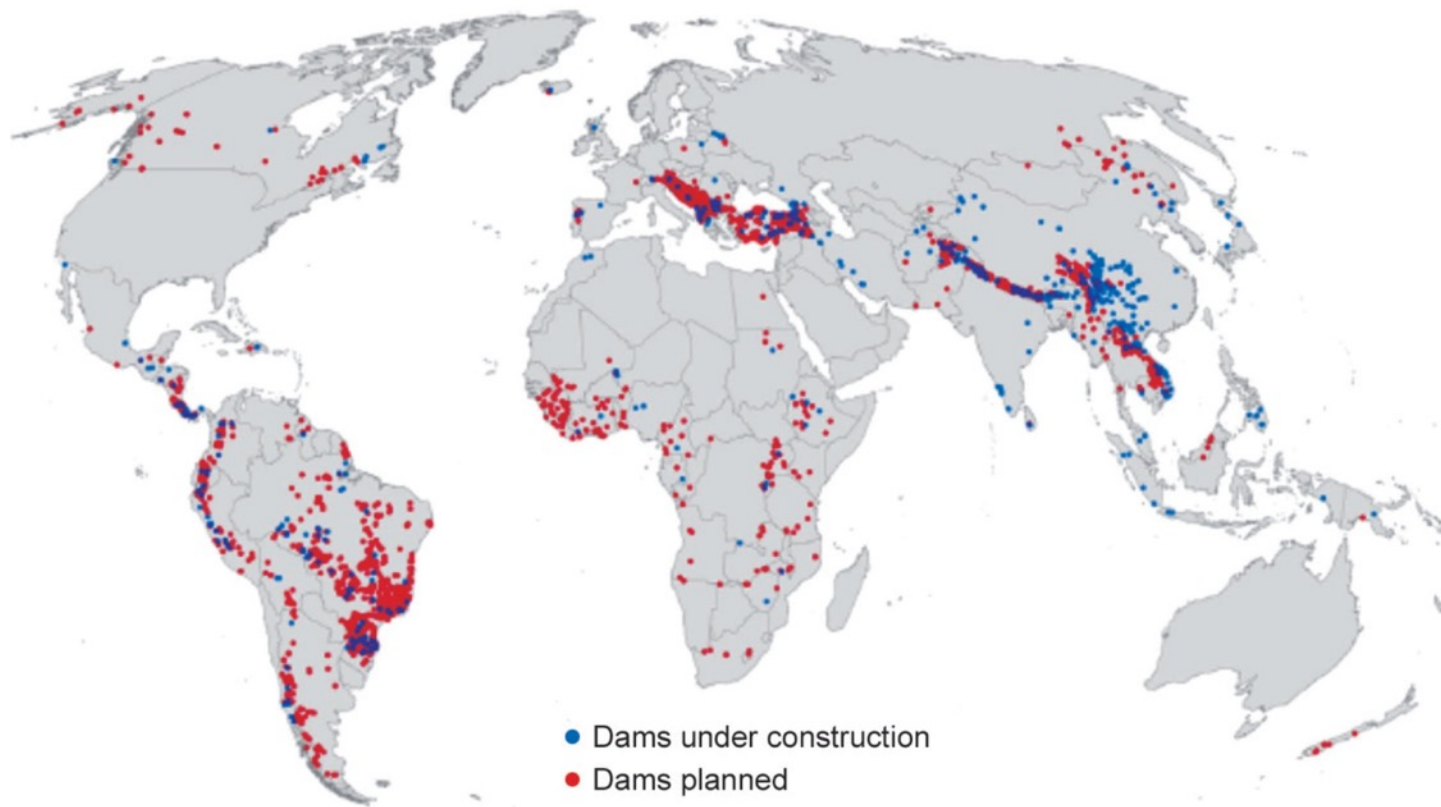
# Hydro Potential

Africa has developed its potential hydro resources the least of the global regions

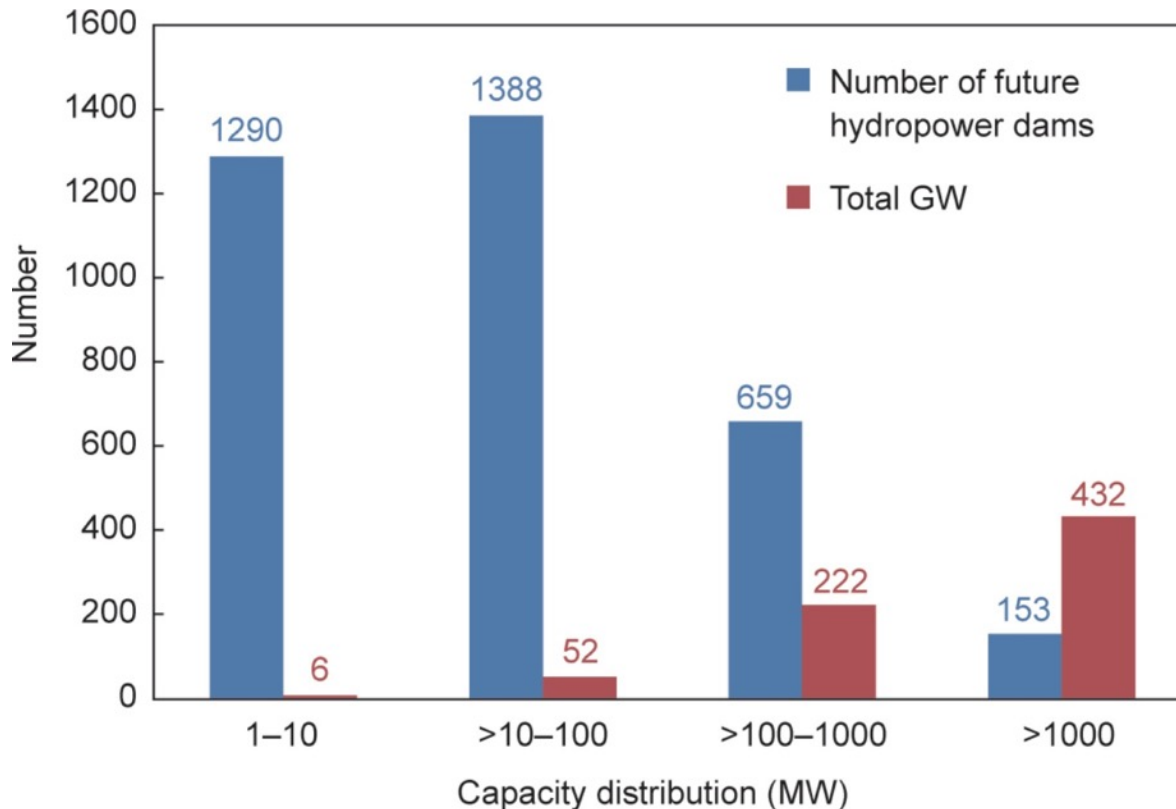
Asia, with the largest potential, along with Latin America have not reached the same development stage as Europe or North America



# Planned Projects out to 2030



# Project Breakdown



6GW of small scale hydro in the pipeline on a global basis (2015 figure)

52GW of medium scale projects

These numbers will continue to grow while the larger scale projects will continue to come up against an increasing trend of social and environmental pressures e.g. as in Chile



# Example Market



**INDONESIA**

**34** Province  
Capital : Jakarta

**253** Million Population  
4th most populous country on earth

**13,500** islands

**48.7m** people  
without electricity

Jakarta

3,181 Miles

# Indonesia



**Climate – includes tropical rainforest and monsoon type.**

**Rainfall in Indonesia is plentiful, particularly in west Sumatra, northwest Kalimantan, west Java, and western New Guinea.**

**Many of the larger islands are mountainous offering opportunity for hydro development**

# Indonesia – Government Support

The National Electricity Plan has a target of 25% from renewables by 2025 to be delivered by state utility PT Perusahaan Listrik Negara (PLN)

Government has calculated that investment of US\$18Bn in hydro power is required to achieve this target.

Latest allocation to hydro under the tender process for IPPs is 6.7GW with a further 2.1GW to be delivered by PLN by 2025.

Feed-in Tariff – PLN is mandated to take any renewable power at a fixed rate but in Feb 2017 this was capped at 85% of the local rate if this is above the national average. In many areas this is at US\$0.10/kwh or above



# SDI Support



# SDI Support

**Practical, tailored services to new or existing exporters based in Scotland**

- **Guidance on the best routes to international markets**
- **Access to international market opportunities research**
- **Assistance with shaping your international strategy**
- **Facilitate connections and business relationships with partners**
- **Global networking support**
- **One-to-one international trade adviser support**
- **Access to events, trade missions and webinars**

# SDI Support

## International Market Research - 0800 019 1953

Companies based in Scotland get free access to reports on:

- Competitor insight
- Global market intelligence
- Credit rating checks
- Industry trends and forecasts
- Consumer demographics
- Supplier databases



<http://www.exportsavvy.co.uk>

## International Strategy Workshop

This workshop delivered through SDI designed to help individual businesses draw up a coherent international strategy and associated action plan.

## International Manager for Hire

Funding for a highly qualified business professional with extensive international expertise to work for the company for up to 12 months. Eligible activities include market assessment, product customisation and setting up internal systems to deal with international markets.

