

**ofgem**

## **Smart Metering Implementation Program: Statement of Design Requirements**

27 July 2010

### **Consultation Response**



This response has been summarised to the related bullet points in the ofgem:  
Smart Metering Implementation Program (July 2010)  
consultation document for ease of access.

Any queries about these responses should be viewed in light of that consultation document.

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**Question 9:** Are there any particular technical issues (e.g. associated with the HAN) that could add delay to the timescales?

#### Twin (or Combined) Domestic Island-Side (Switch-able) Import and Export Bus

Landlords, Housing Associations, ALMO's and Local Authority property owners will have a domestic metering requirement to export distributed generation from roof-top fixed capture technologies and other micro generation; whilst the import capability of single and multiple occupant property meters are remotely disconnected.

That functionality requirement also gives rise to the need for export disconnect provenance, protocol and interoperability considerations.

The Provenance of 'export disconnect' is mainly a lines work safety and CUSC licensee response requirement.

The Protocol and Interoperability functionality is a technical issue that will require a cost analysis and time line.

This functionality requirement also avoids anti-quid-pro-quo or "catch 22" situations, where the metered property occupant/owners would otherwise be unable to 'earn' import connection tariff price from export sales.

#### Funding of Cost and Time-Line Analysis

The Functionality Requirement Analysis for this feature is eligible for funding under the Low Carbon Networks Fund: Projects and Partnerships.

## The Electric Supply System As It Expands In Diversity

Currently, distributed generation from domestic Photo-Voltaics, and other micro generation have two main limiting factors.

1.

District Network (DN) 11,000V↔415V 600-800kVA Transformer Capacity

Although not an immediate barrier, as Domestic PV uptake is at the foot of its sales ramp, the Export to Import over parity of Low-Med Volt District Network Transformers are a future analysis and investiture.

That 415V Export windings of most DN Ring-Main Transformers are  $\frac{1}{4}$  the size of 11kV Import windings peak capacity. Upgrades might eventually become a Distributed Energy Market 'exchange marker' between Distributed Energy Generators / Aggregating Agents / Operators and DN Operators / Electricity Suppliers / Grid UK.

Where Grid region suppliers are not the only in house 'exchange floors' contracting with end user generators, the DN upgrade markets will be further diversified.

As current Domestic PV uptake is being applied in single property and block parcels, from Southerly roof face capture apertures, the orientation of current housing stock is important. Strategic Analysis of stock orientations, including Azimuth to aperture geography, is one way DNO/Suppliers, Ofgem and National Grid Plc can derive DN upgrade potentialities. As DN and 11kV Earthing / Neutral cable capacity is currently not rated for 'Whole Hillside PV Reveal' Volt / Amp Dumping, to provide Tri-Phase DN to geo-electrostatic parity balancing.

Example

**1,000** – 1,500W (@ 230V) = **4.3** – 6.5A Domestic Island Export      x  
(100 – **600** PV Homes ÷ 60% aggregation of 3 Phase Sinusoidal Power is)  
60 – **360** Phase aggregated PV Homes (of 600 homes non-aggregated)  
per 600-800VA 11kV Ring-Main transformer =  
258-390VA – **1,550-2340VA REAL POWER** 'DN PV Reveal' Export Potential  
per 600-800VA 11kV Ring-Main node (>2x current capacity)

The present (2010) domestic uptake and penetration potential of fixed roof-top PV capture in the UK is largely dependant on current housing stock type, tenure and orientation, and the UK 'Feed-in-Tariff'. This potential is the bench mark by which DN Operators (DNO) will draw the time-line for Ring Main up-grades i.e. over capacity / upgrade dates; and calculate how to grade levels of over-capacity though out 11kV node investiture-cycles.

After a certain stage of domestic PV penetration further distributed PV generation will rely on housing stock replacement by redevelopment / infill and new built properties. That future generation will be assessed as a coefficient against property stock replacement rates and upgrade capacity end-of-life 11kV market cycles, and in rare cases in situ MAX potential. As 'Whole Hillside PV Reveal' over capacity and MAX will occur on localised time-lines. The current price of **2000VA** 11kV upgrade is tendered by DNO / Suppliers.

