



# SOLAR CONFERENCE

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**Claire Mack**  
Chief Executive  
Scottish Renewables

# **Securing a solar future:**

The role of solar in our future energy system

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**Hannah Smith**

Senior Policy Manager

Scottish Renewables

**James King**  
Associate Director  
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# **Christos Markides**

Professor of Clean Energy Technologies  
Imperial College London



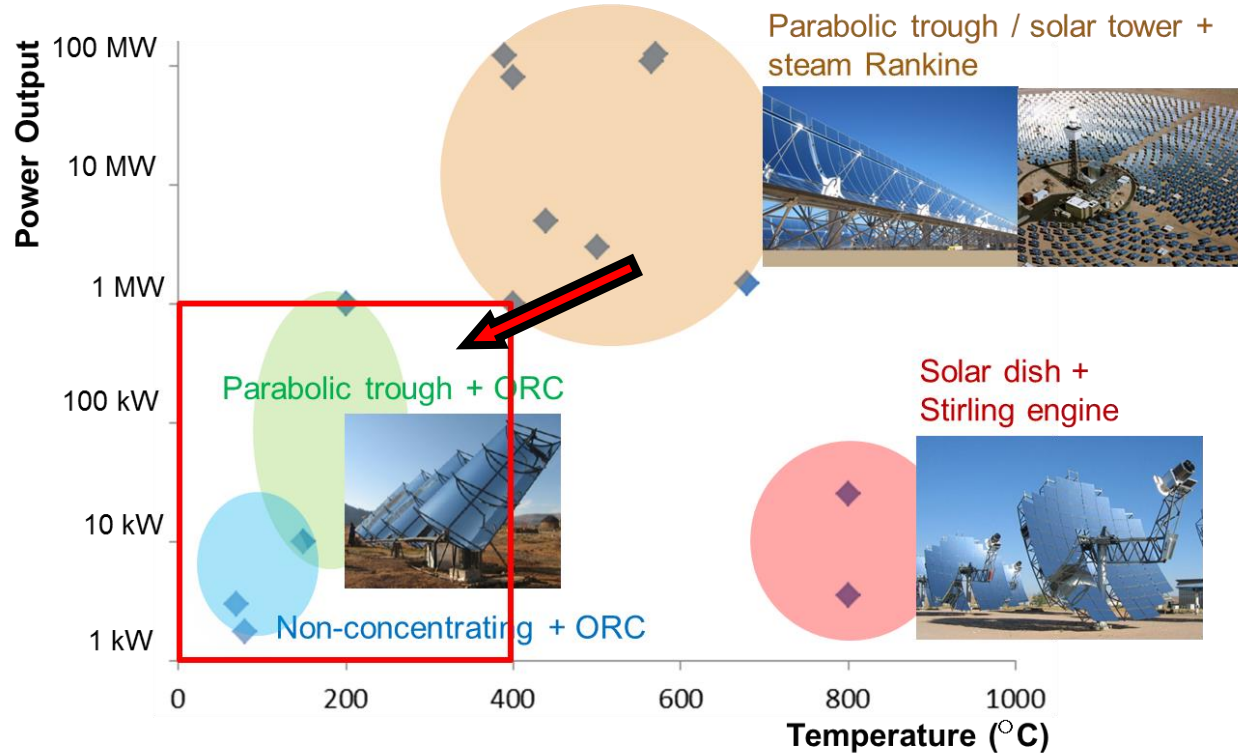
# Solar-thermal and hybrid photovoltaic-thermal systems for renewable heating and power

**Christos N. Markides**

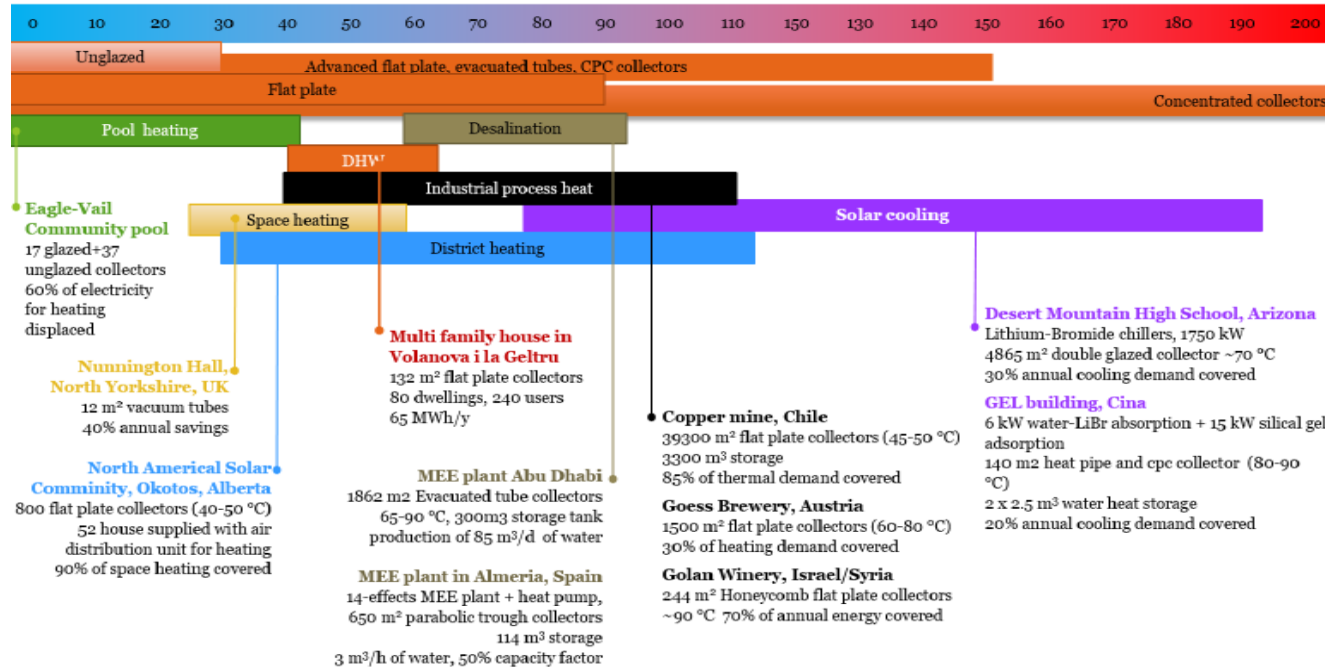
[c.markides@imperial.ac.uk](mailto:c.markides@imperial.ac.uk)

Professor of Clean Energy Technologies  
Head of the Clean Energy Processes (CEP) Laboratory  
Department of Chemical Engineering

# Scale of interest



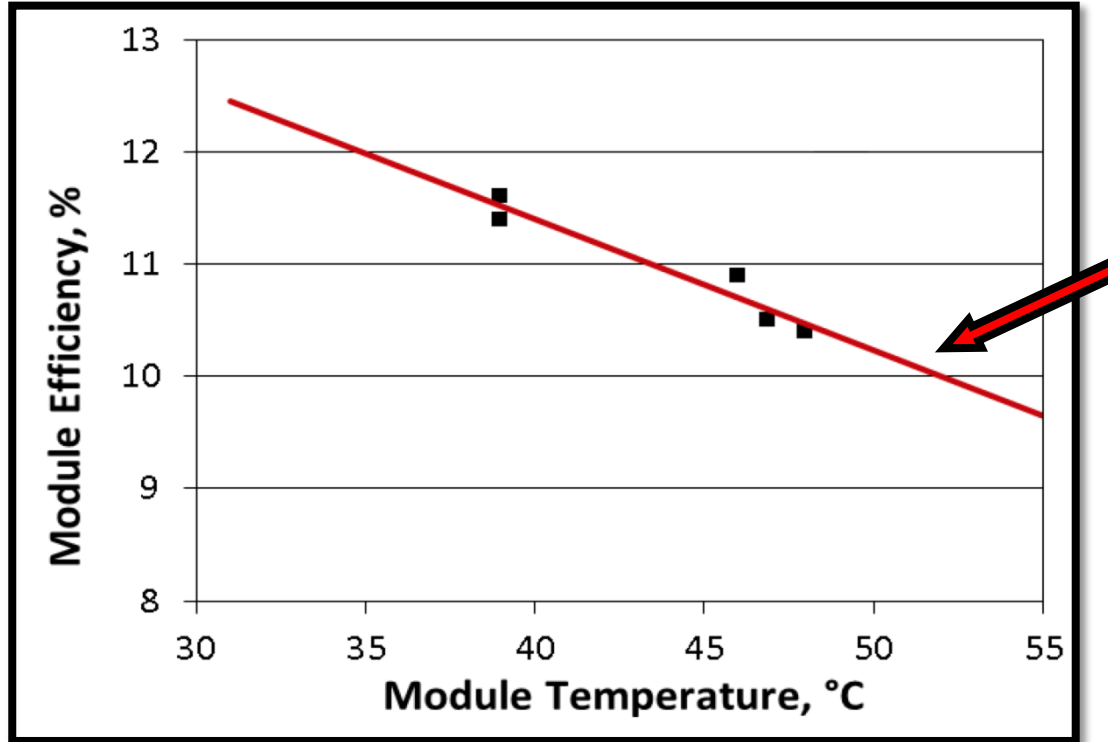
# Solar-thermal technologies & applications: Overview



Ramos, et al., 2017. Solar-thermal and hybrid photovoltaic-thermal systems for renewable heating, *Grantham Briefing Paper*, 3.

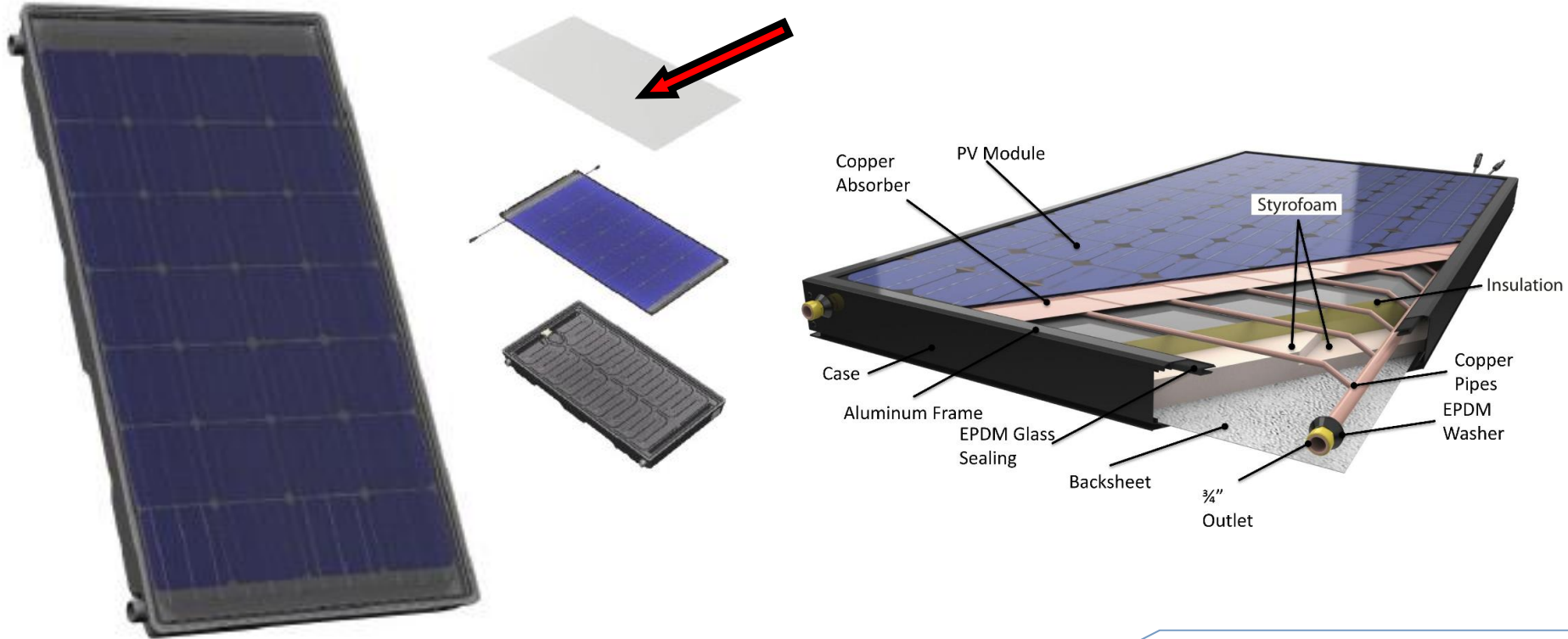
[www.imperial.ac.uk/grantham/publications/briefing-papers/solar-thermal-and-hybrid-photovoltaic-thermal-systems-for-renewable-heating.php](http://www.imperial.ac.uk/grantham/publications/briefing-papers/solar-thermal-and-hybrid-photovoltaic-thermal-systems-for-renewable-heating.php)