# Contact Details

Paul O'Brien, SDI

[paul.obrien@scotent.co.uk](mailto:paul.obrien@scotent.co.uk)

[paul.obrien@hient.co.uk](mailto:paul.obrien@hient.co.uk)

HEADLINE SPONSOR



Scottish & Southern  
Electricity Networks



# HYDRO CONFERENCE & EXHIBITION

6 JUNE 2017 PERTH

**GILKES**  
Hydro

 **TEXO Drone**  
Survey & Inspection Ltd





**ADDING VALUE TO HYDRO AND PUMPED STORAGE  
IN A FLEXIBLE ENERGY SYSTEM**

**CHAIR:**

**HANNAH SMITH**

**SCOTTISH RENEWABLES**





**STEPHEN MCINALLY**  
**BUSINESS DEVELOPMENT TEAM MANAGER**  
**SMARTESTENERGY**

# Innovative PPA structures

Stephen McNally,  
Business Development Manager

6<sup>th</sup> June 2017



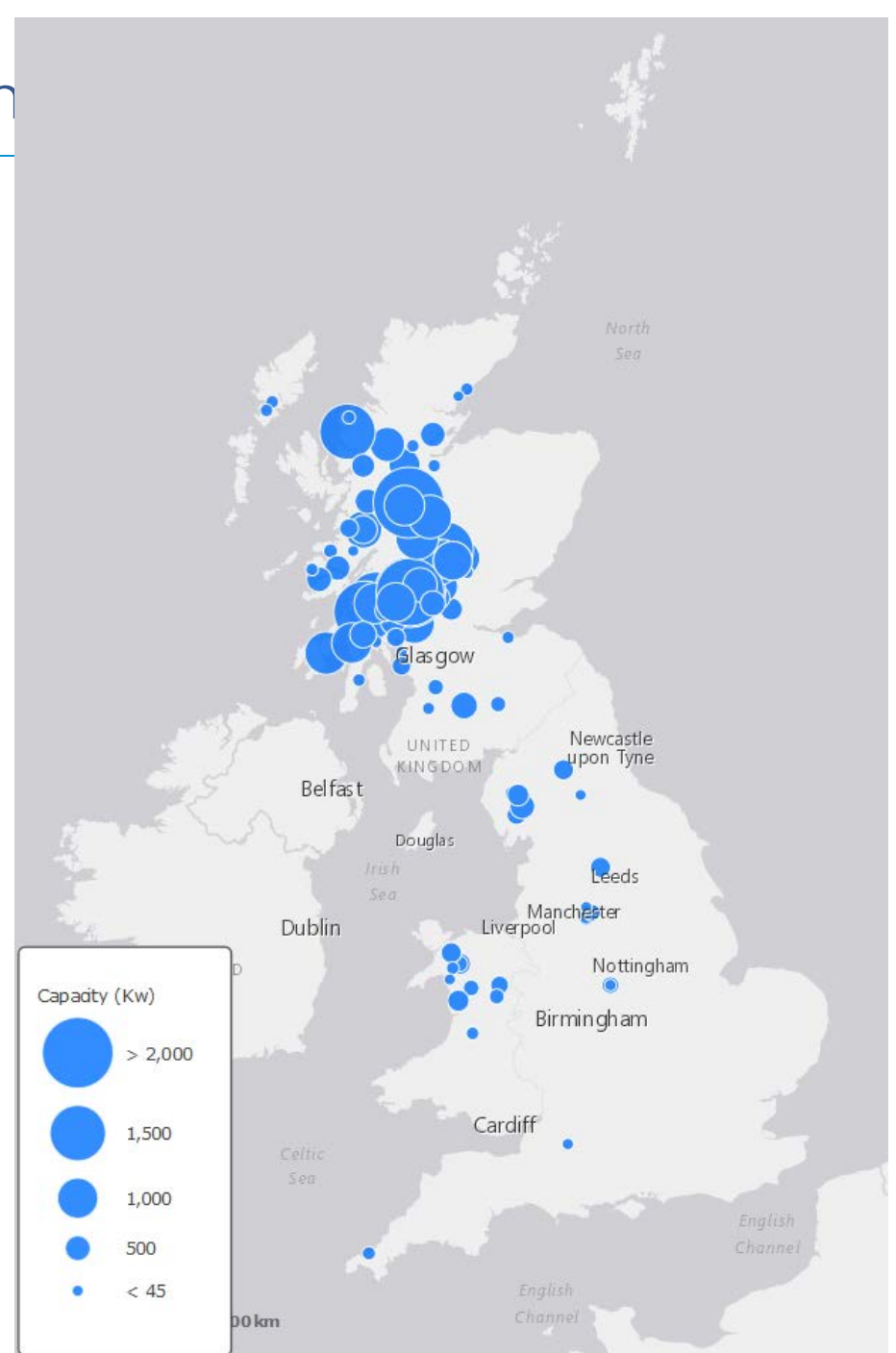
# Contents

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- ▷ Introduction to SmartestEnergy
- ▷ Hydro in Scotland
- ▷ Transition to a New Energy Market
- ▷ Current Challenges
- ▷ Power Purchase Agreements (PPAs)
  - ▷ Fully Fixed
  - ▷ Flexi-base
  - ▷ ManagedPPA
  - ▷ Seasonal Time of Day Structures (STOD)

# SmartestEnergy – a next generation

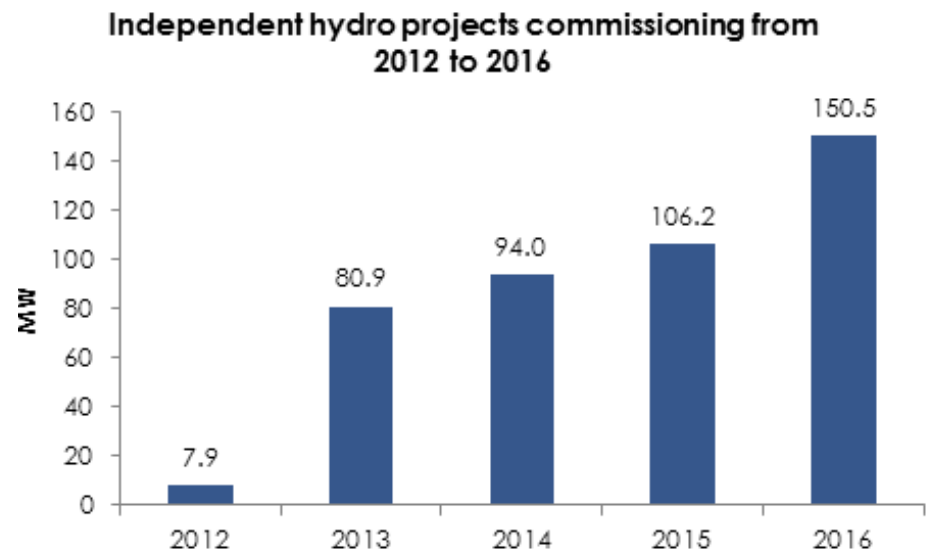
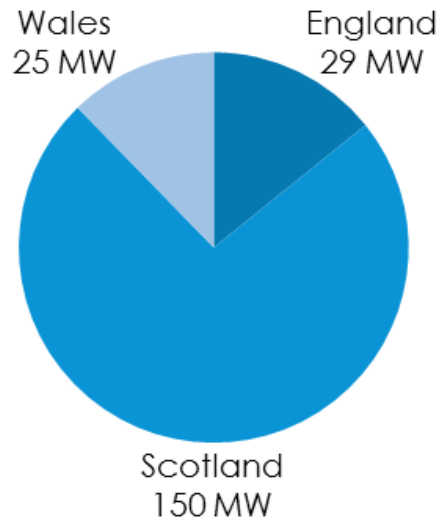
- ▶ 17% of independent distributed renewable generation
- ▶ 2.6 GW portfolio with 430 customers and 571 sites across England, Scotland and Wales
- ▶ 59 MW hydro portfolio with 108 customers and 124 sites



# Energy entrepreneurs are at the forefront of the transition

---

- ▶ 6,400 renewable projects across GB with a combined capacity of 12.75GW
- ▶ 2,615MW independent renewable capacity in Scotland
- ▶ Scotland is the main contributor to GB's independent hydro capacity
  - ▶ 281 Scottish hydro projects with a total capacity of 150.5MW
  - ▶ Independent hydro capacity in Scotland has increased 18-fold from 7.9MW in 2012



# The transition to a new energy system is happening now

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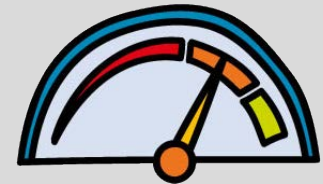
## **Ambitious targets set for 2030**

Scotland's draft energy strategy outlines targets for renewables to supply half of Scotland's entire energy needs by 2030



## **Growth of battery storage**

Rapid growth of battery storage to help balance supply and demand – 578MW by 2020\*

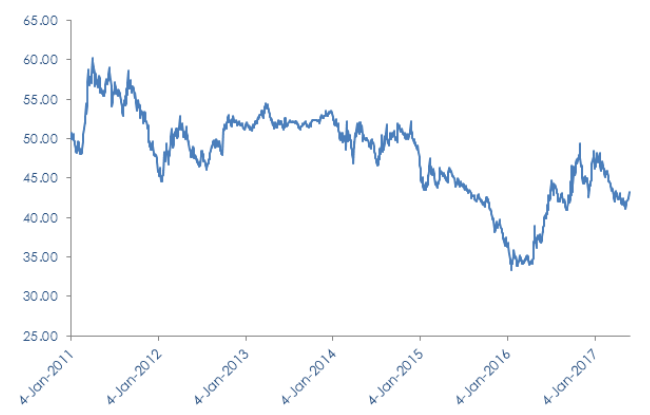


## **Demand response plays a vital role**

Increased flexibility with DSR capacity set to rise to 5.7GW by 2026 – Future Energy Scenarios Report

# A perfect storm of challenges

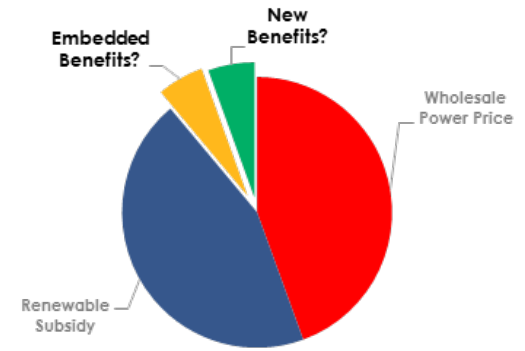
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Wholesale energy prices increasingly volatile



Cuts to Feed-in Tariff and the demise of ROCs



Potential changes to embedded benefits

**Commitment to the sector remains high** and generators are actively seeking to **maximise existing revenue** streams ...



1. Framework structure for multiple price fixes over a long contract period

2. Flexibility to sell your power in multiple hedges to suit your risk strategy

Route to market options

3. Outsource the selling of your power to trading experts

4. Take advantage of new contract structures emerging (i.e. Corporate PPAs)

A photograph of a dam with water flowing over it, creating a large splash and white foam. The dam is made of concrete and has several spillways. The water is a deep blue color, and the sky is a pale, hazy blue. The overall scene is a dynamic and powerful display of water energy.