'Follow Phase' Metronomic Code could save distributed generation dissonant phase 'blur' harmonics generated from non-Smart inverters and appliances.

2.

## Ring Main, Primary and Grid Level Storage and Regeneration Capacity

'Whole Hillside' PV balancing across sub Grid supply networks will require centralised regional Grid level, sub Grid supply and Earthing 'balance control' for aggregated PV and Industrially Diversified renewable export etc.

The diversification of energy supply, capture and storage; including Diversified Industrial 'Base Units of Energy Autonomy', will create new nodes of daytime and weather related electricity generation and storage capacity. From vehicle charging and re-energising stations, industrial compressed air energy storage, distributed domestic island storage, energy from organic / agricultural AD fleet heat and power reserves, Tidal energy Grid region over parity, industrial park and on-shore wind flight export, to 'card crediting' energy fitness centres. Black Start Variable Load Reserve Balancing Storage Fleet and distributed energy storage aggregation are up-coming considerations for Grid control.

CCS has a 40 – 70 year suitable geology resource within Europe and the Mediterranean Basin for 'once through' infrastructure investiture. And an un-mapped 'once through' potential globally.

Present 'demand follow' Mega Steam generation fleet are either 'Spinning Reserve' fuel and import balance of trade inefficient and/or demand peak Ramp inefficient. And, to supply inter-Grid boundary and poly-localised balancing services for 'Whole Hillside PV Reveal' and other distributed renewables, those technologies represent over-priced capital market investiture as whole Grid load parity fleet.

The only sub-Grid Supply Point and inter-Regional Grid 'fleet scale' Black Start and Demand Follow technologies capable of control services within and beyond 2010 market fuel cost and Carbon limits, are Pumped Hydro and near market launch CAES TES systems.

Both of these technologies are at above market efficiencies for Grid Region level deployment (and potential for sub-Grid deployment). And are the only reciprocal refurbish-able infrastructure investitures to provide decarbonisation and energy multipliers as bicentennial or 'Hold Water' strategic adjustments.

Further, these technologies are currently the only Grid Level Fleet that provide Off-Shore Wind Flights maximised decarbonisation and energy multiplier potential.

## Wind Fleet with Energy Storage Fleet – Pumped Hydro and CAES TES

On/Off-Shore Wind Flight Name Plate Export efficiencies of 30-**60%**. Compared to 99% Wind Flight Name Plate Export, minus Storage / Regeneration Auto-Arbitrated Load and transmission losses.

Pumped Hydro	Efficiency
Coastal Lagoon and suitable post extraction systems -	80-85%

CAES TES in suitable post extraction systems and industrial park / medium scale sub-Grid plant fleet - **65-75%**

Wind Flight Gain      Trans / Dist Loss      Regeneration Loss  
**40-70%**      -      (5%      +      35%)  
=      24% Wind Flight Name Plate 'Energy Return' Gain;  
for the price of Carbon Neutral Grid 'Parity Follow' near  
perpetual electricity infrastructure.

= The combined Wind Flight / Storage 'Energy Return and Gross Multiplier' efficiency is roughly **79.5 – 92%**.  
Minus refurbishments.

Ignoring pre-existing infrastructures, the 'cradle-to-cradle' and fuel energy return ratio of coal fired generation fleet is 11 times energy inputs, and fission 16. Those technologies also present large fuel energy to Carbon electric inefficiencies (coal) and fuel market price-riser inefficiencies (fission).

The net 'cradle-to-cradle' Energy Return Multiplier of on-shore and off-shore wind flight are upward of 50 times energy input in absolute terms.

Extra to the energy multiplier 'efficiency gain' of wind flight 'Full Name Plate' export in co-action with 'Parity Follow' storage and regeneration fleet, are large long-term capital investiture and end consumer savings (GDP) (from the number of Carbon+ and maleficent toxic fission mega steam generation fleet market cycles being reduced), distributed and Industrially Diversified full renewable aggregation utility, and large efficiencies in all 'Load Reserve' markets from 'Parity Follow' variable load and supply fleet.

In conjunction with Wind and other renewables, CAES TES and Pumped Hydro electric energy storage and regeneration fleet have extra-long-term energy return ratios as renewable efficiency multipliers in near perpetuity (energy return ratios currently unknown). And replace old fleet technologies with cheaper Carbon Neutral market-cycle investiture and fleet revenue life-cycle elongation.