## Motivation for a hybrid PV-thermal collector

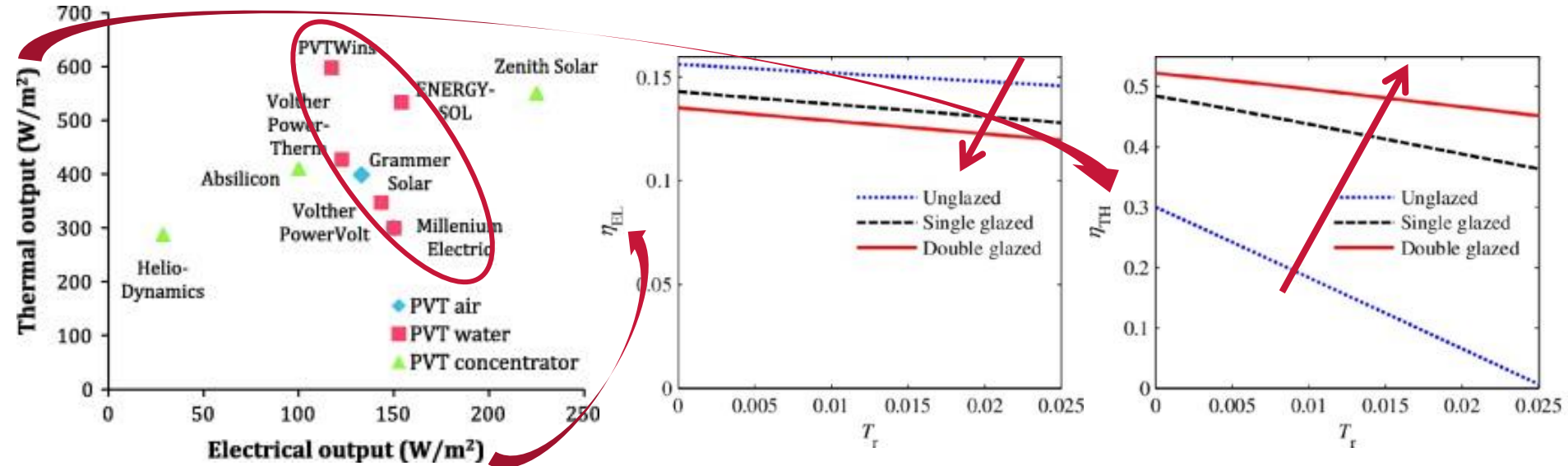


<http://large.stanford.edu/courses/2013/ph240/alshakhs2>

# Traditional commercial PVT panel designs



# Performance: Thermal & electrical

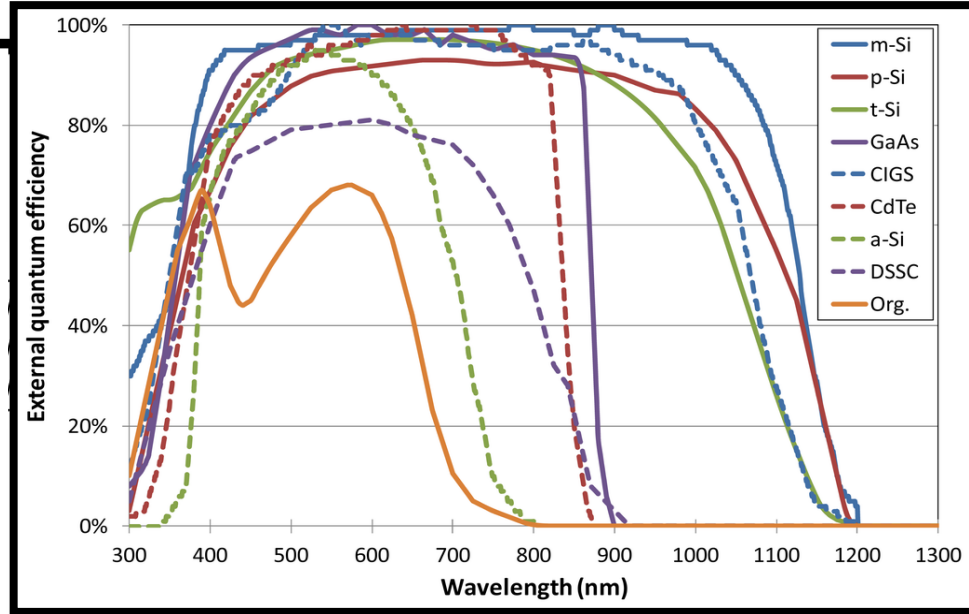
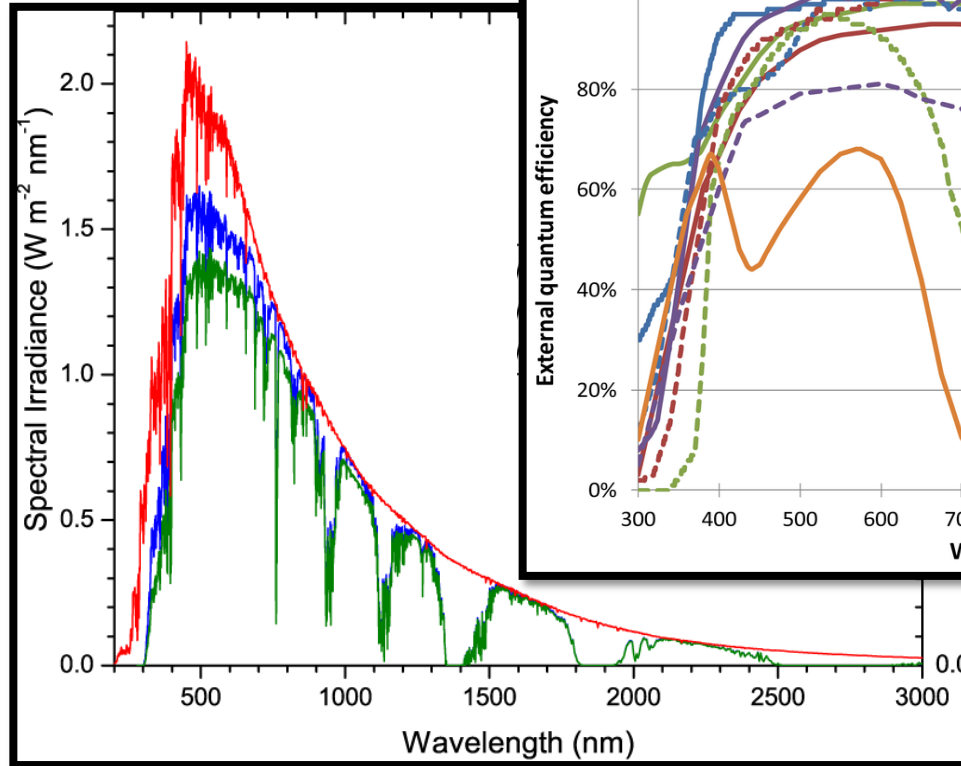


Herrando, Markides, Hellgardt, 2014. A UK-based assessment of hybrid PV and solar-thermal systems for domestic heating and power: System performance, *Applied Energy*, 122:288. [www.sciencedirect.com/science/article/pii/S0306261914000907](http://www.sciencedirect.com/science/article/pii/S0306261914000907)

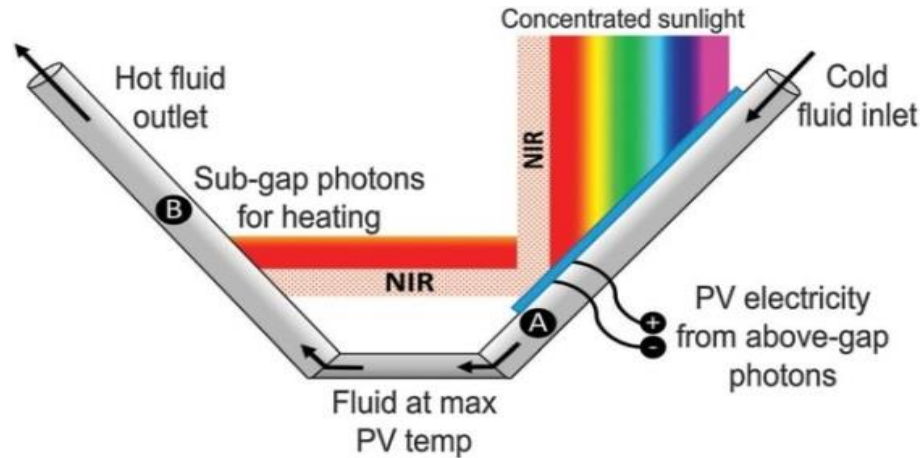
Herrando, Markides, 2016. Hybrid PV and solar-thermal systems for domestic heat and power provision in the UK: Techno-economic considerations, *Applied Energy*, 161:512. [www.sciencedirect.com/science/article/pii/S0306261915010958](http://www.sciencedirect.com/science/article/pii/S0306261915010958)

Ramos, et al., Hybrid photovoltaic-thermal solar systems for combined heating, cooling and power provision in the urban environment, *Energy Conversion and Management*, 150:838. [www.sciencedirect.com/science/article/pii/S0196890417302273](http://www.sciencedirect.com/science/article/pii/S0196890417302273)

# Motivation for a spectrally-split hybrid collector



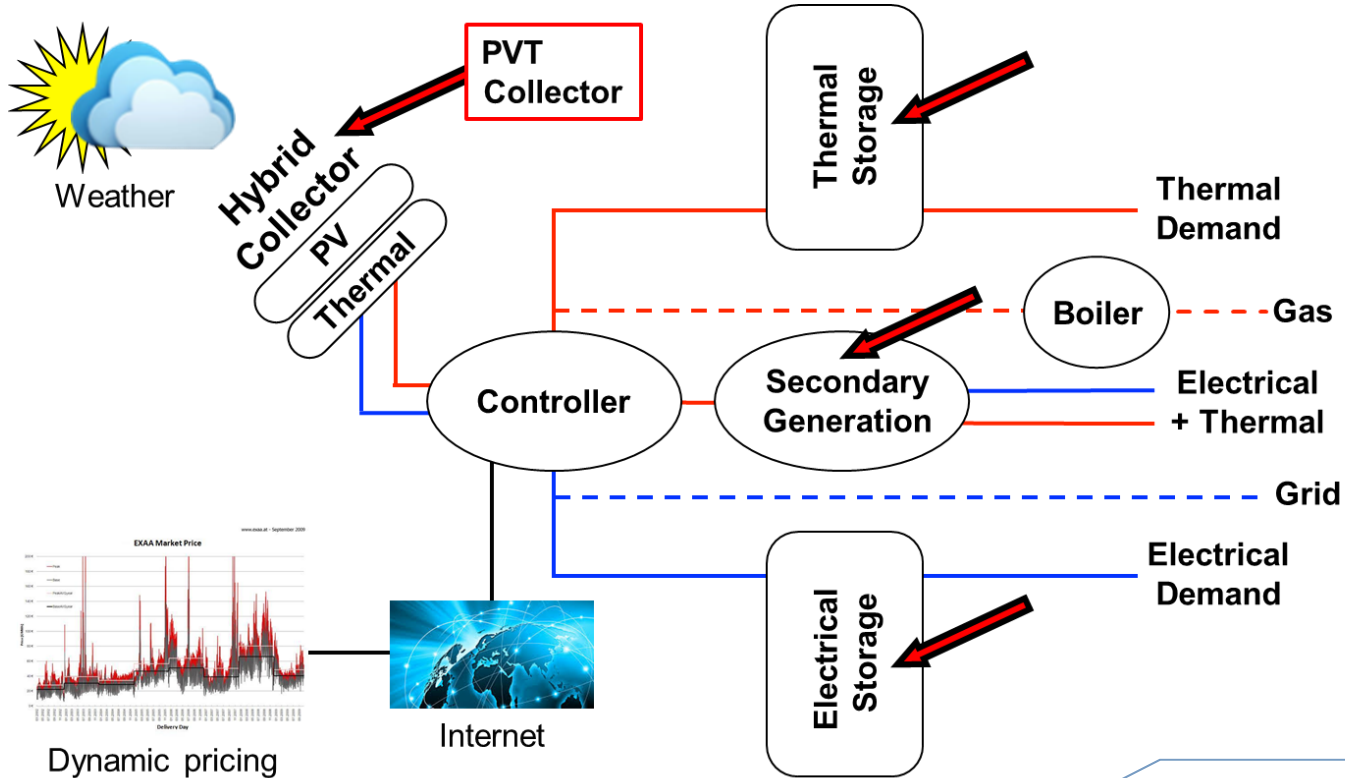
# Next-generation high-efficiency PVT concepts



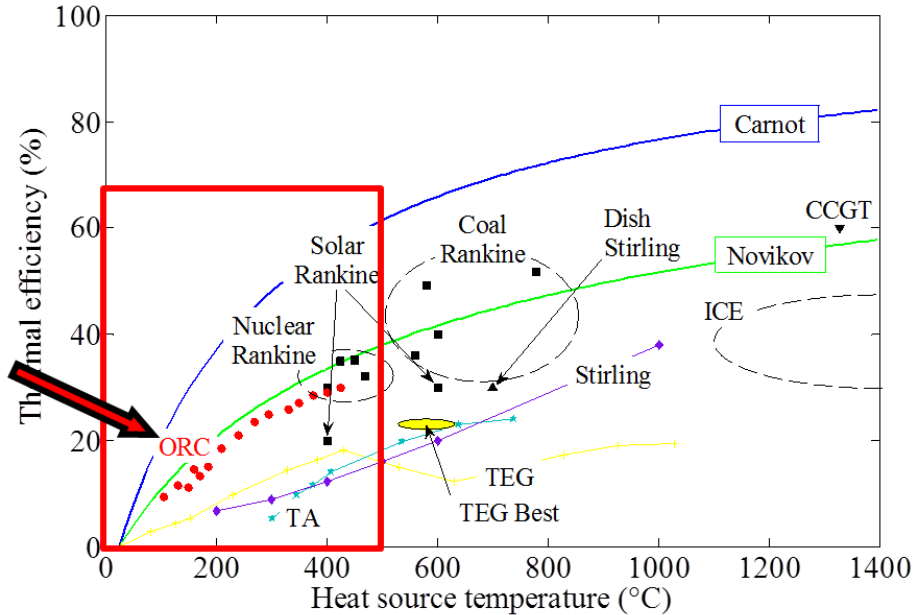
<https://arpa-e.energy.gov/?q=publications/hybrid-solar-converters-maximum-exergy-and-inexpensive-dispatchable-electricity>



# Hybrid PV-thermal combined heat & power systems



# Other options for additional power and/or cooling



Markides, 2015. Low-concentration solar-power systems based on organic Rankine cycles for distributed scale applications: Overview and further developments, *Frontiers in Energy Research*, 3:47(1-16). <https://www.frontiersin.org/articles/10.3389/fenrg.2015.00047/full>  
 Kheirabadi, Freeman, Cabal, Markides, 2017. Experimental investigation of an ammonia-water diffusion-absorption refrigerator (DAR) at part load, *ASME 2017 Heat Transfer Summer Conference*, <https://dx.doi.org/10.1115/HT2017-4830>

# Solar-thermal and hybrid photovoltaic-thermal systems for renewable heating and power

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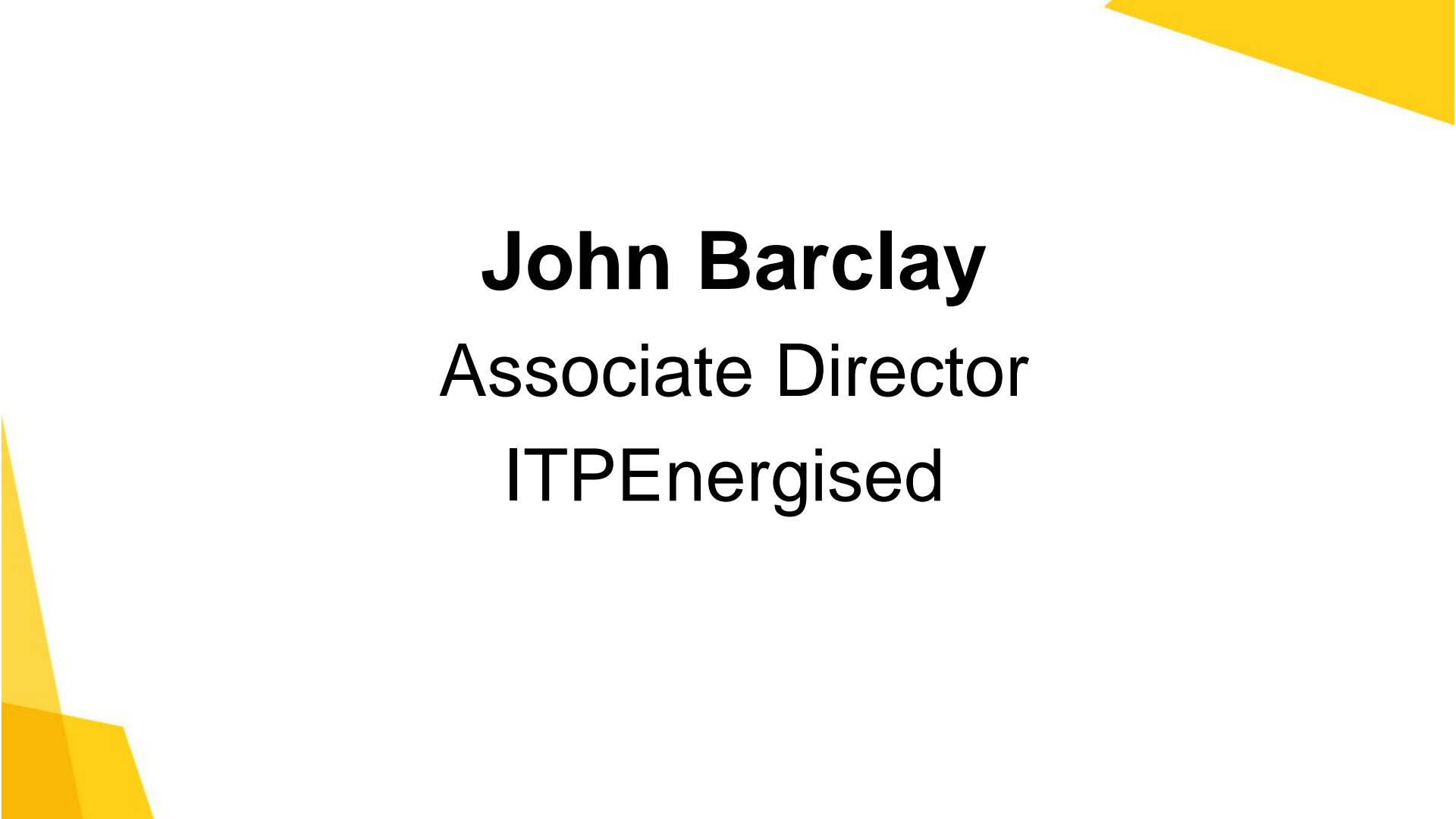
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# **Delivering a route to market**

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**John Barclay**  
Associate Director  
ITPEnergised



# ITPEnergised

## John Barclay – Associate Director

A leading consultancy offering energy, environmental, engineering technical advisory and renewable asset management services



# C&I Approaches to Energy – Look back to 2016

- 2016 difficult year for engagement
- Uncertainty of subsidy for LZC technologies
- Reduction in energy prices; 40% in NG (~1.6 per kWh) and 15% in electricity (~8p per kWh wrapped up costs)
- Hangover from Energy Savings Opportunities Scheme – race to the bottom
- Policy uncertainty – Still no visibility of simplified reporting framework consultation highlighted in UK Budget March 2016
- The above had swayed some but not all e.g. retailers
- But some positive signs.....