Engage in the PPA  
market to maximise  
revenues

Thank you

Stephen McNally  
Business Development Manager,  
SmartestEnergy



Sourcing energy for  
a sustainable future



**EUAN NORRINGTON**  
**LEAD COMMERCIAL CONTRACT MANAGER**  
**SCOTTISH & SOUTHERN ELECTRICITY NETWORKS**

# SR Hydro Conference 2017

Euan Norrington  
Lead Commercial Contract  
Manager



# Who Can Add Value to Hydro and Pumped Storage in a Flexible Energy System?

Making the right choices when applying for a connection

- Heatmaps
- Contract Manager
- Online resources

When you are ready to apply

Flexible Connections

Outages

Next steps and further engagement

# Making the right choices with Hydro and Storage



Check our generation and demand  
Heat-map tools



Speak to our Contract Manager for  
that area



Use the online resources and guides  
available on Storage

# Heat-maps



Map	Summary	Download	Legend
	<b>Abernethy</b>	Transmission Status: Constrained	Distribution Status: Constrained Voltage (kV): 132 / 33
<b>Grid Supply Point (GSP) information in detail</b>			
Location (Lat, Long): 56.339761, -3.294071 Minimum Load (MW): 12.68 Maximum Load (MW): 53.84 Contracted Generation (MVA): 106.64		Fault Level (kA): 17.50 Transformer Nameplate Rating (MVA): 60.00 Reverse Powerflow Capacity (%): Consortia Count: 0	
<b>Transmission Works:</b> Errochty Substation 132kV busbar and switchgear reconfiguration, install two new 132/53kV 120MVA grid transformer units. <b>Transmission Reinforcement Completion Date:</b> Oct 19			
<b>Distribution Works:</b> Abernethy - Bridge of Earn 33kV Circuit - Increase Capacity <b>Distribution Reinforcement Completion Date:</b> March 2018			
<b>Contracted Generators</b>			
<b>Quoted jobs</b>			
<b>Contracted Generators</b>			
<b>Project Name:</b> Abernethy Project 01 <b>Technology Type:</b> Wind <b>State:</b> Connected		<b>Voltage(kV):</b> 33kV <b>Connection date:</b> Connected <b>Contracted capacity(MVA):</b> 9.949	
<b>Project Name:</b> Abernethy Project 02 <b>Technology Type:</b> BioGas <b>State:</b> Connected		<b>Voltage(kV):</b> 33kV <b>Connection date:</b> Connected <b>Contracted capacity(MVA):</b> 4	
<b>Project Name:</b> Abernethy Project 03 <b>Technology Type:</b> Wind <b>State:</b> Connected		<b>Voltage(kV):</b> 11kV <b>Connection date:</b> Connected <b>Contracted capacity(MVA):</b> 0.45	
<b>Project Name:</b> Abernethy Project 04 <b>Technology Type:</b> Hydro <b>State:</b> Connected		<b>Voltage(kV):</b> 11kV <b>Connection date:</b> Connected <b>Contracted capacity(MVA):</b> 0.434	
<b>Project Name:</b> Abernethy Project 05 <b>Technology Type:</b> Hydro <b>State:</b> Connected		<b>Voltage(kV):</b> 11kV <b>Connection date:</b> Connected <b>Contracted capacity(MVA):</b> 0.297	
<b>Project Name:</b> Abernethy Project 06 <b>Technology Type:</b> Other <b>State:</b> Connected		<b>Voltage(kV):</b> LV <b>Connection date:</b> Connected <b>Contracted capacity(MVA):</b> 0.237	



# Speak to our local Contract Manager Commercial Contract Team



Euan  
Norrington



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euan.norrington@sse.com

**Telephone:**  
01738 516596

**Mobile:**  
07469 411748

Lead Commercial Contract Manager

Andy  
Crumley



**Responsible for:**  
Western Isles, Community  
Projects and Large  
Distribution Connections

**Telephone:**  
01738 516886

**Email:**  
andy.crumley@sse.com

**Mobile:**  
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Commercial Contract Manager

Gavin  
MacKintosh



**Responsible for:**  
Highlands and Islands,  
Orkney.

**Telephone:**  
01738 456478

**Email:**  
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Commercial Contract Manager

Mark  
Westwood



**Responsible for:**  
South Caledonia

**Telephone:**  
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**Email:**  
mark.westwood@sse.com

**Mobile:**  
07342 026407

Commercial Contract Manager

Gary  
Simpson



**Responsible for:**  
North Caledonia &  
Shetland

**Email:**  
gary.simpson@sse.com

**Telephone:**  
01738 453253

Commercial Contract Manager

Lenka  
Nejedla



**Telephone:**  
01738 512141

**Email:**  
lenka.nejedla@sse.com

Commercial Contract Administrator

# North Regional Model

## Highlands and Islands

### Head of Region -

Colin Pirie - 07767 852305

### Connection Delivery Manager -

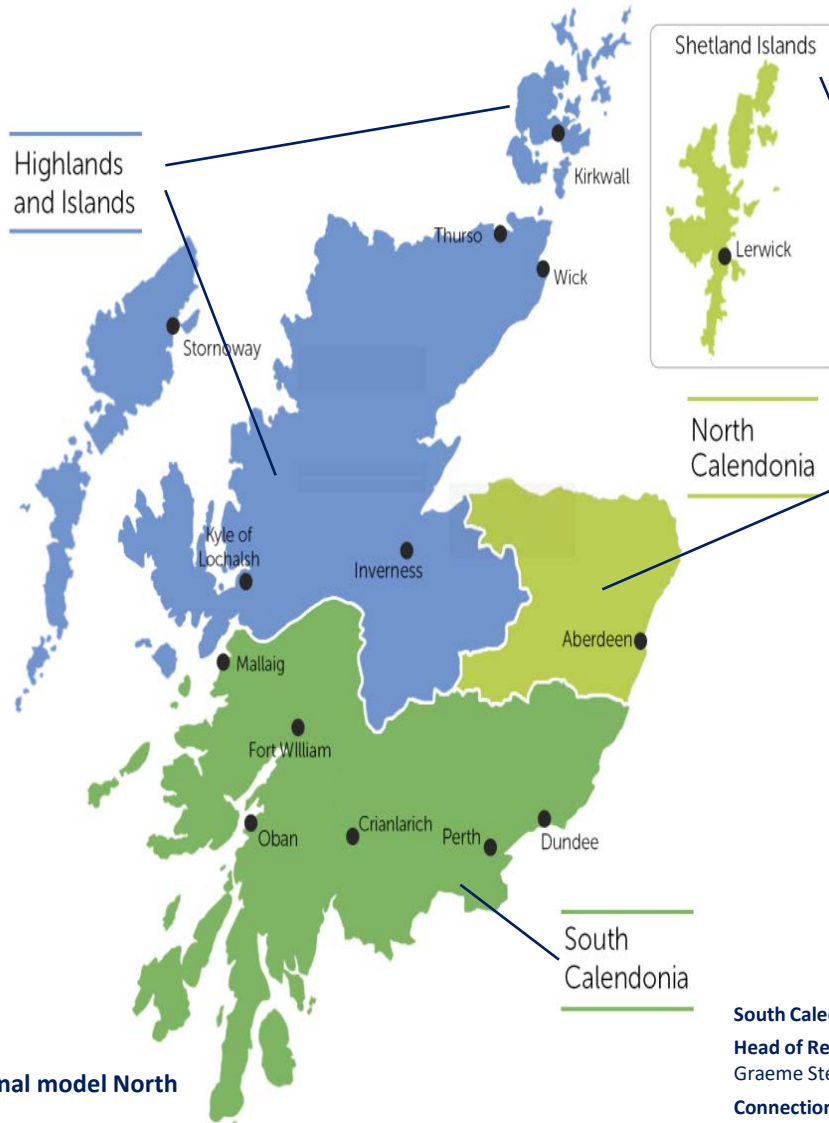
George MacDonald - 07767 852803

### Customer Relationship Manager -

Pamela Harvey - 07469 411432

### Customer Connection Manager -

Ian Jessiman - 07469 411438



Highlands and Islands

Shetland Islands

North Caledonia

South Caledonia

## Shetland Islands and North East Scotland – North Caledonia

### Head of Region -

Neil Wilson - 07767 852350

### Connection Delivery Manager -

Alan Bowie - 07810 858763

### Customer Relationship Manager -

Shona Horn - 07500 912566

### Customer Connection Manager -

Ian Jessiman - 07469 411438

## South Caledonia

### Head of Region -

Graeme Stewart - 07825 843868

### Connection Delivery Manager -

Traci Kidd - 07767 852057

### Customer Relationship Manager -

David Morrissey - 07767 852093

### Customer Connection Manager -

Asante Mtalimanja - 07979 854433

## Scottish and Southern Electricity Networks regional model North

Director of Operations - Dale Cargill

Contact details - 07767 852890 dale.cargill@sse.com

Head of Connections - Barry Will

Contact details - 07767 852098 barry.will@sse.com



# Online Resources

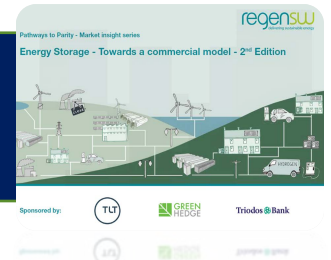
## IET storage guide

<https://www.regensw.co.uk/storage-towards-a-commercial-model>



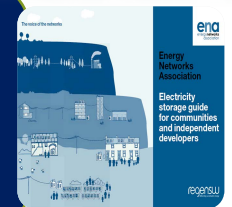
## Energy Storage - Towards a Commercial Model 2nd edition

<https://www.regensw.co.uk/storage-towards-a-commercial-model>



## Guide to connecting electricity storage guide for communities and independent developers

<https://www.regensw.co.uk/guide-to-connecting-electricity-storage-guide-for-communities-and-independent-developers>



# When you are ready to apply for a connection



Provide as much information as possible on the intended use and mode of operation for your storage project