Set against those revenue cycles and savings, Smart Control 'Parity Follow' upgrades of DN, Primary Relay, Grid & Supply Point and new Grid connection infrastructure can be reconciled within market adjustments to supply; property owner / house holder 'Base Units of Energy Autonomy', decarbonisation of local and surface transport, efficiency of Industrial and Agricultural renewables aggregation utility and minimal toxicity Carbon Neutral electric transition.

## Transport

I would also like to highlight some issues surrounding Public Transport Traction and Future Market Share of technologies currently vaunted and near market launch for the Hydro-Carbon to Electric Drive Train transition.

Industry Research on Global unit capacity, from proven Global resources of Rare Earth Elements involved in the production and manufacture of Nickel Hydride and Lithium Ion electric storage media and associated assemblages, show a total (2010) Global family car replacement capacity of roughly [2/3rds](#). That does not include other surface transport such as rail boggy assemblages, road freight or Public transport fleet or an expansion in demand for individualised auto-motive transport globally.

The third technology presented as a Hydro-Carbon energy substitute and transition is the Hydrogen Fuel-Cell Electric Drive Train family sized car. With a fuel to drive wheel efficiency similar to diesel, [20-25%](#). Using Hydrogen as a renewable fuel through Fuel-Cell technology, at current stages of development, is in its self highly inefficient at 35-42%.

One technology, MDI compressed air engines in partnership with TATA Motors, presents fewer re-energising and toolage issues and has a high plug to wheel (non-thermally conditioned) efficiency 18-40%. With no limit on market share. Current drive ranges for non-thermally conditioned air engine family units are in excess of 91-165km. And drive ranges for thermally conditioned family units of 270-670km+. Compared to transitional electric storage media, which at present have no infrastructure or capability for recycling, and 'traditional' drive trains, this early stages technology is advancing. Non-thermally conditioned Compressed Air drive trains already have plug to wheel energy efficiency ratings up to [40%](#) in urban use, and 60% as a short term objective.

Compressed Air Engine technology has the capability to power heavy loads at high reciprocal braking efficiency, re-energising station near-instant recharges, zero carbon emission urban and range travel and better than electric and conventional car unit assemblage perpetuity life-cycling costs.

Trunk route/district CAES TE'S' ('System') re-energising stations have the ability not only to supply economies of scale to transport nodes. But also to enable contiguous renewables balancing services as 'at scale' DN & Primary level Renewable Energy Storage Reservoir and Uptake.

In economic terms, the current fractional reserve fiscal plateau cusp gives energy efficiency market and revenue cycles rising fractions in GDP terms.

Although electric drive train storage media technologies can provide end user electricity balancing, they are limited in unit life-cycle efficiency as 'at scale' aggregated reciprocal balancing servers. Where as CAES TE'S' re-energising stations for large transport fleet and cars may approach decentralised scales of contiguous local balancing service. And at the high end of industrial park scale may also double as contiguous reciprocal reserve for regeneration to the sub-Grid level. i.e. supplying Primary Supply Nodes and DN Ring Main; where the largest transmission and distribution efficiency losses are encountered.

## Rough Cost Efficiencies of Transport Power

### Electric Storage Media –

slow recharge	0.1	
skills range	0.5	
high energy cost efficiency	0.8	
recharge infrastructure	0.8	car / home
	+ 0.3	street (/ station)
	+ 0.4	Grid (/conveyance)
	<u>2.9</u>	

energy & infrastructure balancing reciprocity 0.8

### Compressed Air –

swift recharge	0.9	
skills range	0.5	
med energy cost efficiency	0.4	
recharge infrastructure	0.6	car / home
	+ 0.7	station (/ street)
	+ 0.6	Grid (/conveyance)
	<u>3.7</u>	

energy & infrastructure balancing reciprocity 0.6

### Hydro Carbon –

swift recharge	0.9	
skills range	0.8	
low energy cost efficiency	0.1	
recharge infrastructure	1	car / home
	+ 0.7	station (/ street)
	+ 0.1	conveyance (/Grid)
	<u>3.6</u>	

energy & infrastructure balancing reciprocity – 0.7

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