# C&I Approaches to Energy – State of Play

- 2018 suggests positive sentiment to energy cost reduction – carbon?
- Acceptance that FiT is finished and that RHI is uncertain
- Increase in energy prices; 25% in NG (~2p per kWh) and 30% in electricity (~11p per kWh) with wholesale now ~45% of overall cost
- CfD, ROC and FiT charges now at ~3.3 pence per kWh
- BSUoS, CM and CCL charges now at ~1.2 pence per kWh
- Combined cost of above now greater than straight consumption unit cost
- Suggestion of early action Energy Savings Opportunities Scheme 2
- Policy uncertainty – still not clear exactly what SECR will involve
- Although still inertia on PPAs and LZC technologies for most
- Combined Heat & Power providing 2-3 year paybacks vs renewables

# C&I Approaches to Energy – Outlook

- More PPAs with large tech companies and resulting coverage
- SEEP and ambitious targets from SG
- SG owned energy company – RTM?
- Forecast for continued increases in gas and electricity prices
- NDEE Framework for Public Sector – gathering momentum
- LCITP transformational projects well underway
- Reduction in battery momentum?
- Significant reduction in grid carbon intensity = C&I companies reducing CFs even by doing nothing
- Huge increases in EV uptake and charging points
- Experience suggest significant variations in C&I awareness

**Figure 1: - Breakdown of an energy bill**

Costs are scaled to 100GWh / 55-65 load factor / Customer in London

Charge	Cost p.a.	%	Forecast
Energy (inc. losses)	£4,926,381	46.5	↑
Supplier costs (inc. margin and risks)	£188,349	1.8	→
Transmission charges (TNUoS)	£875,542	8.3	↑
Distribution charges (DUoS)	£983,078	9.3	↑
Balancing use of system charges (BSUoS)	£277,292	2.6	↑
Renewables obligation	£1,864,000	17.6	↑
Feed-in Tariff charge	£543,000	5.1	↑
Climate Change Levy	£568,000	5.4	↑
Contracts for Difference (CfD)	£221,834	2.1	↑
Capacity Market (CM)	£112,350	1.1	↑
Other charges (BSC, AAHEDC, Metering)	£30,753	0.3	↑
<b>Total estimated cost</b>	<b>£10,590,578</b>	<b>100</b>	<b>↑</b>

Source: Novus Energy - Focus on Non-Energy charges, November 2017

# C&I PPA Challenging Customer?

- Objects to renewable energy as they only see costs hitting their bill
- No carbon management plan or reduction strategy
- Only interested in lowest cost of energy today with no hedging strategy
- Procurement department with no real understanding of energy markets.
- Buys energy exclusively via TPI
- Buys energy through a national framework. No current option to go elsewhere. In Scotland that includes NHS Boards, LAs, Higher Education boards etc
- May be in a sector where recent history would suggest that their market is under threat. Example; Scottish Paper Industry over the last 15 years.
- Organisations who already generate much of their own electricity due to nature of operation such as refining and chemicals or via on-site CHP, renewables or conventional power generation.
- Examples like Michelin, DSM, Ineos, GSK, AG Barr, grain distilleries via AD

# C&I PPA Target Customer?

- Fully engaged in carbon reduction and has publically stated reduction goals and may be a member of RE100
- May already have a PPA outside the UK so has some internal knowledge
- Takes long term view on energy procurement
- Has a senior director with buy in on carbon reduction
- Has a dedicated member of staff who understands energy procurement
- Has a reasonable degree of energy consumption and pays the bills. Many companies with large numbers of office based staff will be tenants and a landlord pays the bills.
- Potential to engage with large landlords who could potentially market their renewable electricity supply to tenants
- Sectors; F&D, automotive, hospitality, manufacturing, tech, real estate, retail

# Some of our clients





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**Ronan Lambe**  
Legal Director  
Pinsent Masons LLP





# Routes to market for Subsidy free Solar

Ronan Lambe  
Legal Director

**THE LAWYER**  
AWARDS 2018  
LAW FIRM OF THE YEAR



Pinsent Masons

# Snapshot of activity in the Solar Sector since closure of the RO

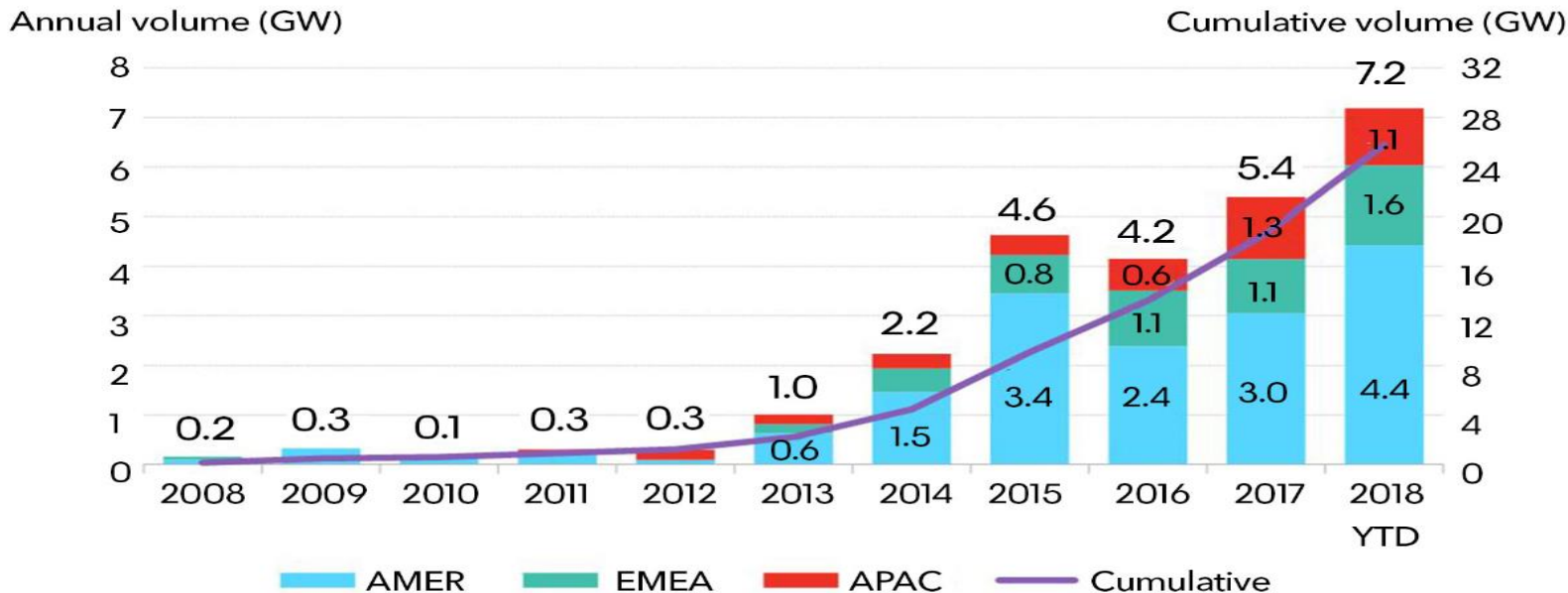
- Buoyant secondary market for RO and FiT projects
- Capital not necessarily recycled into new solar projects
- UK solar developer clients forced to innovate
- Focus of some developers has switched to other markets and models
- Playing the long game – smaller number of larger / mega projects in the pipeline

# Corporate PPAs – a Refresher

- How do you plug the economic gap when subsidy / support is removed?
- Removal of subsidy has coincided with Corporates becoming more sustainability conscious
- Sustainability agenda combined with a desire to hedge exposure to wholesale price increases and short term volatility has resulted in Corporates contracting directly with developers
- Corporate PPAs which have been entered into have typically been long term (10 – 20 year) agreements, where an index linked fixed price per MWh is paid
- Fixed price nature of the contract, combined with the creditworthiness of a number of the Corporates can result in an attractive and bankable proposition

# Corporate PPAs – No global slowdown

Global corporate PPA volumes, by region



Source: Bloomberg NEF. Note: Data is through July 2018. Onsite PPAs not included. APAC number is an estimate. Pre-market reform Mexico PPAs are not included. These figures are subject to change and may be updated as more information is made available.

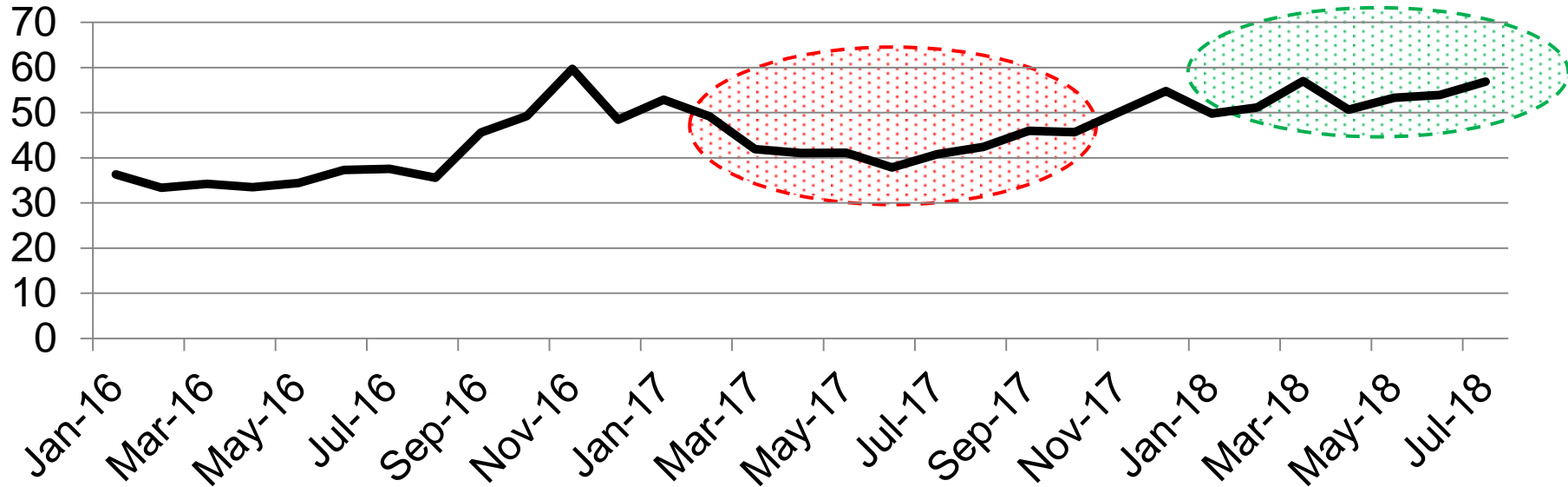
# The 'Lesser Spotted' UK Corporate PPA...



- Few Corporate PPAs entered into the UK in the last 18 months
- Several reasons for this, but comparatively low wholesale electricity price has been key

# N2EX Day Ahead Price – January 2016 – July 2018

£/MWh



Source: <https://www.nordpoolgroup.com/Market-data1/GB/Auction-prices/UK/monthly/?view=chart>

# Corporate PPAs – reasons to be optimistic?

- Some evidence that the uptick in wholesale power prices is piquing interest among Corporates
- No drop off in numbers of the largest Corporates committing to procure some or all of their electricity needs from renewable sources
- Perception of complexity is slowly being eroded
- Platforms / fora beginning to emerge to link developers with Corporates
- Emergence of club deals in other geographies could spur uptake from smaller Corporates

# Corporate PPAs – caution still required

- Largest Corporates arguably have most / all the advantages – has resulted in Corporate PPAs with relatively low power prices in other geographies
- Some Corporates remain wary to contract – noting how some early adopters have had their fingers burned
- Some Corporates will choose to procure their own on-site generation, rather than contract with third party generators
- Platforms which have emerged look good for Corporates, perhaps less so for developers
- Many of the largest Corporates aren't present in Scotland / UK, or if here can't or won't procure power this way



# Innovation in traditional PPAs for subsidy free projects


- Removal of subsidy and consequent slowdown in new project development poses a challenge for offtakers
- Anecdotal evidence that some offtakers are open to taking more price risk – encouraged by recent offtake market entrants
- Enhanced liquidity in the offtaker market has reduced discounts on power prices being paid
- Anecdotal evidence of increased Senior Lender flexibility regarding offtake strategy

# Is flexibility the future?

- The addition of storage has long been heralded as a game changer for renewable technologies
- UK's first 'subsidy free' solar park incorporating storage has been operational for a year, but questions remain around whether that project represents a bellwether
- Is the solar plus storage revenue stack sufficient?
- Co-location of solar with other generating technologies to reduce LCOE should be explored
- Pace of technological and social change in the Energy industry represents opportunity – Blockchain and Peer to Peer platforms

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**Josh King**  
Operations Manager  
AES Solar