Storage applications currently follow the 'DG application process', however there are currently plans underway to finalise a specific process for storage



Be clear in your application whether your storage project will be 'new', or whether it is being paired with an existing connection



Where you are pairing with an existing connection, we will need to consider whether the request is a 'material change'



The Active Power, Reactive Power and Apparent Power characteristics are very important when completing your ENA application form for storage



Introduction of new milestones specific to storage technology:  
-SO contract award such as EFR

# Flexible Connections

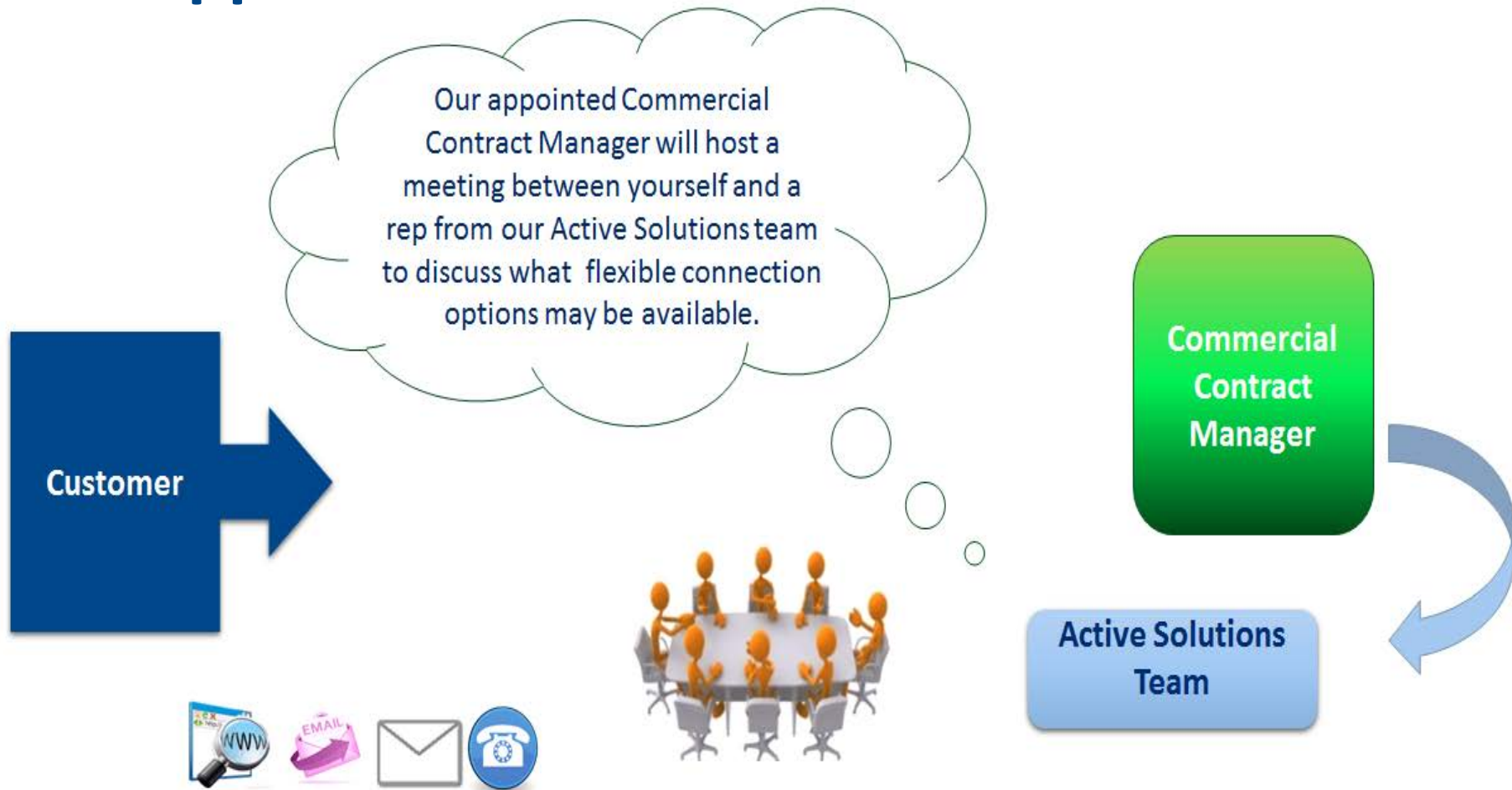
- As part of our connections improvement plan for 2017, we have committed to make it possible for you to request a 'Flexible Connection' for your connection.



# Pre-application Requirements

- Currently only applicable to generation connections
- Should hold a Standard Quotation that is within its validity period (which is 90 days after the Quotation is issued)
- Thermal constraints only
- Can find out more about what flexible options may be available by following this link
- <https://www.ssen.co.uk/AlternativeGenerationConnections/>

# Pre-application Consultation Process



# Further considerations.....

- Your 'queue position' can be maintained between traditional and flexible if going from one to the other
- We will provide you with data in order for you to determine if the level of curtailment is acceptable
- A flexible generation connection offer will provide for an enhanced scheme not a minimum scheme
- SSEN won't get involved in 3<sup>rd</sup> Party commercial agreements between 3<sup>rd</sup> Party ANM parties
- In order to operate flexible generation connections we are required to publish and share certain network information. We will use your data to help other applicants who are interested in flexible connections



# Outages

- Be aware of the clauses in your Connection Agreement which explain the situations in which you may be affected by an outage, what our obligations are and what rights you have as a connected customer;
- Ensure that your Site Responsibility Schedule (SRS) contact details are kept up to date;
- If interested, join us at our Operational Forum events – which are due to commence in the coming months. Contact [connectionsfeedback@sse.com](mailto:connectionsfeedback@sse.com)

96% of customers surveyed agreed this commitment will improve information for developers during the time of a planned outage

# Newsletters and Events

**Improved online functions  
Times Are Changing**

**Newsletter for ICPs and IDNOs**

We're excited to publish our first Newsletter for Independent Connection Providers and Independent Distribution Network Operators making you aware of the progress and improvements we have made.

As part of our overall connection strategy, we're hard on delivering the service you receive from us by enabling you to identify your own point out your own design approval, and allow policy changes and website functions.

The following Newsletter will inform you find it:

- Modernised and more accessible Design & Specification Documents
- Enhanced Geographic Information Systems
- High Voltage Network

Start your journey here: <https://www.scottishandsouthernenergy.co.uk>

**A. POC Self Identification**

**Our New Inspection and monitoring process and online tracking**

We have now set up an internal Network Business Team, including the appointment of inspectors dedicated to carrying out site inspections. The inspectors will be conducted on a relative sample of all works undertaken by both ICPs and SSEPD's own staff.

ICPs are encouraged to be pro-active in notifying the SSEPD Team Manager who is responsible for overseeing the scheme, when their works will be starting and when they are going to be ready for inspections, this will ensure that the process is not onerous on the ICP.

Works should not start without a programme being presented to the SSEPD Manager. The ICP will need to provide updated programme(s) to the Manager to ensure they have the correct information to provide to the Inspector.

Important initial stages of the process are:

- Programme of works being supplied to SSEPD Team Manager
- Design Notification Approval & signed adoption agreement

To ensure your security and privacy, you will need to register for access. This also gives you relevant documentation, website and policy information.



# We have a full calendar of events lined up to engage with our customers in 2017

National Events

Engagement days

Connections Surgeries

Online


View our events calendar on the SSEN website to find out where we will be next.....

[www.ssen.co.uk/stakeholderevent/basicsearch](http://www.ssen.co.uk/stakeholderevent/basicsearch)



# Engage with us online


Stay updated with the latest news and improvements by following us online:

 Search 'SSEN Connections Engagement'

 [Twitter.com/ssencommunity](https://twitter.com/ssencommunity)

 [Facebook.com/ssencommunity](https://facebook.com/ssencommunity)

 [www.ssen.co.uk](http://www.ssen.co.uk)

 [www.ssen.co.uk](http://www.ssen.co.uk)

 [connectionsfeedback@sse.com](mailto:connectionsfeedback@sse.com)



**DAN HAMMOND**  
**OPERATIONS AND MAINTENANCE MANAGER**  
**DULAS**



**dulas**  
inspiring renewable energy



solar



wind



hydro



biomass

## Getting the Best from Existing Small Hydro Schemes

Scottish Renewables Hydro – Perth – June 2017

Dan Hammond (O&M Manager) [dan.hammond@dulas.org.uk](mailto:dan.hammond@dulas.org.uk)



Continued R & D and innovation



Excellent customer service



Knowledgeable, experienced staff



Over 3 decades  
of heritage



Quality  
assured

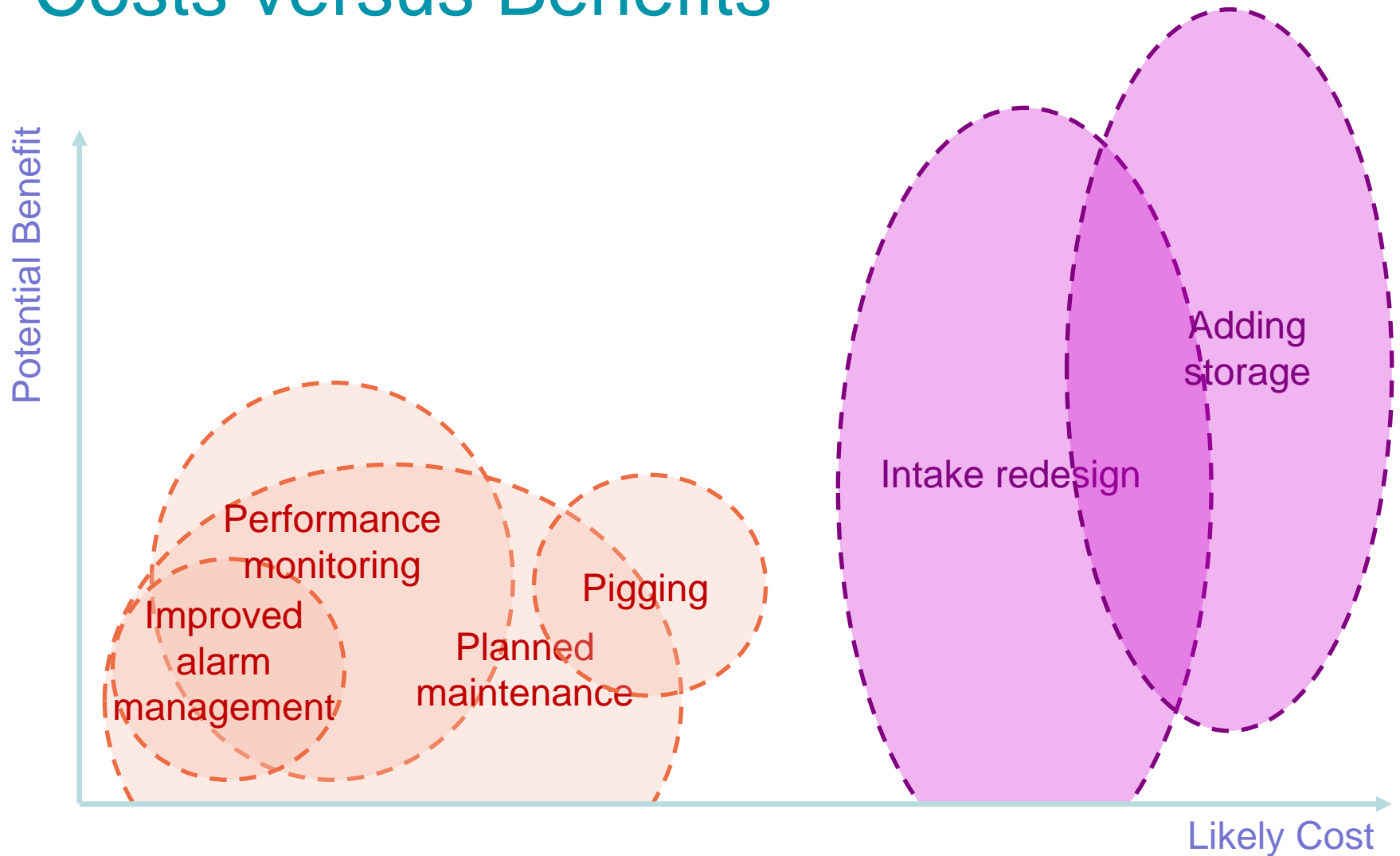
We create  
inspiring &  
reliable  
renewable  
energy  
solutions

# Optimisation

- “...make [a system or process] as good as possible in some defined sense.” (Wiktionary)
- Make *existing small hydro schemes* as good as possible *in terms of generation (and hence revenue) at a reasonable cost.*



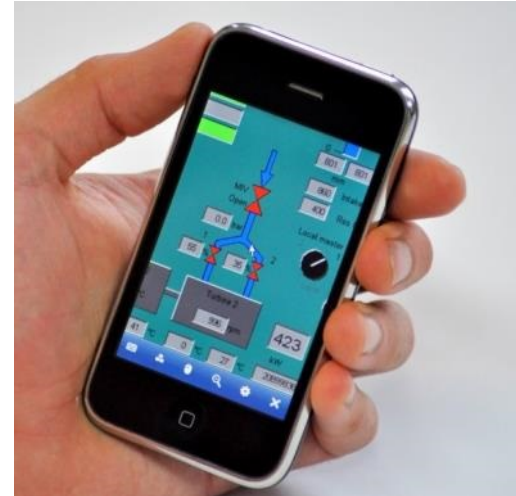
# Costs versus Benefits



\*This is very scheme dependent

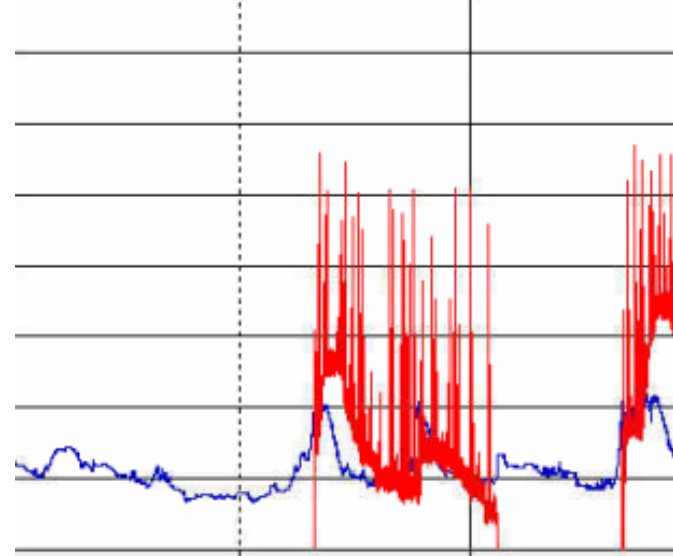
# Alarm Management

- 400kW Pelton scheme, prone to grid faults (G59 trips)
- Prior to improvement:
  - Grid faults require manual re-set
  - 8% generation lost over 4 months
- With improved alarm management:
  - Grid faults automatically reset
  - Reduced generation lost to 2% over subsequent 11 months
- Cost of reprogramming ~£500
- Estimated £5k/year benefit

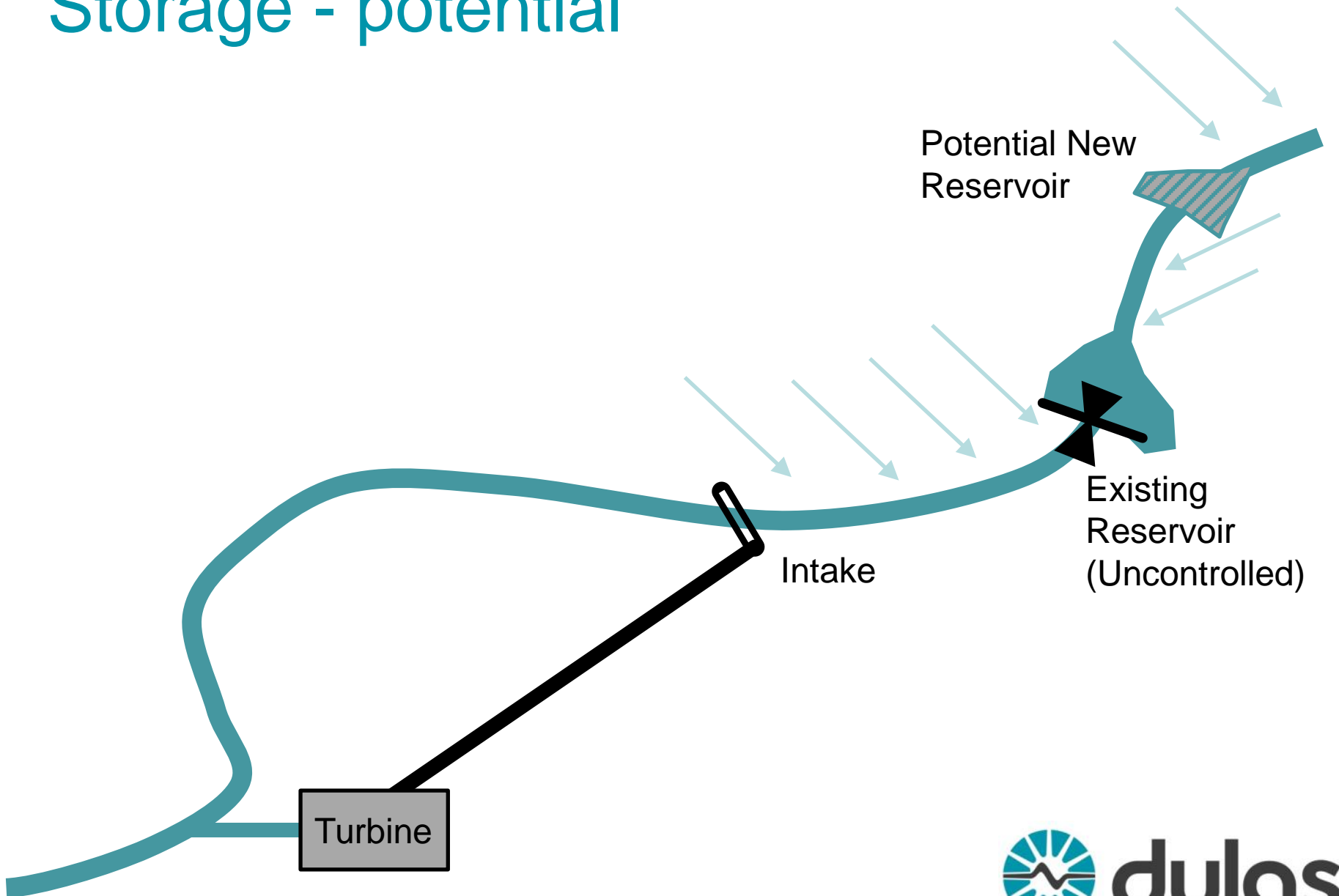


# Performance Monitoring

- 920kW Pelton scheme, with side intake
- Poor adjustment of intake control set points resulting
  - failing to start when water available
  - excess water lost over weir
- Based on comparison with a neighbouring scheme, an estimated 125MWh lost over 3 winter weeks
- Would have been picked up by regular (daily or weekly) monitoring of scheme performance data
- Cost of daily monitoring for 1 year ~£3k
- Lost revenue over 3 weeks ~£11k



# Storage - potential



# Storage - potential

- Fixed release from reservoir, sized to maximise generation
  - Projected ~25% increase in generation
  - Minimum cost option
- Actively controlled release from reservoir
  - Projected ~30% increase in generation
  - Greater capital and O&M costs
- Second reservoir upstream
  - Projected 3-6% on top of above options
  - Major civils works required
- All subject to consents!



# Storage - operating

- Scheme built 2000
- Reservoir added 2002
- Actively controlled released from the reservoir increases scheme generation by ~20% versus run-of-river prediction
- ...some schemes do better...