**AES Solar**  
EST. 1979

# Solar Routes to Market

Josh King MPhys PGD MIET

Operations Manager

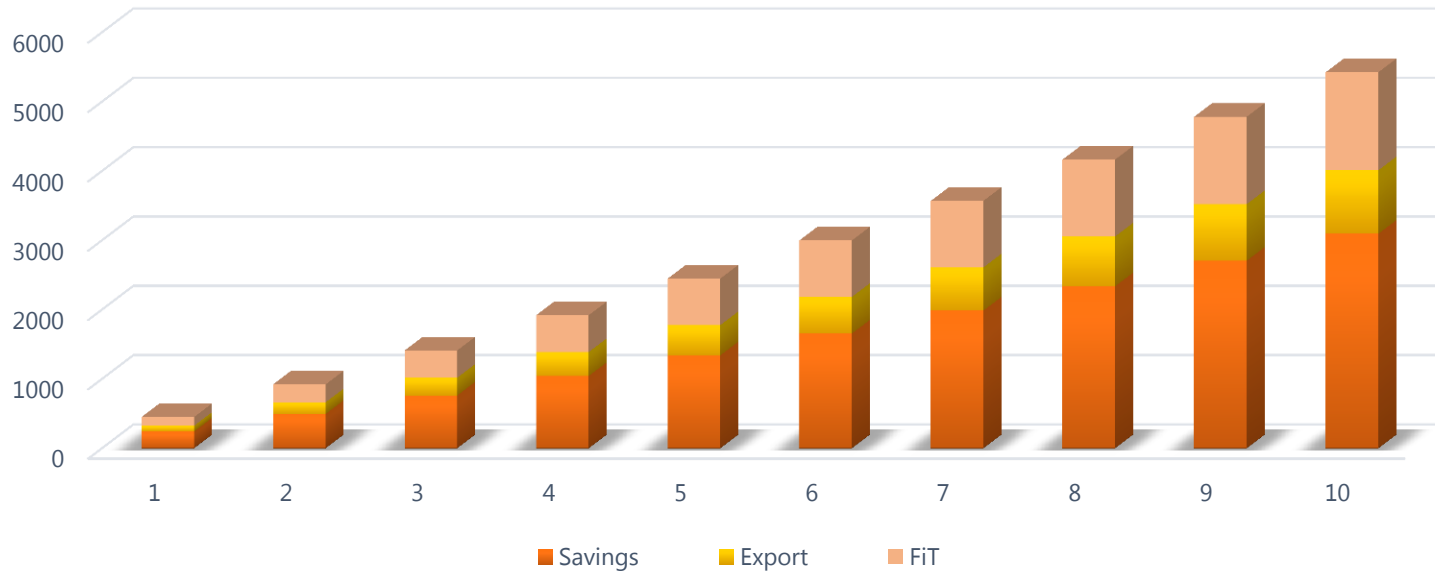
AES Solar

1 to 1 Million  
Solar Roofs in Britain

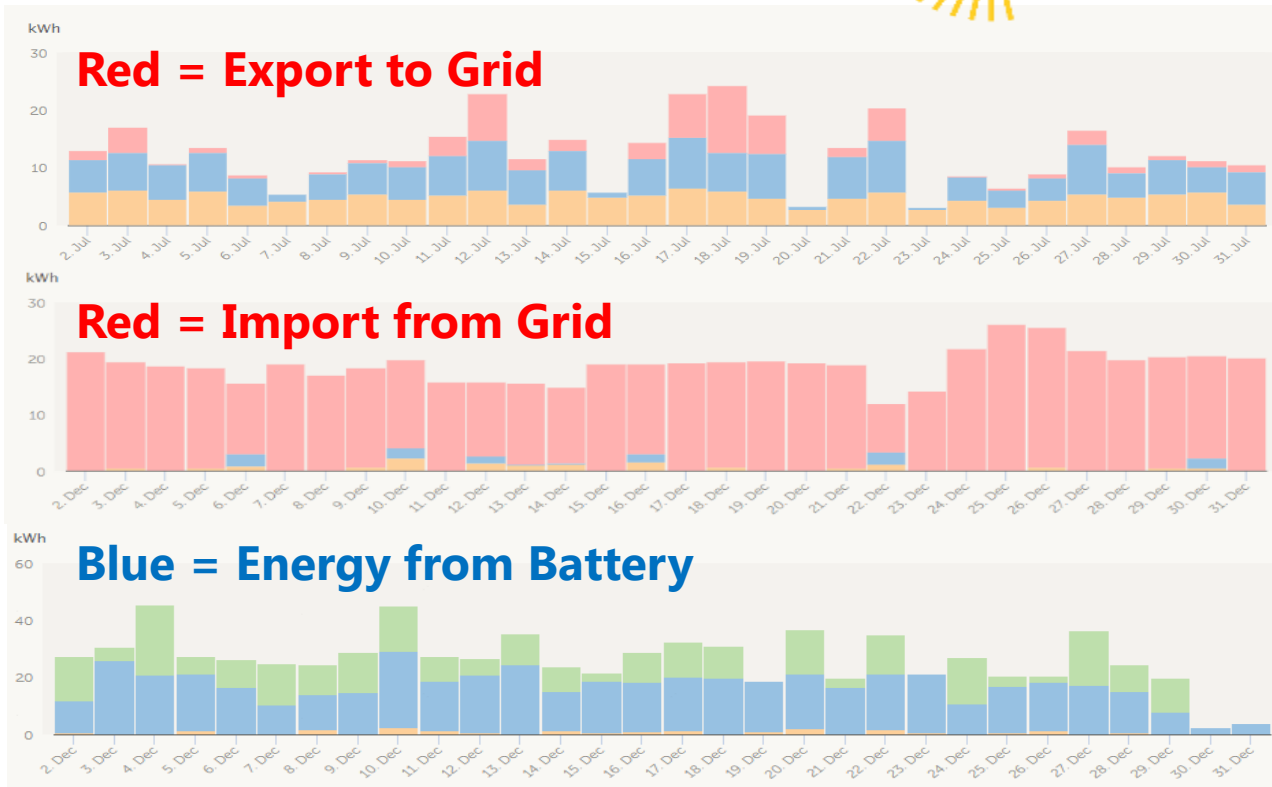
[www.aessolar.co.uk](http://www.aessolar.co.uk)

# The End of Support

## Residential Solar (4kWp) Economic Benefit



# Utilising Storage



# Emerging Markets for Storage

- Store Excess Renewables
- Peak Shifting
- Vehicle to Grid (V2G)
- Virtual Power Plants (VPP)
- Energy Storage as a Service (ESAS)
- Balancing Markets (BM)
- P2P Energy Trading
- Home Energy Management Systems (HEMS)



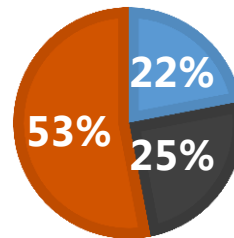
Images: Solo Energy



# Solar in Scotland



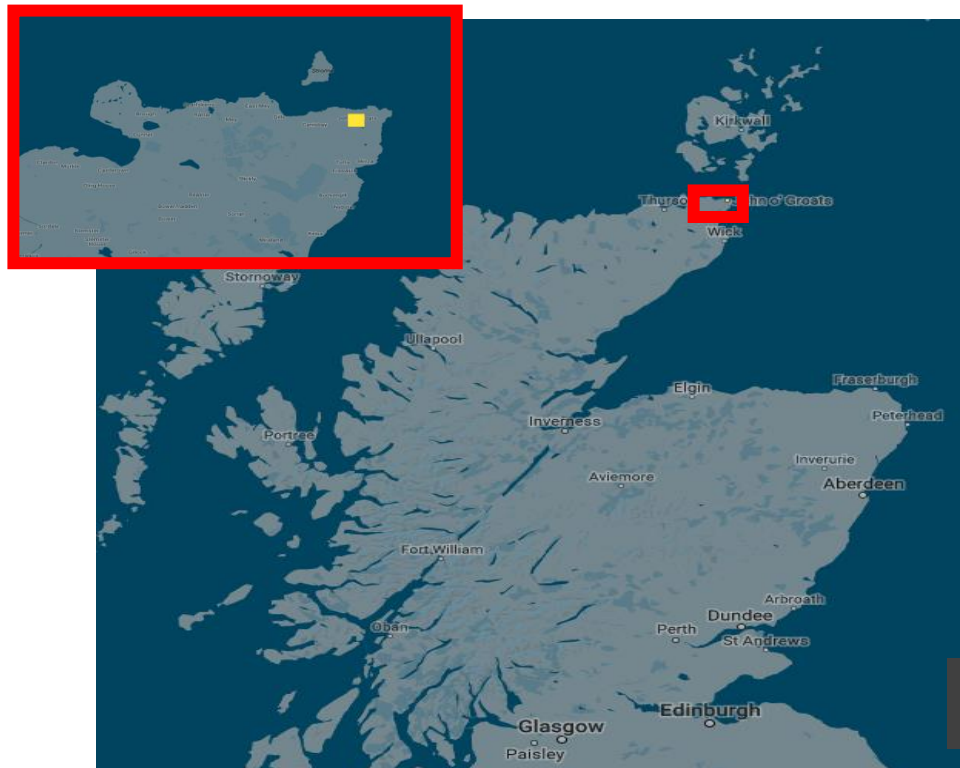
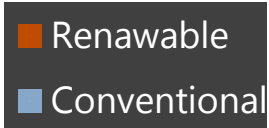
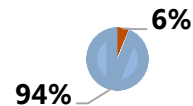
## ENERGY DEMAND



## HEAT DEMAND

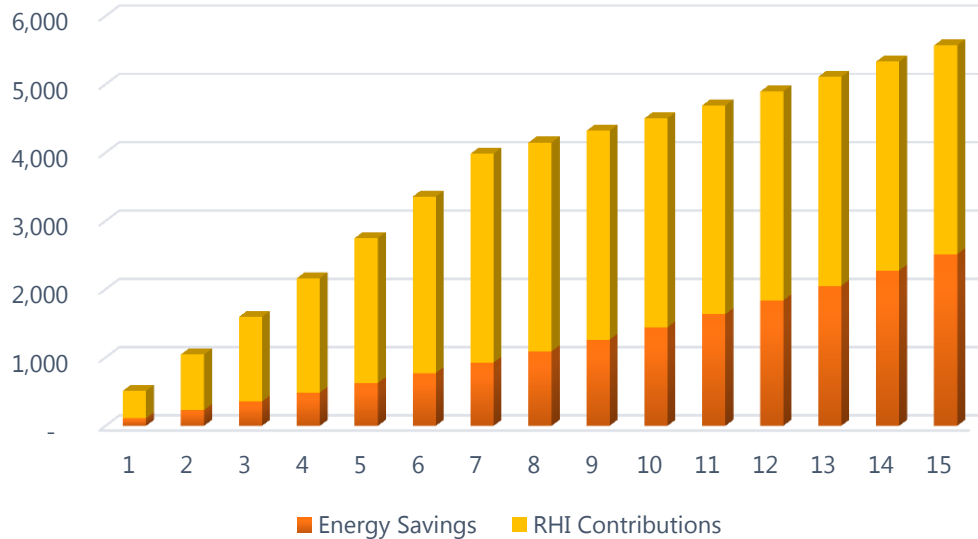


## HEAT GENERATION



# Solar Heat Markets

## Domestic Solar Thermal Benefit



- Market Attention
- Reducing Costs
- System Integration
- Building Regulations
- Space Heating Contributions
- Smart Technology
  - Aggregation
  - Heat as a Service

# Solar District Heat

## Solar District Heating

LCOE = 3-4 p/kWh

Solar PV (BEIS Yr 2020)	
LCOE (p/kWh)	Power
12.8	<10 kW
10.9	250kW - 1MW
7.3	1MW - 5MW
6.7	> 5MW

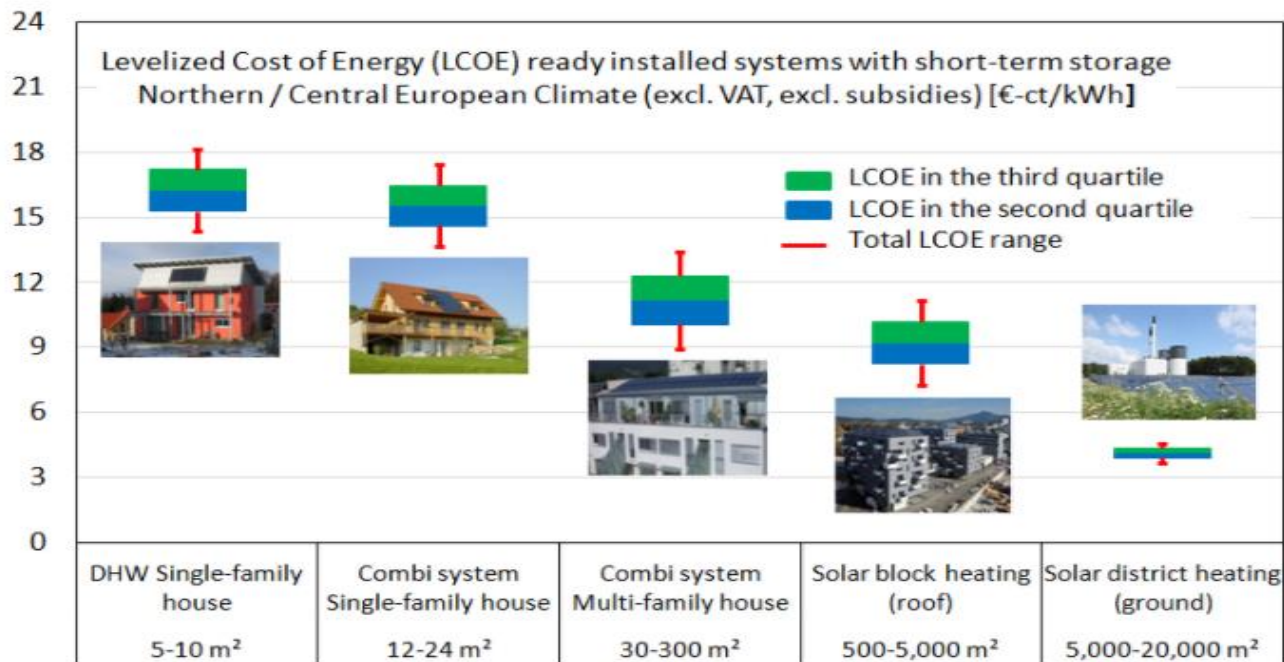


Image: IEA SHC

# Funding in Scotland



- Home Energy Scotland
- Solar PV: £5,000
- Solar Thermal: £5,000 years
- Battery Storage: £6,000
- 10 years interest free for £5,000 - £9,999
- 12 years interest free £10,000+
- Other renewables and energy saving improvements covered
- Local Energy Scotland
- CARES Enablement Grant: Up to £25,000 grant
- CARES Development Loan: Up to £150k at 10%
- CARES Innovation Grant: Up to £150k to fund innovation

# Solar Rebound Effect

- Building Regulations Encourage Renewable
- Developers Value Engineer <1kWp
- Installers forced into driving costs down by QS
- Homeowner prohibited from meaningful amount of Solar



# Business Rates

- 100kWp for Manufacturer in Aberdeenshire

## Savings Less Business Rates



# STA Scotland Key Asks



1. Put in place an ambitious **Solar Action Plan for Scotland**, for solar PV, solar thermal and hybrid PV-thermal, and establish Scottish targets for both technologies. We suggest that a target of 6GW for solar PV and 200,000m<sup>2</sup> or 141MWh for solar thermal by 2020 are both ambitious and achievable. Such a target would create over 8000 quality Scottish jobs, £1.3bn annual increase in GDP, power to £1.53mn homes and a reduction of 2.31mn tonnes of CO<sub>2</sub> emissions.
2. Address major **grid constraints** by ensuring the calculation methodology for constraints is reflective of the technology. Solar and wind are different technologies and have different profiles and as such **co-locating** solar, wind and storage should include diversification factors within the calculation methodology. Additionally, Ensure contracted capacity is released back to the grid within a certain timeframe of connection offer.
3. Simplify the **business rates** framework for solar in Scotland and exempt self-owned commercial solar rooftops as a productive investment technology from 2019 onwards.
4. Extend **permitted development** to all rooftop solar PV installations. Clear guidance should be distributed to each individual local authority building control department clarifying that Building Warrant is not required in the absence of any structural alteration to the roof, in line with the rest of the UK.
5. Every new building should have a meaningful amount of solar. Please put forward ambitious buildings regulations to further decrease net energy use of new buildings in the next round of the **Scottish Building Standards** to drive higher use of on-site renewable energy.