# Intake and Control Improvement

- 650kW Pelton with poorly performing side intake and various control issues
- Dulas Improvements
  - New Coanda Screen Intake
  - Reprogrammed control system
  - New SCADA
- Approx. 620MWh increase in annual generation (49%) in average year



# Knowledge is Power<sub>(export)</sub>

- The cost-benefit of different improvement options is highly site specific
  - Have the right sensors
  - Log the data
  - Monitor performance over time
  - Review against expected performance (predictions, river flow data, neighbouring schemes)
  - Identify where generation is being lost (get the basics right)
  - Then identify where generation might be increased





# Why Optimisation?

- Getting the basics right pays dividends
- There are big improvements to be realised on some schemes
- It's all site specific
- Without good data you can't make good decisions

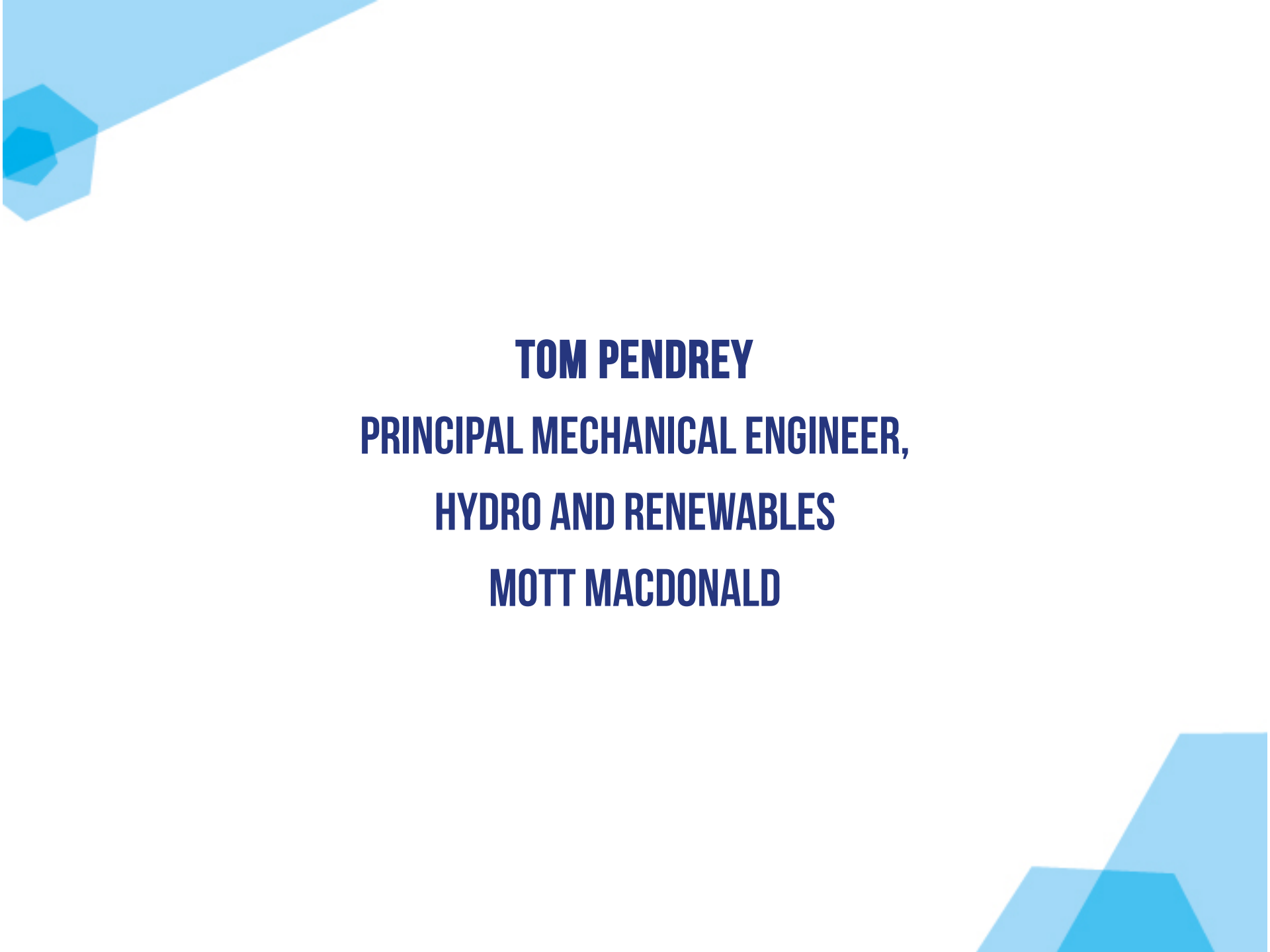


# Accreditations and memberships



Cert. no. 1140 Solar PV





**TOM PENDREY**  
**PRINCIPAL MECHANICAL ENGINEER,**  
**HYDRO AND RENEWABLES**  
**MOTT MACDONALD**

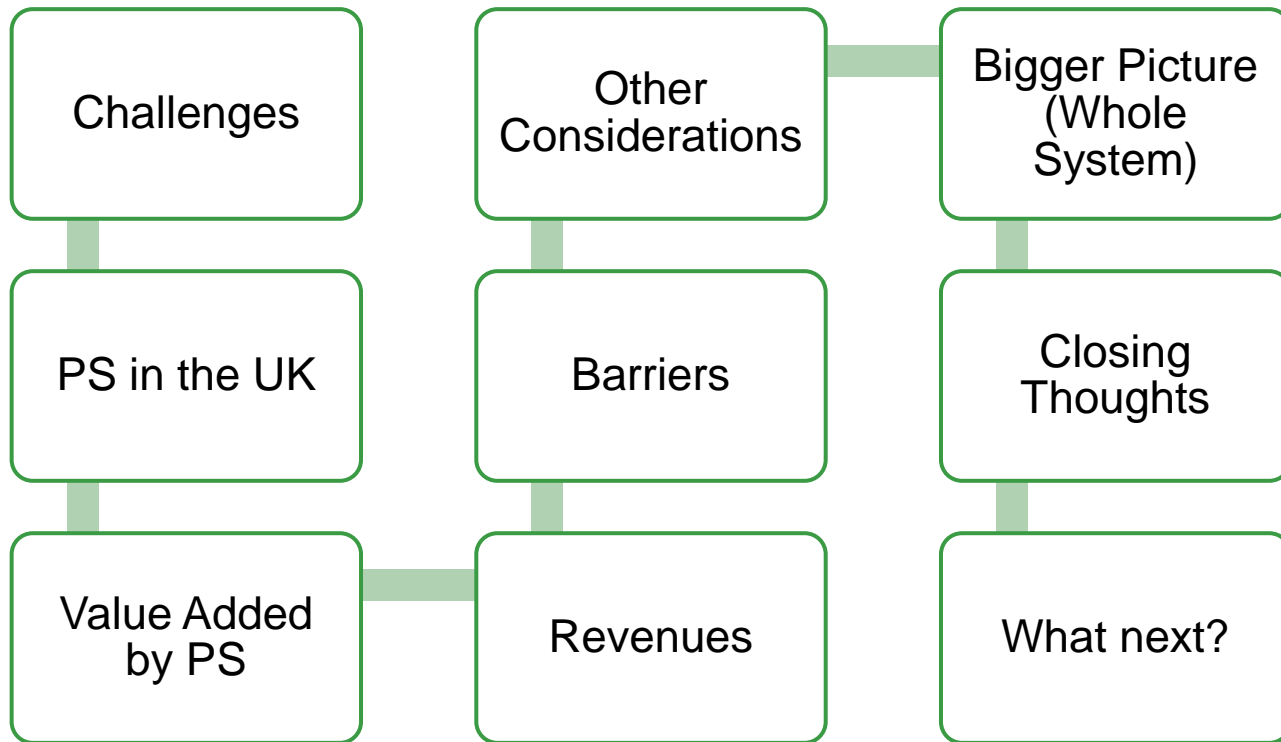
# New pumped storage hydro in the UK – is there a case?

Tom Pendrey

Scottish Renewables Hydro  
Conference, Perth

6 June 2017

# Structure



# Challenges facing the UK energy market

1

Keep the lights on

2

Security of supply

3

Stable system

4

Ability to black start

5

Work with intermittent renewables

6

Reduce system operating costs

7

Create a smart and flexible network

8

**System Operability**

# Pumped Storage in the UK

## Existing

### Dinorwig

1,728 MW

288 MW x 6

Full power in 16 seconds from spinning

8.64 GWh stored energy

### Cruachan

440 MW

2 x 100 MW + 2 x 120 MW

Full power in 2.5 mins from spinning

8.8 GWh stored energy

### Ffestiniog

360 MW

4 x 75 MW

~ 1.3GWh stored energy

Full power < 1min

### Foyers

300 MW

6.3 GWh stored energy

## Consented

### Coire Glass

600 MW

50 hours

30 GWh stored energy

### Glenmuckloch

400 MW

~ 4 hours

~ 1.7 GWh

### Glyn Rhonwy

99.99 MW

600 MWh stored energy

## In development

Lots...

# Value Added by Pumped Storage

1

Flexible and reliable

2

Frequency response

3

Energy storage and security

4

Inertia while turbinning AND pumping

5

Spinning Reserve

6

Demand Management

7

Black start

8

Reduced system operating costs



# Further considerations

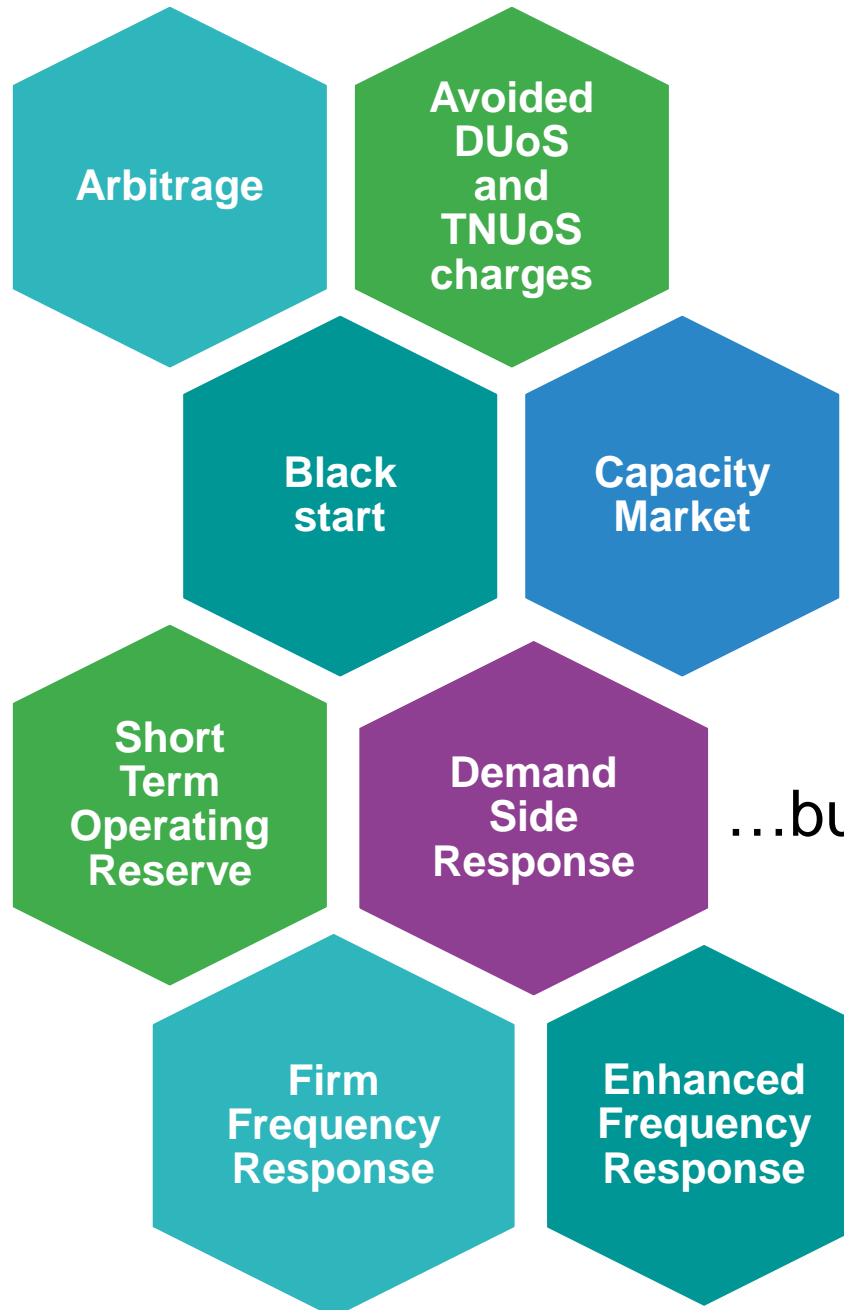
Interconnectors

Batteries

Large  
construction  
project

Intermittent  
renewables

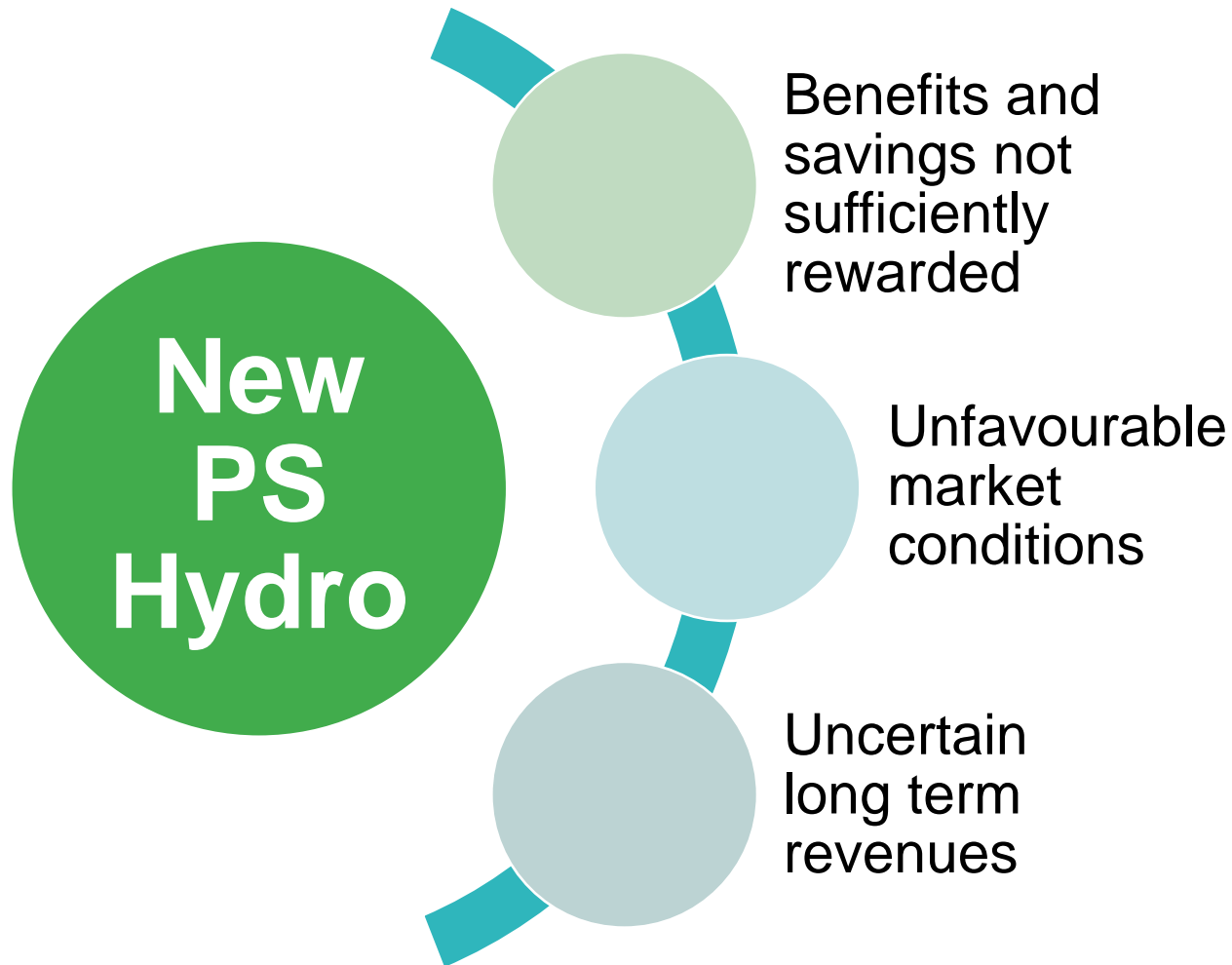
# Revenues



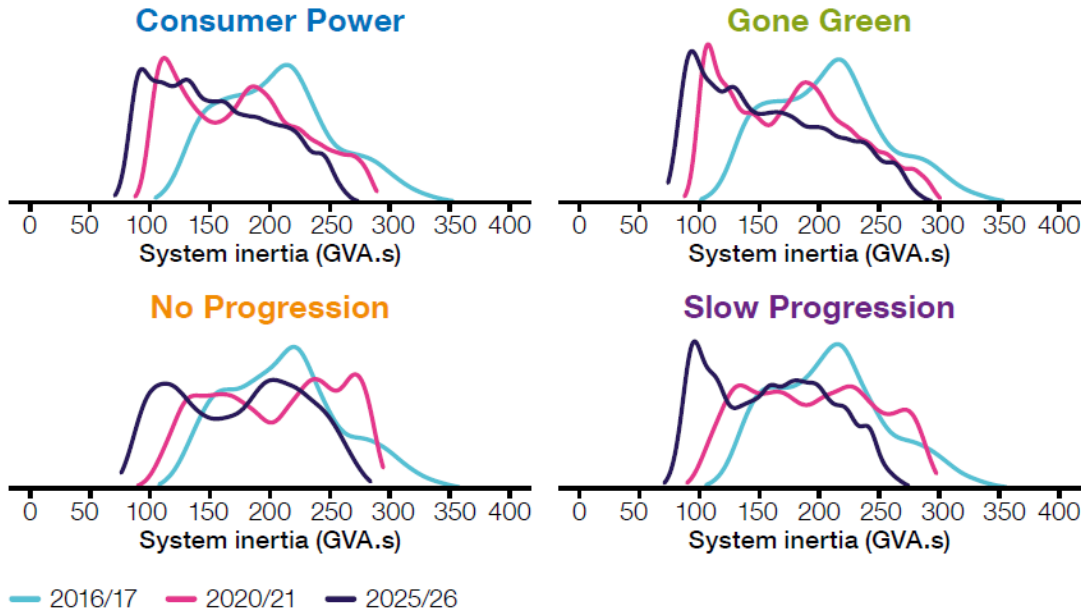
...but (how) do they stack up?