# STA Scotland Key Asks



6. Assess the capacity and adopt an ambitious target for the rollout of solar on **the Scottish Public Estate**. We propose a clear mandate by the Scottish Government to direct local authorities in the development of solar installations across their portfolio.
7. Support the case to HM Treasury/HMRC that the **5% reduced rate of VAT** be retained for all integral parts of solar PV, thermal and storage systems for new installations, retrofits, and repairs.
8. Encourage UK ministers to accept STA's position on the forthcoming **Post-FiT Consultation**. This includes preserving the export tariff, a mandatory requirement for MCS certification for domestic PV & storage installations and repairs, fair tax treatment, removing market barriers to smart homes and Time of Use Tariffs and allocating any future government subsidy to low income groups.
9. Recognise the role of **solar thermal** in decarbonising heat. Promote ambitious new building standards with a high renewable heat requirement and consider a solar thermal grant as an alternative to the failing Renewable Heat Incentive (RHI). Introduce further measures to encourage solar thermal to reduce the carbon intensity of district heating networks.
10. Ensure that **planning policy and guidance** for ground-mounted solar PV provides a positive and consistent framework for deployment while protecting the environment, embracing the STA's 10 Commitments for Solar Farms.





# Furthering Solar in Scotland





**Hannah Smith**

Senior Policy Manager, Scottish Renewables

**John Barclay**

Associate Director, ITP Energised

**Ronan Lambe**

Legal Director, Pinsent Masons LLP

**Josh King**

Operations Manager, AES Solar



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# **Kerr MacGregor Award for Solar Innovation**

# **Accessing the Network**

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**Marc Smeed**

Principal Consultant

Xero Energy

# OPEN NETWORKS + CHARGING FUTURES



# Smart Systems and Flexibility Plan Ofgem/BEIS (July 2017)

Decarbonisation + Digitisation + Decentralisation +  
Technology costs = new electrical network investment and  
operational strategy

› Open Networks

- DNO -> DSO transition
- Technical requirements
- Functional requirements
- Market arrangements

› Charging Futures

- Network access arrangements
- Network charges / signals
- Small users Vs big users



- Define the role and functions of a 'Distribution System Operator' (DSO) and **who** is best to deliver these functions.
- What is a DSO?
- Most DSO functions are either not DNO functions or significant extensions of existing functions.

## PASSIVE

### DNO

- Network Operation
- Investment planning
- Connections & rights
- System def' & restoration
- Service provision
- Charging

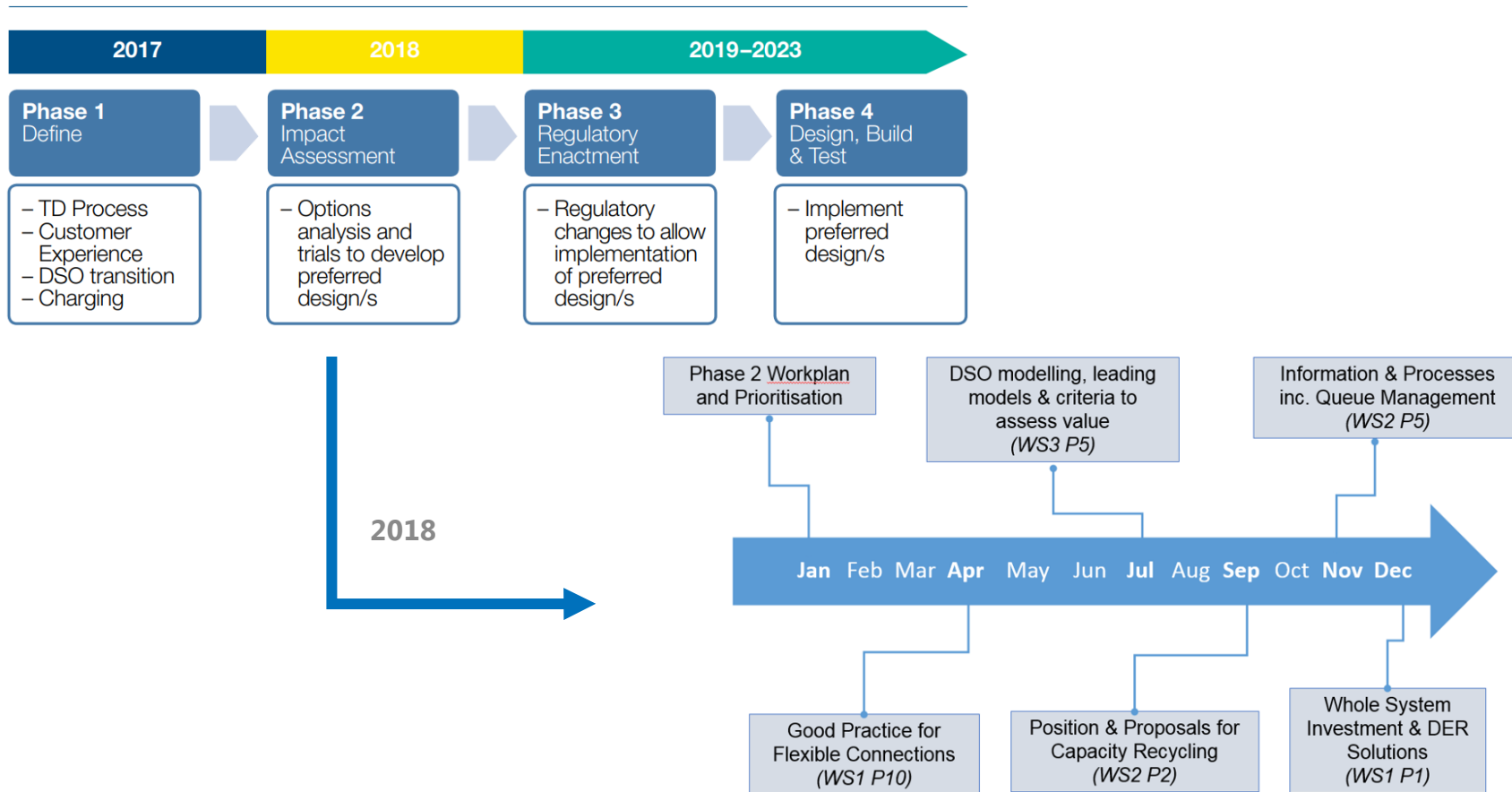
## ACTIVE

### DSO

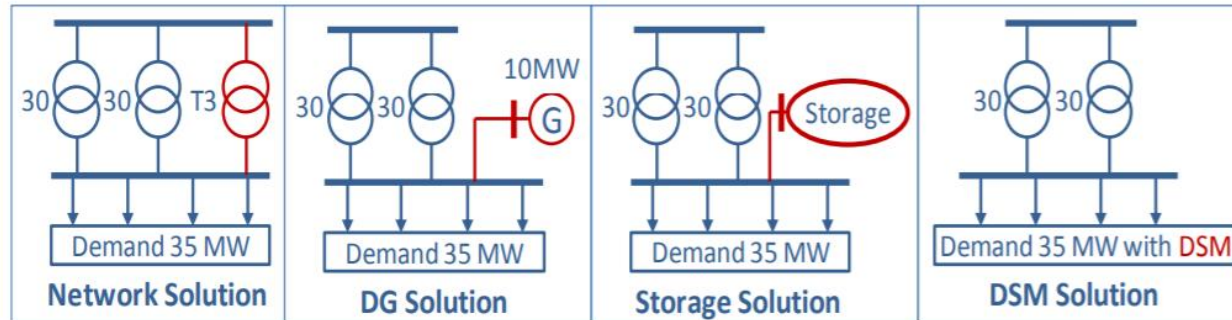
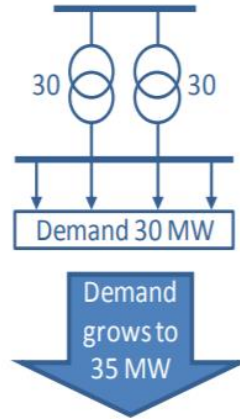
- **System coordination – new function**
- Network Operation – extended function
- Investment planning – extended function
- Connections & rights – extended function
- System def' & restoration – extended function
- **Service/Market facilitation – new function**
- Service provision – extended function
- Charging – extended function

- DNO's response to Ofgem/BEIS policy.
- Game plan for DNOs going into RII0-ED2

# What's the status?



**Can you really trust non-network solutions?**

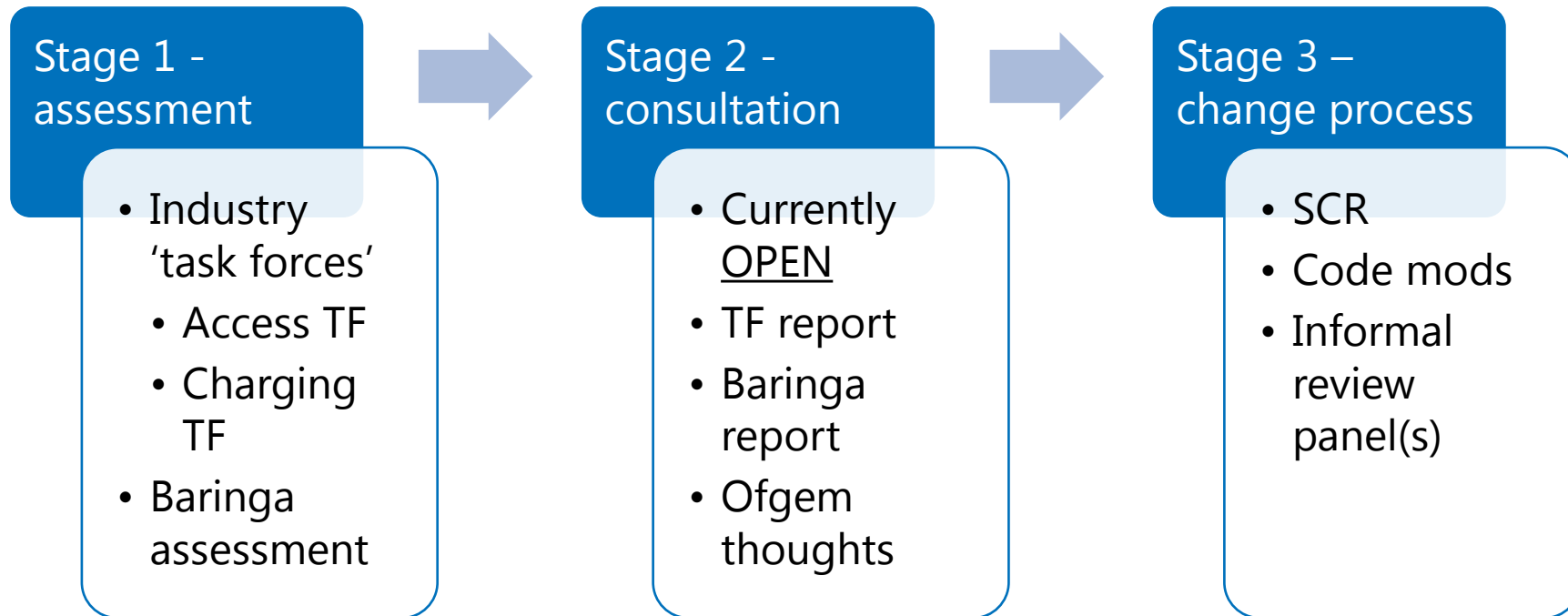


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- Charging:
  - TNUoS for distribution connected generation
  - Wholesale review of DUoS methodology
  - Wholesale review of distribution connection charges (shallow charging boundary)
  - BSUoS as embedded benefit
  - BSUoS 'cost reflectivity'
- Access
  - Time limited network access rights
  - 'Use it or lose it'
  - More network access options
    - Time day/year
    - Short-term/Long-term
    - Firm/non-firm
    - Local network access options
  - Cap on unrestricted distribution network constraint

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# **Alistair Menzies**

Head of Planning & Design

SP Energy Networks



Alistair Menzies  
Head of Planning & Design  
(Ayrshire & Clyde South District)

4<sup>th</sup> September 2018

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# SR Solar Conference

**SPEN Update:  
Connecting to the  
Distribution Network**

# Agenda

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- High Level Overview
- Our Changing Network
- Generation Considerations
- Statement of Works Update
- Queue Management Update
- DSO Vision

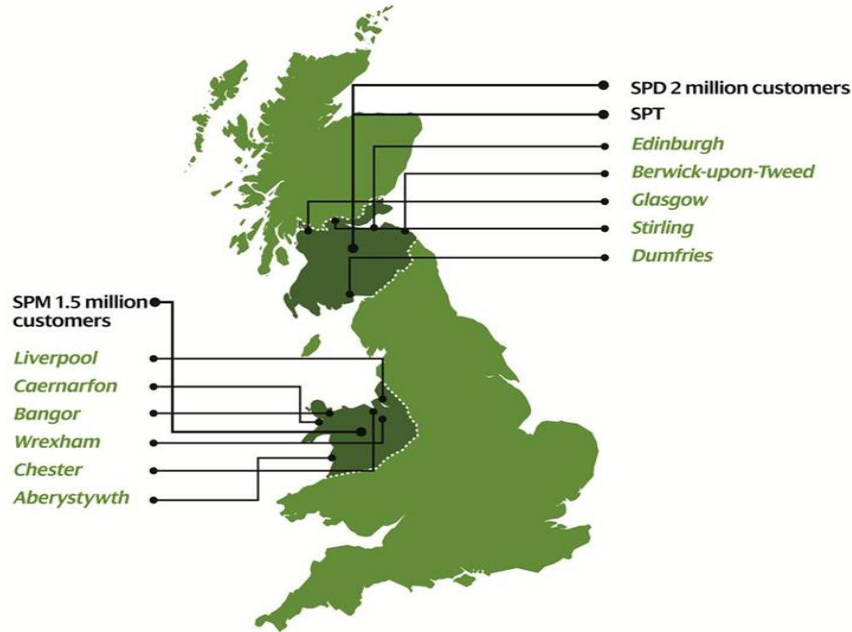


# SP Energy Networks Overview

## Distribution

(Scotland, England & Wales)

- 3.5million connected customers
- 16% of annual electricity bill
- 28% UK's distributed renewable generation but only 14% customers



## Transmission

(Scotland only)

- 4% of annual electricity bill
- 56% of Scotland's transmission connected renewable generation
- Gateway South for all of Scotland's renewable generation

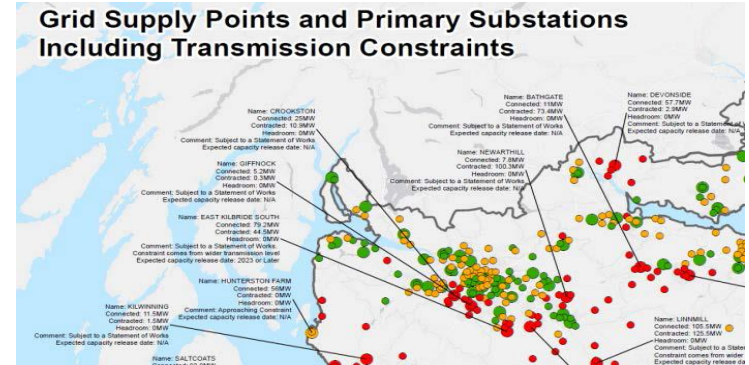
# Incentive through Connections Engagement (ICE)