**Inertia?**

# Barriers



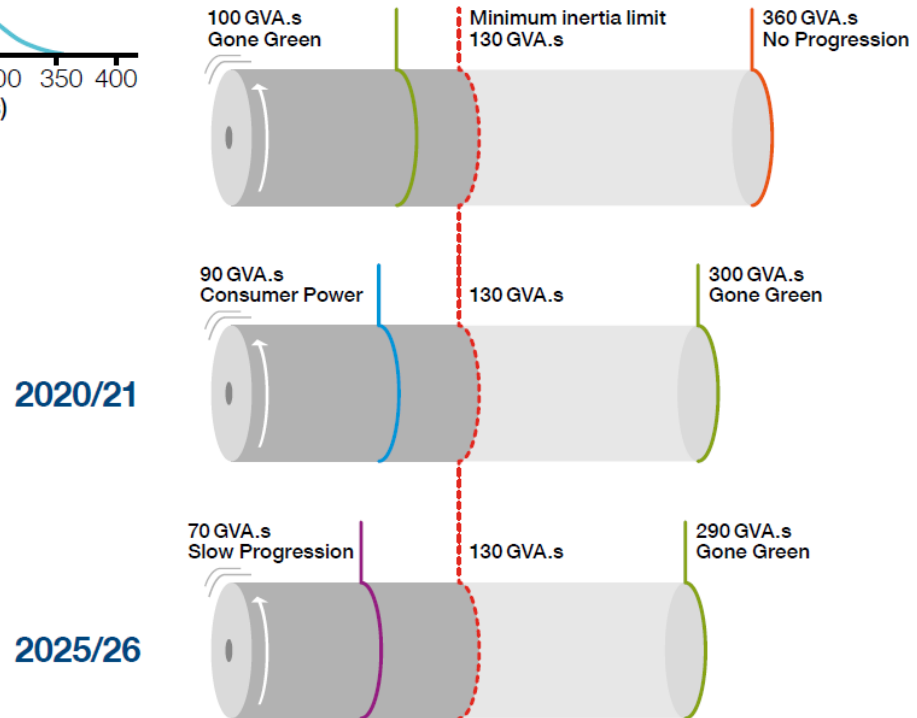
# System Operability – Frequency management (1)



Source: NGET SoF 2016

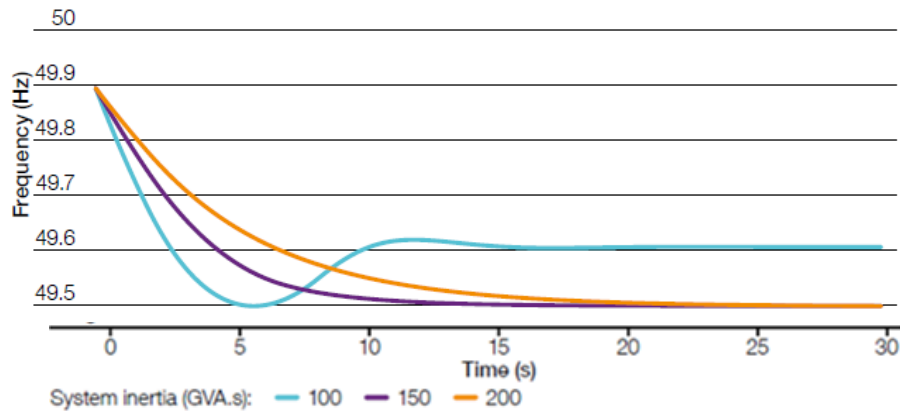
- ## Future Energy Scenarios
1. No Progression
  2. Slow Progression
  3. Consumer Power
  4. Gone Green

- ## System Operability means:
1. Balancing and flexibility
  2. Frequency management
  3. Voltage management
  4. Whole system coordination



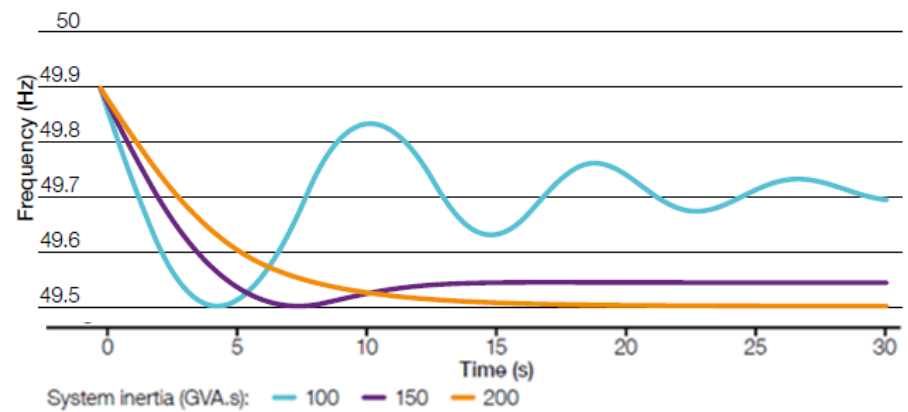
# Frequency management – Loss of Generation Scenarios

## Frequency Containment Simulation of 500MW Generation Loss



Source: NGET SoF 2016

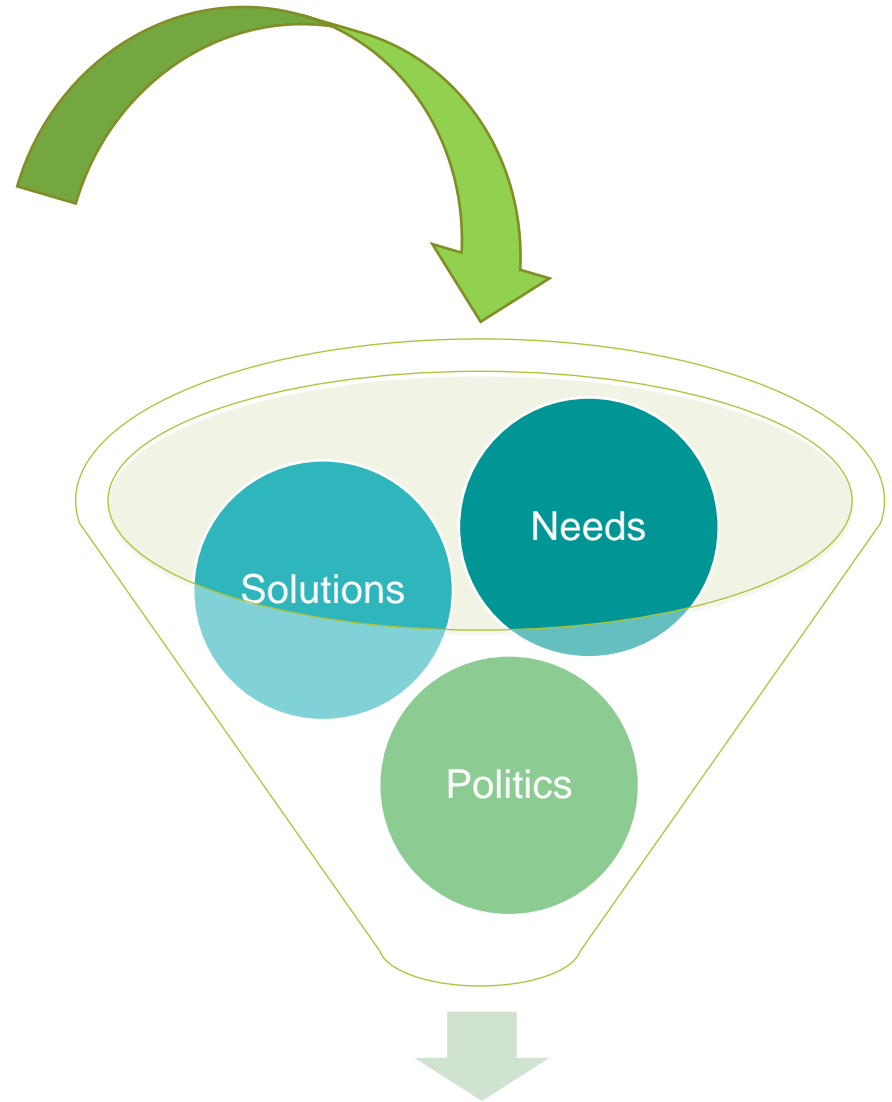
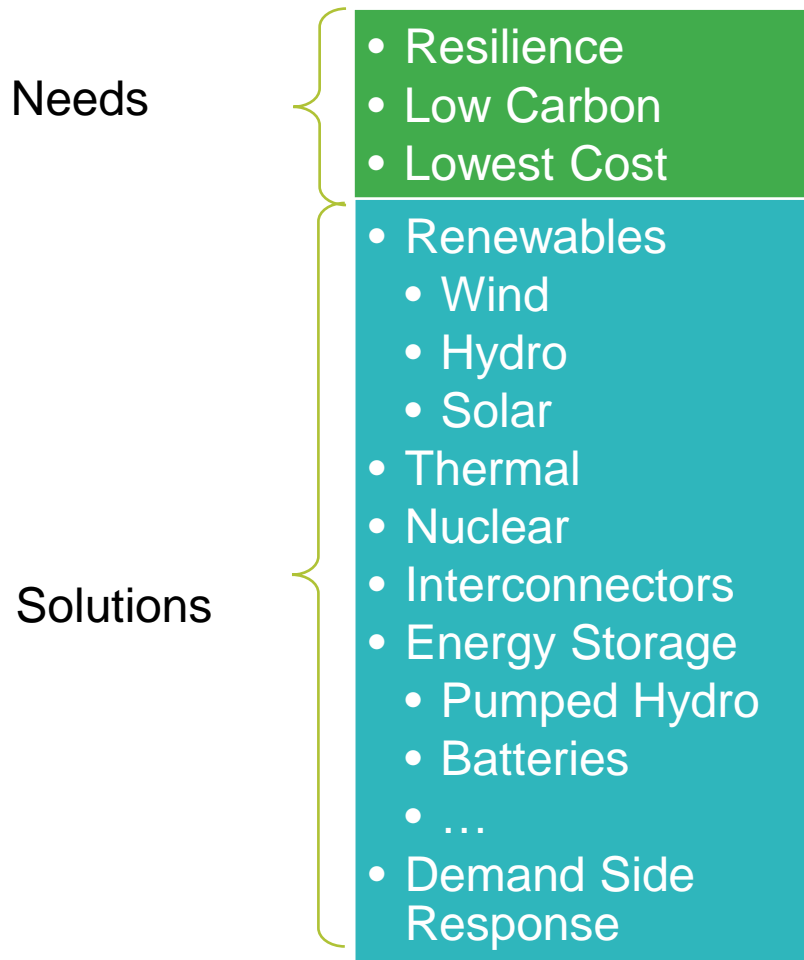
## Frequency Containment Simulation of 600MW Generation Loss



Source: NGET SoF 2016

**SQSS permits max 1,320 MW loss...**

# Bigger picture...



**The Electricity Mix**

## Closing thoughts

A low carbon future will need to address increasing challenges with innovative solutions.

New pumped storage hydro could play a significant part in support a smarter grid, ensuring stability, flexibility and security of supply.

(Part of a)  
Smarter Grid

Stability

System flexibility

Energy security

# What next?

1. Continue to develop consented projects as well as other technically feasible projects
  2. Progress innovative solutions to increase value that PS can add, for example:
    - Variable speed and ternary units
    - Hybrid projects, e.g. wind/PS, solar/PS
  3. Work with government to develop fiscal and regulatory platform that further recognises the value that PS adds
-



# Thank You

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# HYDRO CONFERENCE & EXHIBITION

6 JUNE 2017 PERTH

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