## What is ICE?

- OFGEM\* incentive
- Penalty only (SPEN - £6m exposure)
- To drive electricity distribution network operators (DNOs) to **understand and meet the needs of all stakeholders with a connections interest**

## What has SPEN done (extract)?

- Developed industry leading 'Heat Maps'
- Introduction of '**Flexible Connections and Principles of Access**' Policy – enabling connections in constrained areas
- Introduction of '**Queue Management**' Policy - releasing capacity by tackling 'under-utilised' connections
- Development of revised **Statement of Works** Process
- New provision for multiple G83 & G59 (<200kW inverter connected)



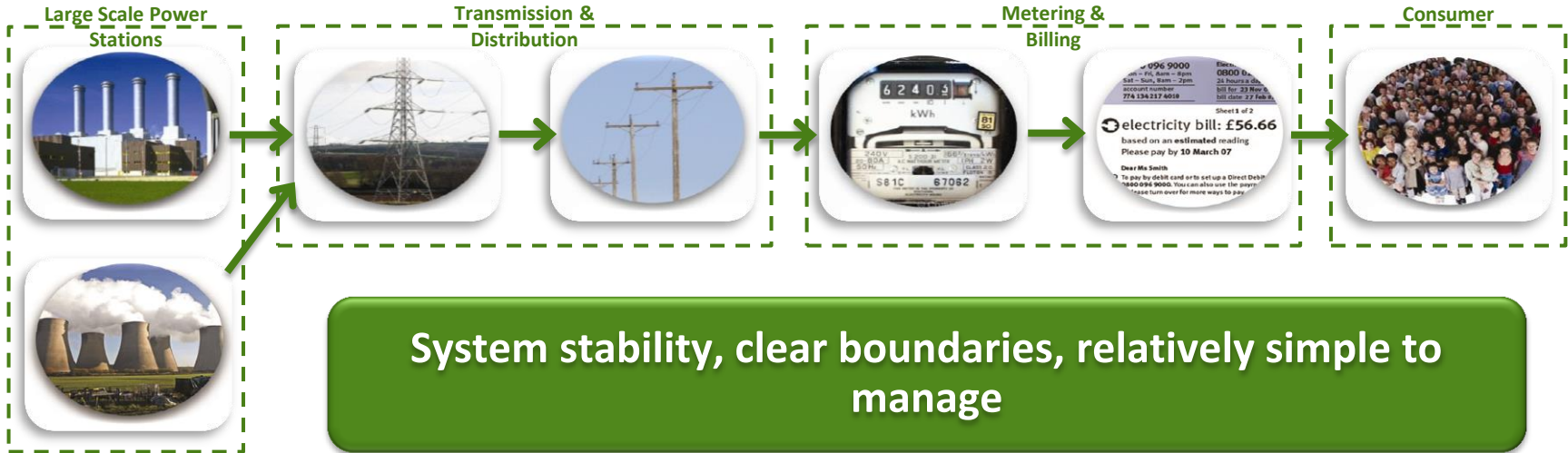
## Generation in SPEN - 2018

---

- 2010: 400 applications
- 2014: 2500 applications
- 2016: 90% decline in generation applications
  - Reduction in Feed in Tariffs (FiTs)
  - Network constraints
- 28% of UK renewable distributed generation - 16% of the UK population
- 1.83GW of generation connected
- 107MW solar PV connected with 105MW contracted

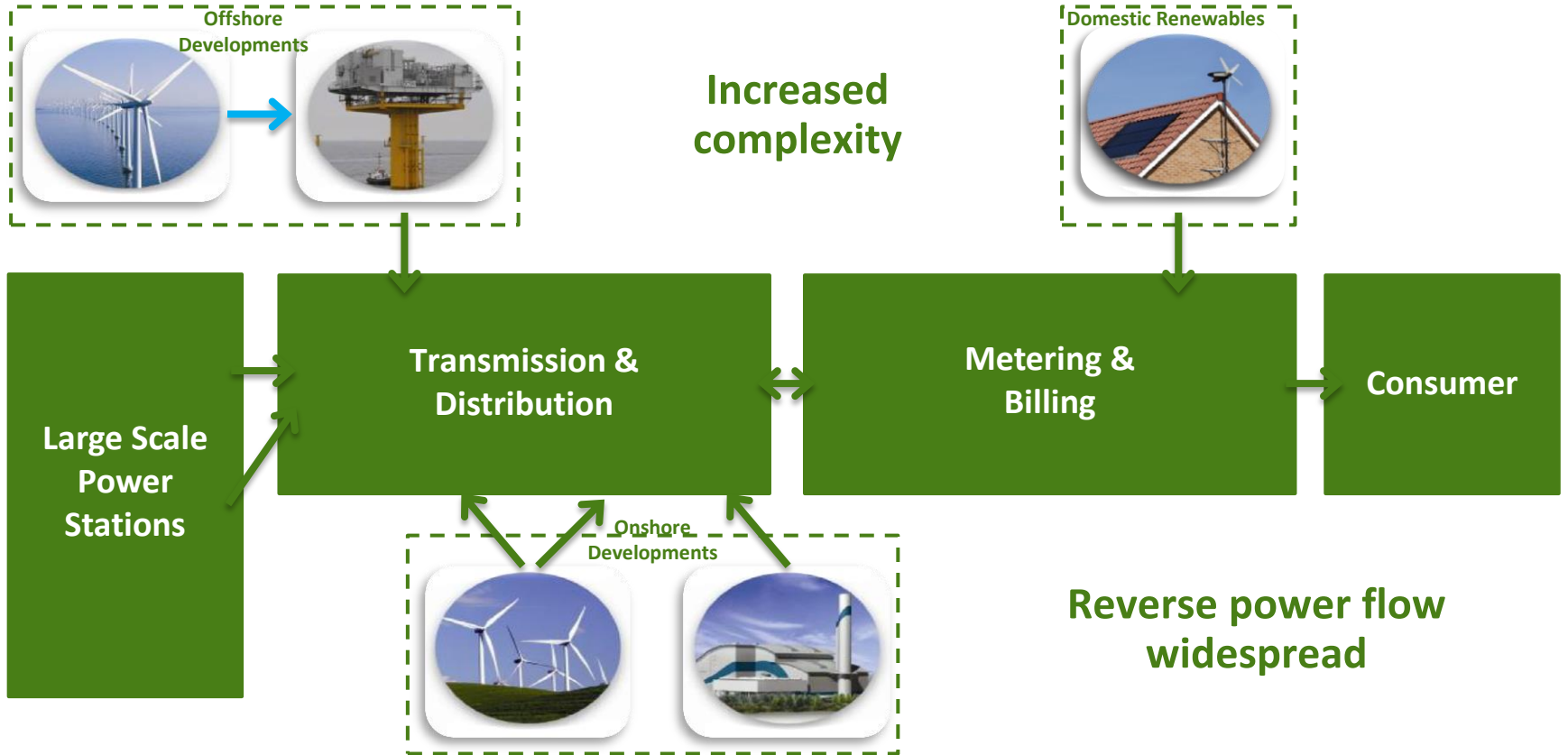


Passive network, with power generally flowing in one direction

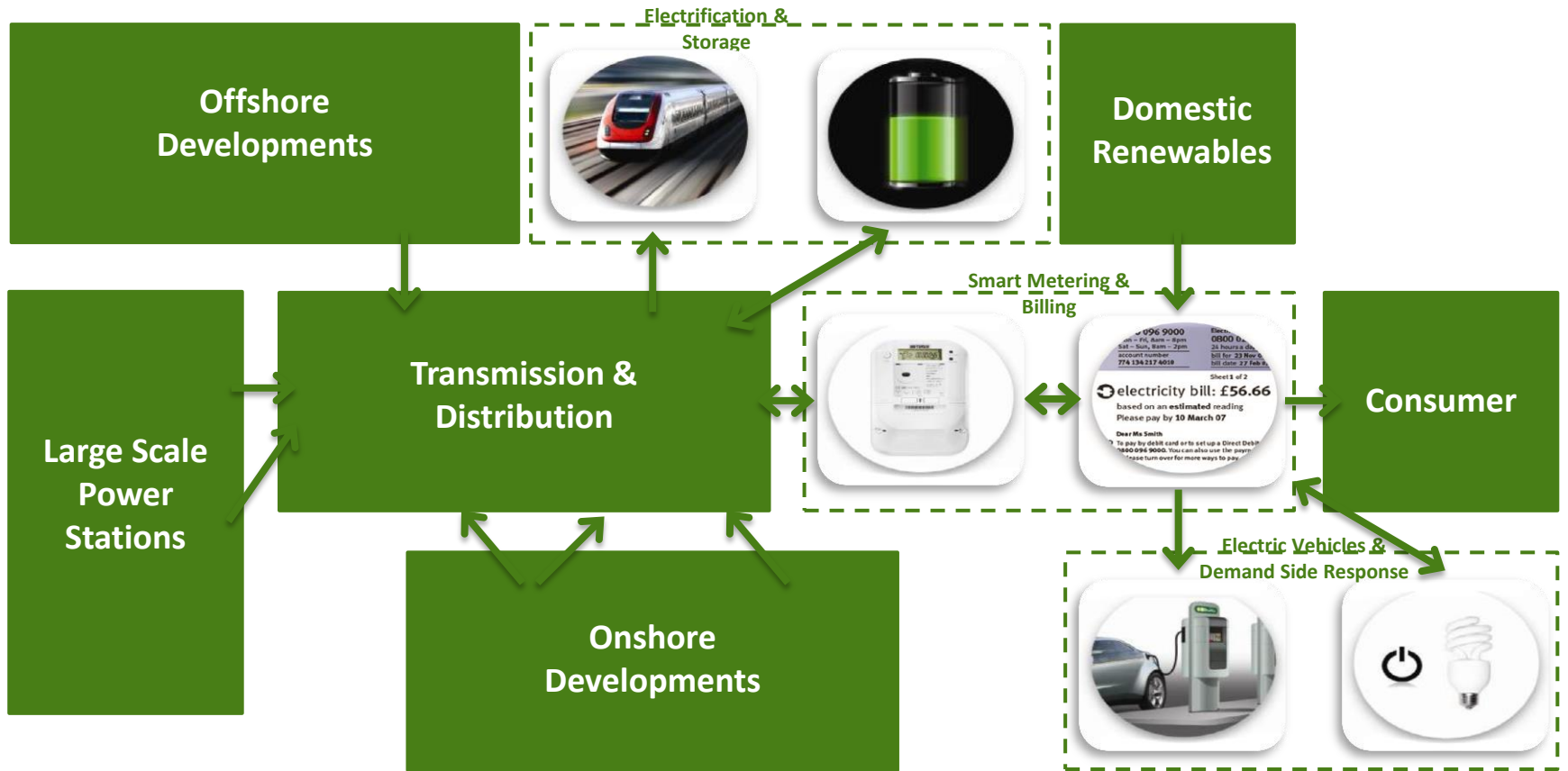


System stability, clear boundaries, relatively simple to manage

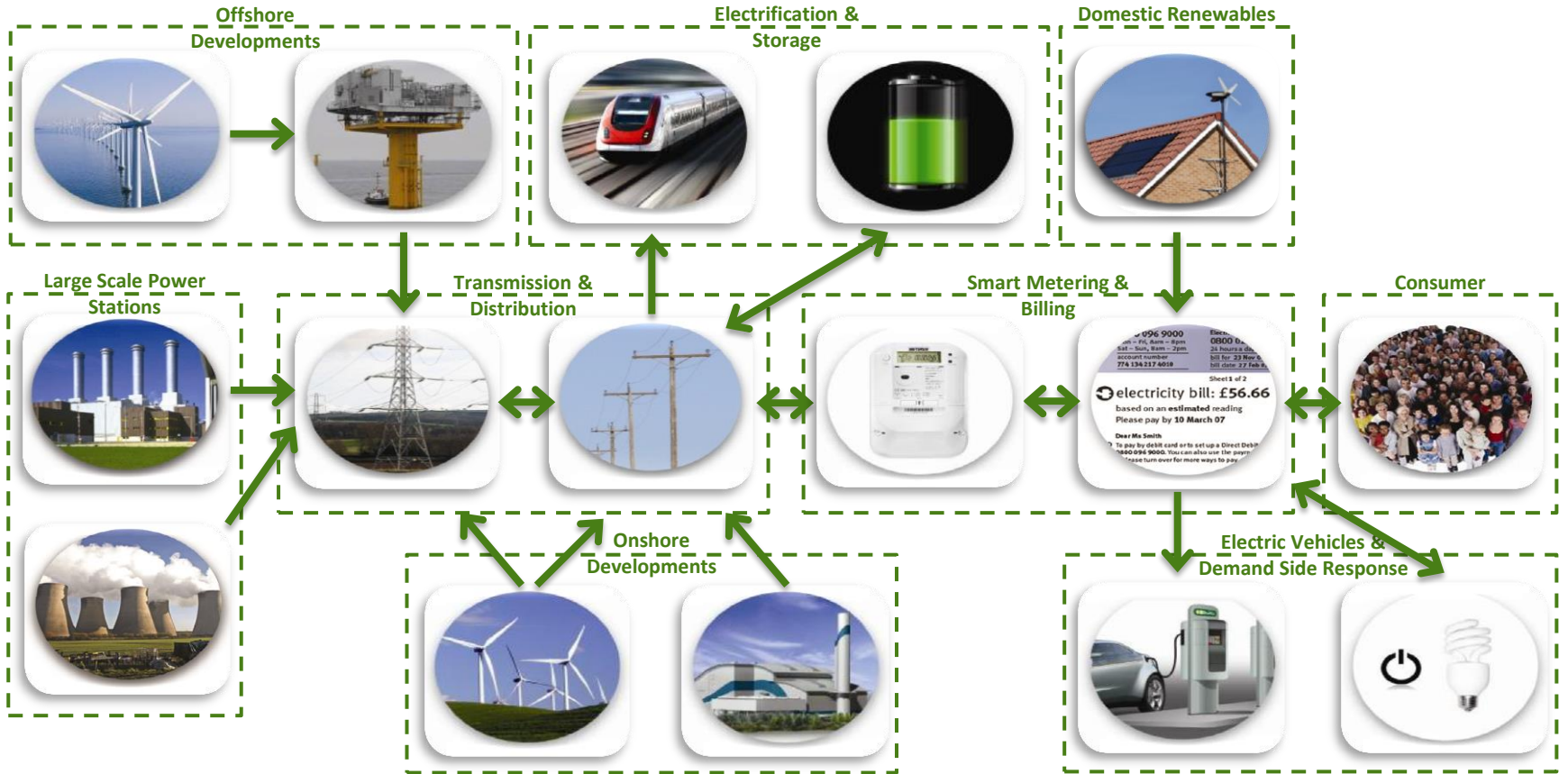
# Today's Network



# Tomorrow's Network



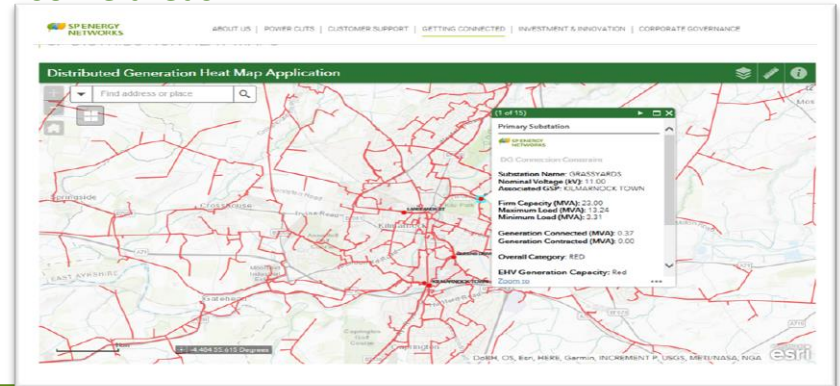
# By 2020?



# Generation Constraints - Considerations

Greater penetration of Solar PV, Heat pumps, EV Charging Points bring new challenges and opportunities for DNOs;

- Network design – added complexity to model
- Network Reinforcement - may have a significant impact on network reinforcement requirements
  - ADMD of 1.5kW – 3kW: Is this appropriate?
- Saturated network - limited / no generation capacity in some areas
- Transmission constraints





# Generation Constraints – Statement of Works Transition

---

## Transition to the DNO Transmission Impact Assessment (TIA)

### Work to Date

- SPEN have been key lead on the development of the new Transmission Impact Assessment (TIA) developed under the ENA Open Networks Project
- SPEN have trialled new process at 4 GSPs – Dunbar, Berwick, Cupar and Linmill
- Fully committed to transition away from SoW to TIA Process as part of wider rollout plan

### What does this mean for SPEN?

- NGET SO will develop planning limits that will be available to SPEN
- New contract schedule will provide visibility of contracted DG for each GSP
- New process will be established for regular information exchange

### What does this mean for Customers?

- DNO can make DG offer without individual application to NGET in most cases
- Provides DG information on transmission impact earlier in the process
- Removes complexities and inefficiencies

# Generation Constraints - Statement of Works Requirements

## Current Process

- All G59 applications in areas of known transmission constraint have to follow the Statement of Works Process.
- The use of SPEN approved Export Limiting Devices will be permitted in accordance with the table below.

Generation Type	Network Condition	Statement Of Works Process Required
G83 (one off applications)	All areas of the network	No
<b>G83 (Multiple applications)</b>	<b>In areas with known transmission constraint</b>	<b>Assessed on a case by case basis</b>
G59 No Export	Areas with known transmission system constraint - Subject to the installation of SPEN approved Export Limiting Device *Large Scale connections assessed on case by case basis	No
G59 With Export	Areas where there is no export or reverse power flow at the Grid Supply Point following connection	No
G59 With Export	Areas with known transmission system constraint	Yes
G59 With Export	Areas where there is export and/or reverse power flow at the Grid Supply Point following connection	Yes

## Exception: Small Scale Inverter Connected Generation

Where small scale inverter generation is to be installed in Transmission constrained areas, studies have demonstrated limited risk in allowing connections to progress.

- limited time and duration when solar PV reaches peak output
- the coincidence of peak power output of solar PV with wind generation is unlikely.

Voltage	Scenario	Requirement for Assessment		
		Statement of Works	GSP 33kV Fault Level Restriction	Voltage
LV	Multiple G83/2 ( $\leq 200\text{kW}$ )	No	No	Yes <sup>2</sup>
	Single Site G59 ( $\leq 200\text{kW}^1$ )	No	No	Yes <sup>2</sup>

# Generation Constraints – Queue Management

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**Open Networks Project – Key Objective:** To develop a GB-wide queue management policy that ensures customers receive the same experience, irrespective of their location, or host DNO

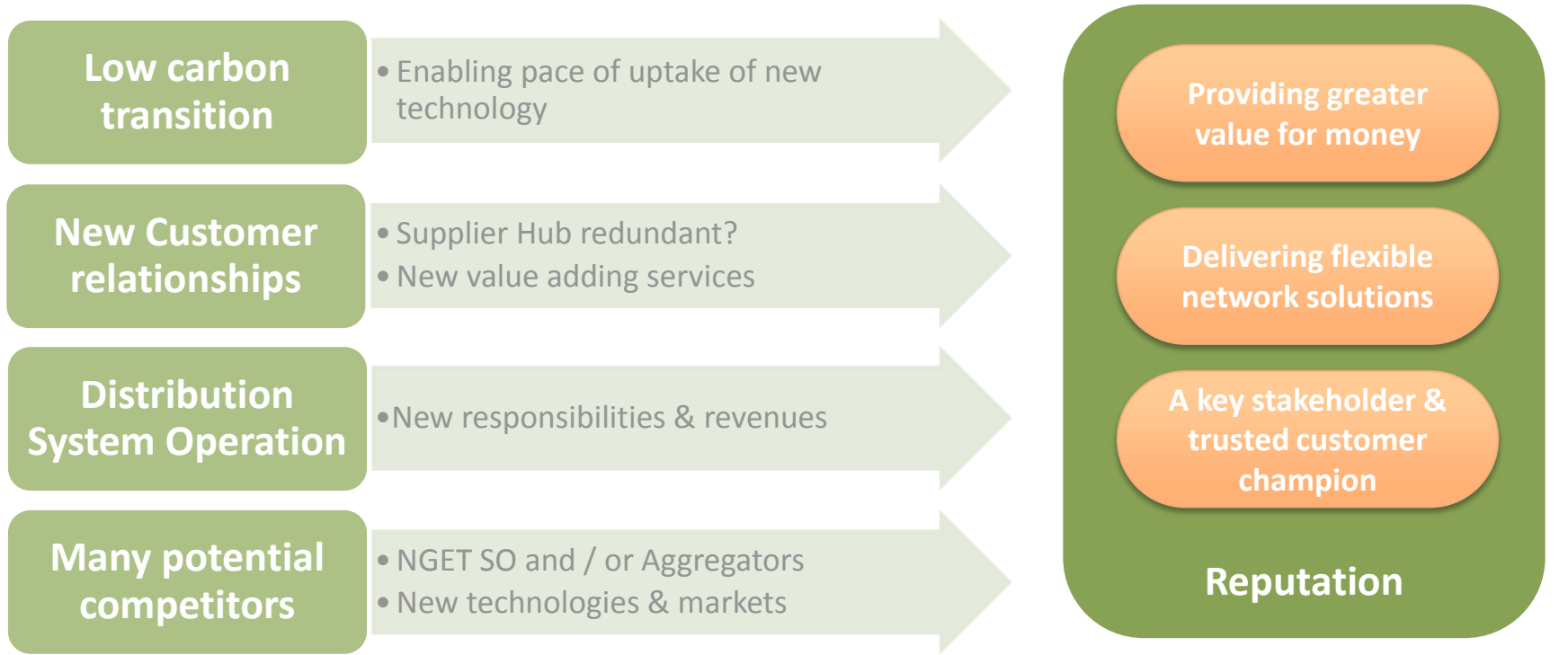
**The following principles are the cornerstone of SPEN's QM Policy:**

- Initial queue position is determined by the date of offer acceptance.
- The maintenance of queue position is dependent on contract milestones being met.
- Opportunities for queue advancement should only be given to those projects able to provide unconditional instruction to commence works.
- SPEN will seek to recover capacity where it is not being fully utilised.
- SPEN will terminate contracts where defined criteria not met.

**Trial Progress (Central & Fife District)**

- 9 terminated projects = 400MW released back to Grid
- 4 projects on notice = potential additional 60MW to release
- Roll out to business in late September

# Distribution System Operation - A Sustainable Future Business Model



Demonstrating the customer benefits of the DNO to DSO transition

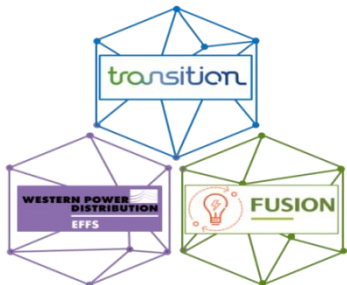


## FUSION – NIC 2017 (£6m) 2018-2023

### DSO project trialling a flexibility market based on the Universal Smart Energy Framework

#### Current work

- Collaborate with SSEN & WPD NIC projects 2017 – this is an Ofgem condition of funding
- Develop IT requirements for project integration in to SP Energy Networks



#### Work over the next month

- Draft Ofgem project direction report demonstrating NIC collaboration – shared by SSEN & WPD
- Present at the ENA Open Networks project on NIC 2017 collaboration
- Hold first FUSION Technical Board to assess business requirements
- Assess and initiate Smart Grid Architecture Modelling (SGAM) of USEF framework

#### Project issues

- No funding until the Ofgem project direction report is accepted and the project fully authorised
- Expectation management of potential trial participants in the trial area (East Fife).



#### Project partners:

INVEST IN FIFE



Imperial College  
London



University of  
St Andrews



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**Cameron Welsh**

Senior Business Development Manager

Flexitricity

# Scottish Renewables Solar Conference 2018

## Opportunities for Energy Storage

Cameron Welsh  
Senior Business Development Manager



**Flexitricity**



## FLEXITRICITY OVERVIEW



**1st**, largest and most diverse demand response aggregator  
**> 9,000** demand response events

**24-hour** operations

**<1s to 30m** response

Capacity Market obligations

**2016 – 2036**

**1st** to develop Negative Reserve service

**10** Years DSR delivery

**100 % Reliable**  
Capacity Market  
delivery

**100 %** Service delivery  
of frequency since 2012

**100 %** TRIAD avoidance  
since 2008

**Flexitricity**

## DIVERSE PORTFOLIO OF FLEXIBILITY



## SYSTEM WIDE VIEW – ENERGY COMPLEXITY



RESERVE



FREQUENCY



RENEWABLES



SECURITY



TRADING



CONSTRAINTS



NEW DEMAND



VOLTAGE



PEAK



HEAT

- National Grid building new toolkit
- Demand is changing
- Variable generation mix
- Location specific challenges
- Volatility

**Flexitricity**

## BATTERY STORAGE ALREADY CONTRIBUTING

### Grid Connected

EFR  
Ancillary Services  
Trading  
DNO Services



**District Heating**  
Scheme Efficiency  
Cost Avoidance  
Ancillary Services



### Co-located

Imbalance payments  
Ancillary Services  
Trading  
Constraints  
DNO Services

### Hybrid

Thin battery Gas Engine  
Ancillary Services  
Trading  
DNO Services



### Behind the Meter

Arbitrage  
Cost avoidance  
Ancillary Services  
DNO Services

**Electric Vehicles**  
Ancillary Services  
Cost Arbitrage  
Trading



## BATTERY STORAGE CONSIDERATIONS

- The 7“C”s of Battery Storage
  - Connection / Constraints
  - Cost Avoidance
  - Cost of System
  - Cell type
  - Choice of Flexibility Service
  - Capacity Market / CfD
  - Cycles
- Additional Benefits
  - Carbon
  - UPS
  - Security
  - Sustainability
- Future Proofing? Whats next?



**Flexitricity**

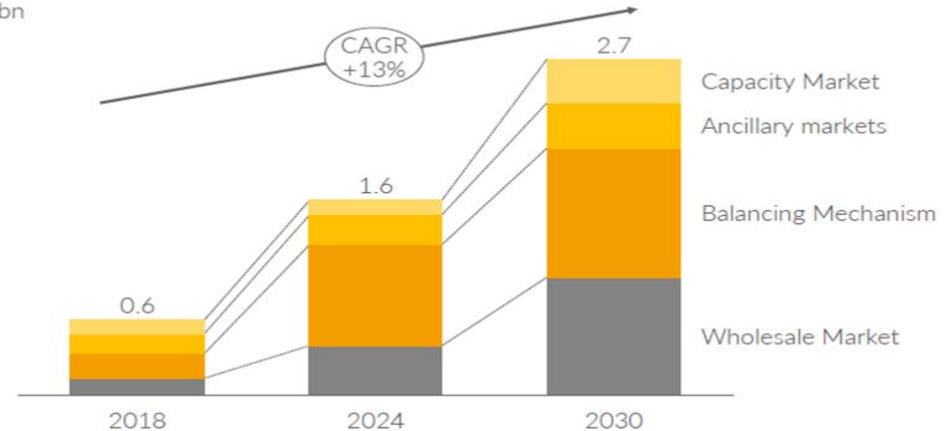
## CHANGING VALUE IN FLEXIBILITY

- Increasing value in real-time energy trades
- Ancillary services market over-subscribed
- Energy suppliers entering DSR market
- Value moves around and Flexitricity optimises it
- Experience, expertise and deep industry engagement is critical for success

Aurora estimate revenue of flexible technologies will be driven primarily by wholesale and balancing

AURORA  
ENERGY RESEARCH

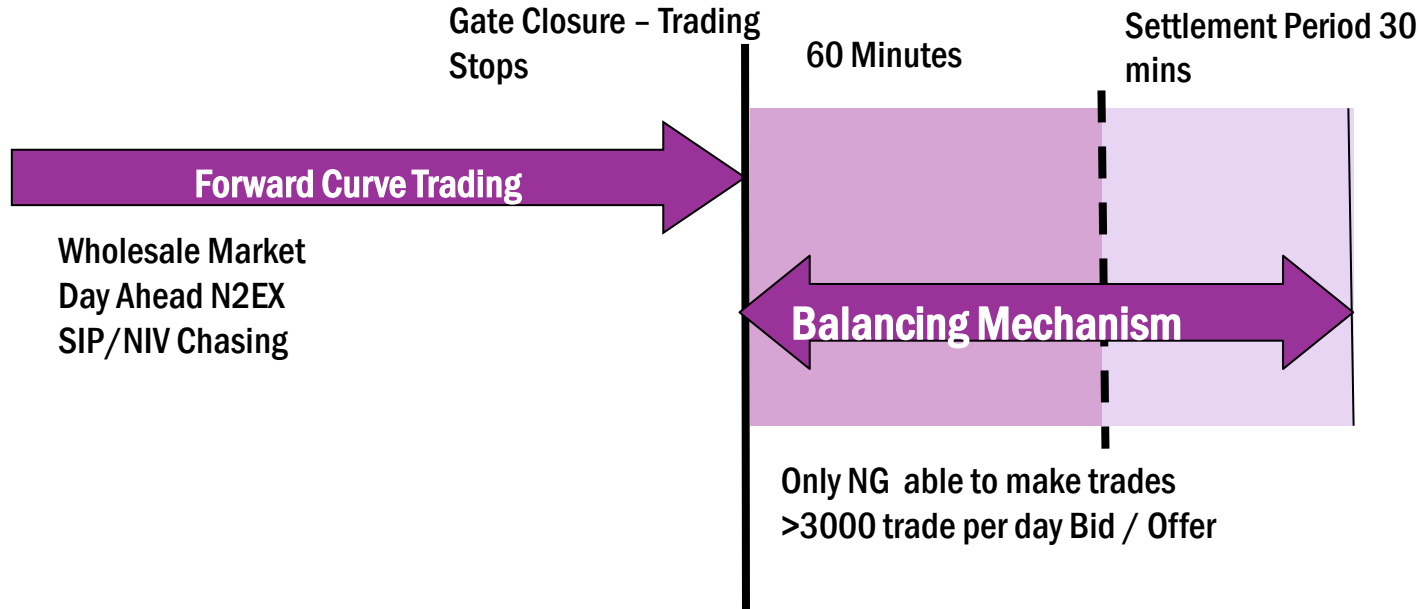
Revenue for flexible technologies  
£bn



Source: Aurora Energy Research

**Flexitricity**

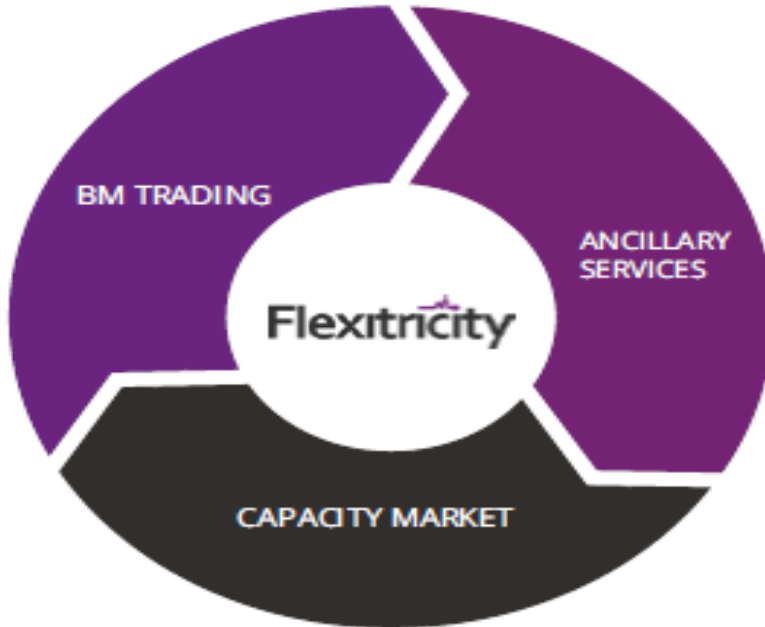
## TRADING IN THE BALANCING MECHANISM



- 48 half hourly opportunities / day
- System Actions
- Market is growing
- Thermal plant coming out

**Flexitricity**

## MONESTISING BATTERY INVESTMENT



- Prioritise the “Day Job”
- Harness Flexibility
- Speed of response = increase value
- Respond to market changes
- Leverage value and risk mitigation from a Portfolio
- Factor in price erosion and market volatility
- Expertise and Experience

**Flexitricity**





Flexitricity operates the first, largest and most advanced demand-response portfolio in Britain.  
Join us today. Call **0131 221 8100**.

**Flexitricity**



**Hannah Smith**

Senior Policy Manager, Scottish Renewables

**Marc Smeed**

Principal Consultant, Xero Energy

**Alistair Menzies**

Head of Planning & Design, SP Energy Networks

**Cameron Welsh**

Senior Business Development Manager, Flexitricity





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# **Planning for sustainable communities**

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**Lisa Peebles**

Operations Officer

South Seeds

# Installing solar power in an urban environment

Lisa Peebles  
Operations officer  
South Seeds



# We are community led



# The space we used

The Croft, Spring 2015



The Croft, late Summer 2015





# Why did we install solar power?



# Installing and using the system

Capturing solar energy



Powering the LED lights



# Demonstrating success

Solar powered electric guitar      Showcasing what is possible



For more information, contact:

0141 636 3959

[info@southseeds.org](mailto:info@southseeds.org)

[www.southseeds.org](http://www.southseeds.org)

or drop in to:

514 Victoria Road, Glasgow, G42 8BG.



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**Nicholas Gubbins**

CEO

Community Energy Scotland

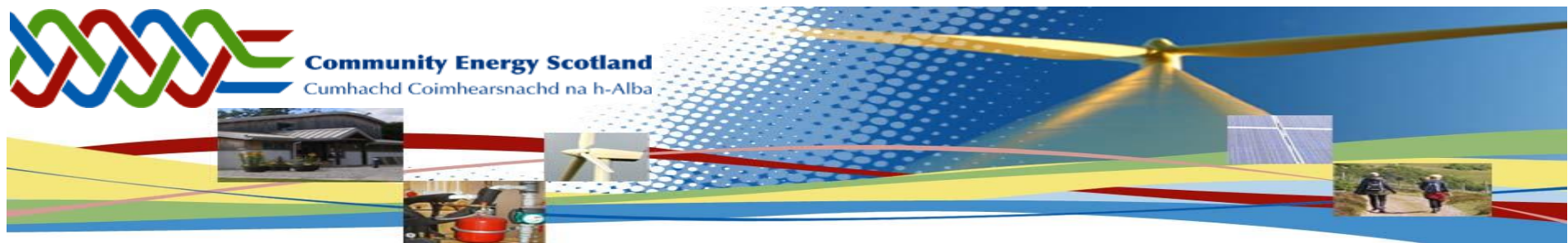


# Prospects for Community Solar

Nicholas Gubbins, Chief Executive, Community Energy Scotland

<http://www.communityenergyscotland.org.uk>

Scottish Charity Number: SC039673



**Vision** - strong, well informed and capable communities across Scotland, able to take advantage of their renewable energy resources and address their energy issues in a way that builds a more localised, democratic and sustainable energy system.



Solar Water - Harris





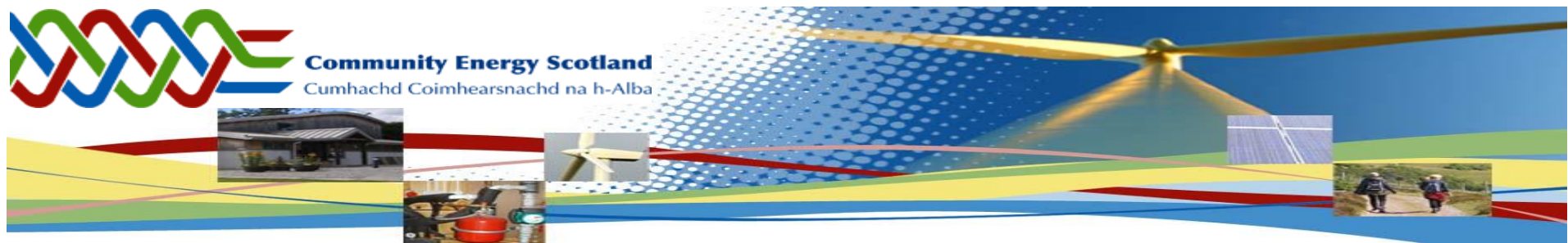
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Muck



Eigg

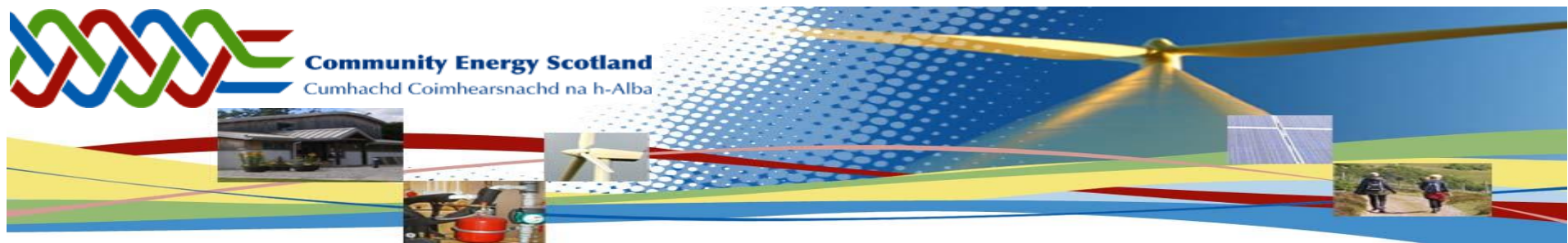


# Why so few large scale community PV?

Wind and hydro have generally offered better returns and are more 'bankable' for project finance, esp for groups without equity to invest

Less of a history/culture of energy cooperatives in Scotland than in England (with notable exceptions like Edinburgh) so fewer developed this way than down south

Slightly lower yields...



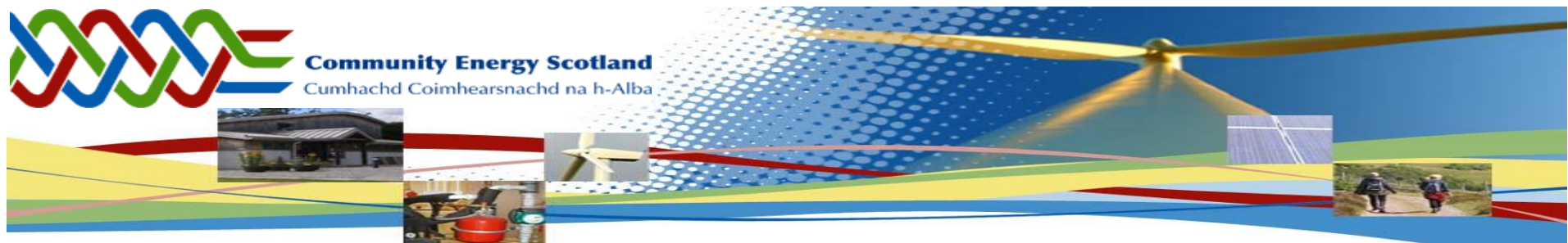
PQ Answer December 2017 (community installations supported by GB FiT):

*Number of installations*

- *1 October 2015 – 30 September 2016*
- *328*
- *209.7 MW*

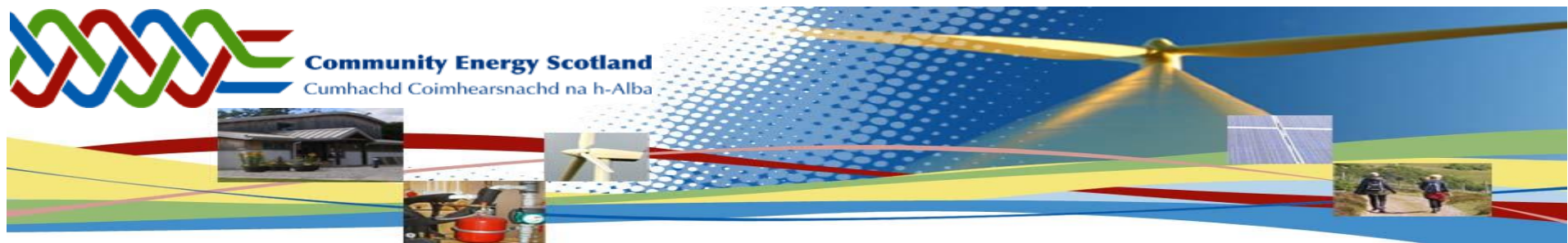
*1 October 2016 – 30 September 2017*

- *36*
- *1.4 MW*



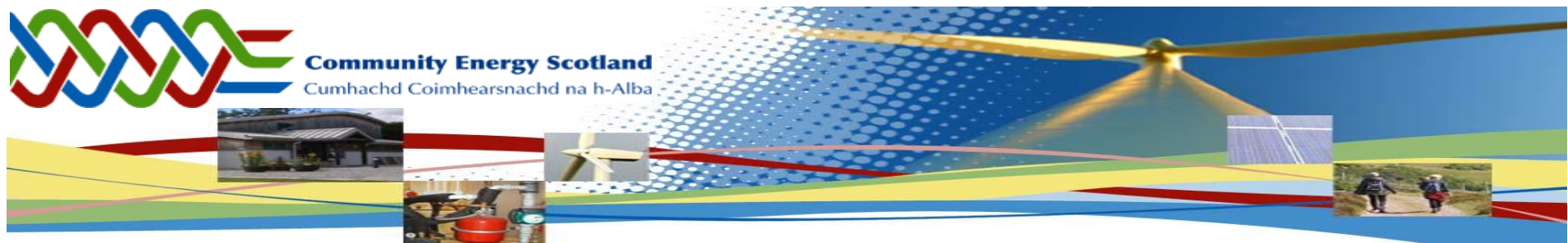
## Case Study – large scale ground mounted

Capacity (MW)	Cost (£M)	Annual Yield (GWh)	Sales income (£) [export only]	Annual OPEX (£) [incl rental]	Simple payback (yr)	
1.8	2.25	1.67	65,000	50,000	133-145	High cost, low PPA, lower yields than South



## 10 year payback period would require...

- Capex reduced to £700/kWp through careful site design, tendering and efficiencies
- Opex reduced to £20k/MWp/year through efficiencies and lower rent
- Average of £120/MWh for power sales, either through direct sales to customers on site or by utilising a battery to store power for sale at peak times
- Grid costs halved



## Conclusions

- Lack of FiT
- Battery storage increasingly significant
- Economies of scale vital
- Local supply / innovation important
- Don't forget solar water!



Nicholas Gubbins  
Chief Executive  
Community Energy Scotland  
Highlands and Islands Social Enterprise Zone  
67a Castle Street  
Inverness  
IV23DU

nicholas.gubbins@communityenergyscotland.org.uk

*Scotland's Independent Community Energy Development Charity*

<http://www.communityenergyscotland.org.uk>

Scottish Charity Number: SC039673

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**Martin Valenti**  
Strategic Director  
Scottish Land Commission



# Transforming Vacant & Derelict Land

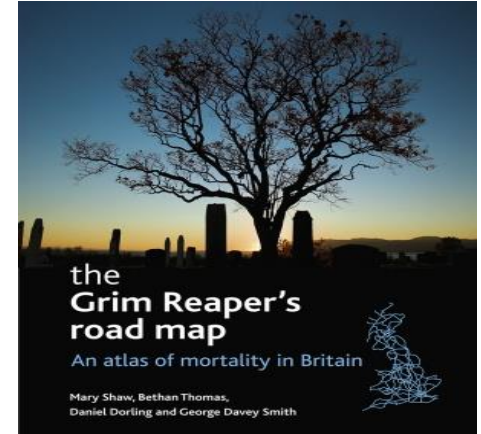
## A Mindset Shift



# THE SVDLS

- Untapped social, environmental and economic opportunity
- Locked development
- Sites are being parked not resolved

Almost a third of Scotland's population is estimated to live within 500 metres of a derelict site. A further quarter live between 500 metres to less than 1,000 metres of a derelict site. Many of these sites are in areas of high social deprivation as defined in the Scottish Index of Multiple Deprivation (SIMD) 2016.



SCOTTISH LAND COMMISSION  
COIMISEAN FEARAINN NA H-ALBA



# Framework Transformation

## 1988 Approach

- Reactive
- Siloed
- Environment
- **Problem focused**
- Process driven
- Unproductive
- Sites being parked



SCOTTISH LAND COMMISSION  
COIMISEAN FEARAINN NA H-ALBA

## 2018 Approach

- Proactive
- Collaborative
- Environment, economy and society
- **Opportunity focused**
- Outcome driven
- Productive
- Sites being developed



Scottish Environment  
Protection Agency

# The art of the possible

Is it possible to create social, economic and environmental success from V&D land?

If only we had access to world class urban designers, architects, built environment, water and land engineers, world class academia, and we could be bold and creative enough to transform former historic legacy into iconic spaces?





# Deserted UK Tin Mine Transformed into 1.4MW Solar Power Plant



Former landfill site set to host  
10MW solar farm



The gas management system will control the levels of landfill gas at the former site as well as generate electricity. It is estimated that the gas system could generate enough electricity to power 1,500 local homes. Combined with the solar farm, the development will generate enough electricity to power up to 5,000 properties.



WISHAWHILL WOOD PUMP TRACK



Edinburgh Spotlight



Culytbraggan former POW camp

## **Peter Speirs**

Public Affairs Manager, Scottish Renewables

## **Lisa Peebles**

Operations Officer, South Seeds

## **Nicholas Gubbins**

CEO, Community Energy Scotland

## **Martin Valenti**

Strategic Director, Scottish Land Commission



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**Joe Mitchell**  
Policy Officer  
Scottish Renewables



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