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Our Ref: (S)1011/hf

18 May 2015

Dr Jeffrey Hardy
Consumers and Sustainability
Ofgem,
9 Millbank,
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Dear Dr Hardy,

**NON-TRADITIONAL BUSINESS MODELS: SUPPORTING TRANSFORMATIVE CHANGE IN THE ENERGY MARKET**

The IET welcomes Ofgem's discussion paper on non-traditional business models and believes strongly that the regulatory environment will need to develop to encourage fresh thinking and to avoid being an inhibitor of beneficial, but potentially disruptive, change. For this reason, we welcome and endorse the way in which this subject is introduced in the overview to the Ofgem Discussion paper.

We have studied the useful Ofgem Discussion Paper and hope that our detailed responses to your questions are of assistance to the Team.

In addition to answering the specific questions posed, the Institution of Engineering and Technology (IET) has included an Appendix in which we consider the future evolution of a Distribution Network Operator (DNO) to a Distribution System Operator (DSO) as this might also be described as an emerging 'non-traditional' business model, but is not covered specifically in the discussion paper.

The attached response has been developed on behalf of the Board of Trustees by the IET's Energy Policy Panel.

If the IET can be of any further assistance on these issues, please let me know.

Yours sincerely

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Copied to: Maxine Frerk, Senior Partner for Smarter Grids and Governance: Distribution.

**Ref (S)1011,** 18 May 2015

**IET Submission to Ofgem on**

## NON-TRADITIONAL BUSINESS MODELS: SUPPORTING TRANSFORMATIVE CHANGE IN THE ENERGY MARKET

The IET welcomes Ofgem's discussion paper on Non-Traditional Business Models (NTBMs), and believes strongly that the regulatory environment will need to develop to encourage fresh thinking and to avoid being an inhibitor of beneficial, but potentially disruptive, change.

Existing business models create sufficient value to make the participation of existing players worthwhile. Potential NTBMs that could provide overall benefit to customers typically struggle because that benefit is distributed amongst many parties in the value chain, and the benefits may not accrue to the party that must invest to create the model.

This is in a context of everything in the electricity system becoming much more dependent on everything else, and the need to view issues in a whole system context. The whole electricity system includes: generators (large and small); transmission; distribution and consumer networks to each point of end use; metering; communications; data; and potentially a whole host of interfaces to systems and actors not traditionally associated with electricity at all, such as the transport system, and information companies. In addition to providing commentary on Ofgem's discussion paper chapter by chapter, we include further discussion of these matters in Section 6 of this response.

In the IET's view, a careful balance needs to be struck between:

- what needs regulating;
- where regulation should be avoided to enable innovation; and
- the forward-looking engineering governance necessary to enable a resilient and cost-effective system to continue to exist in this very different landscape.

Thus we see Ofgem's thinking on NTBM as strongly linked to the IET's work exploring an electricity system architect role, and would recommend that the economic, market and technical aspects of future system development need to be thought about holistically.

In GB, existing business models are based on 3 dimensions that define what is possible:

(i) **the technology dimension** that concerns the engineering of the network, the way power flows through it, the way technical data is measured and used and the technical standards needed to make the whole system operate safely and securely.

(ii) **the commercial dimension** that concerns the many possible flows of commercial data and money between parties to facilitate the working of the value chain and settlement.

(iii) **the market dimension** that concerns the (horizontal) structures that have been chosen and the rules in place which create the concepts of suppliers, TSO, DNOs etc.

NTBMs often cut across the traditional boundaries between these three dimensions in a different way, or potentially bypass one of them completely. The challenge posed by some

NTBMs can be the disruptive impact it has in one or more of these dimensions. Although the market is an artificial creation, significant investment has been made based on its existence. It may be no easier to change a market rule than to introduce a new technology.

We should recognise also that beneficial innovation could come from established participants in the sector and its supply chains, and have regard to not inhibiting such innovation when considering how to facilitate non-traditional new entrants.

Typically, NTBMs represent a move to a more distributed power system, characterised by renewable generation sources, storage, automation and intelligent systems - some of which are integrated within the power networks, and some deployed beyond the meter or part of a Community Energy or Smart City arrangement. A common characteristic of such 'smarter energy' systems is the requirement for sensors, data and its processing and sharing with relevant parties. Similar situations in other sectors are addressed by the recognised approach of Interoperability and Open Systems, typically recognised by international standards and facilitated by developments such as Layer Models.

The establishment of Open Systems requires a coordinating mechanisms and suitable governance, especially in the power system where inadequate interoperability and holistic thinking can jeopardise energy security and stability.

## Section 1

### *Definition of NTBM*

We feel this is well expressed but lacks clarity as to where responsibility for regulation under Ofgem begins and ends. The current arrangements clearly define Transmission and Distribution networks as far as the Meter as the demarcation of regulatory reach. With NTBMs these can and will straddle these boundaries and, as such, become linked to the activities of other key actors such as electricity suppliers, including potential new entrant suppliers who may contemplate Web-based interaction with customers' systems. The impact of one upon the other could be beneficial or detrimental. It would be easy to over-regulate these activities and to inhibit desirable innovation, but such innovation needs to be balanced with a consideration of whole system impacts.

Examples:

- Domestic energy storage, that could provide both consumer/supplier benefit by managing demand peaks, maximising use of generated energy at source (e.g. in conjunction with rooftop solar PV), and network company benefit by reducing network capacity requirements, and potentially needs to monetise both these benefits to be attractive.
- The timing of electric vehicle charging, which could bring consumer benefits by allowing suppliers to minimise electricity purchase at times of higher cost, but needs also to recognise physical limitations on network capacity local to each charging location.

One factor we believe also to be important is the increasing interaction between the energy system and other systems. This is explored in later comments, but it would be helpful to reflect on this in the definition, as the consequences could be significant and could involve other regulators (Ofcom, Ofwat).

## Section 2

*Views on the drivers for market entry*

We believe the four headings suggested by Ofgem are broadly appropriate, but would suggest some additional focus within those headings. Examples include:

- **Electric transport** – the role of the car in society is changing from personal asset towards shared service provision, and there is a commercial battle between car manufacturers and information companies for ownership of value. In the context of electric transport this could lead to car manufacturers, information companies, hire companies or lease fleet operators seeking some backwards integration into the electricity system. This might include acting as suppliers, buying, providing and selling storage and possibly even ownership and operation of network elements.
- **Community heating**, which could create an entirely new market, and potentially a need for Ofgem's remit to be expanded
- **The grid becoming an insurance** - as consumers generate, store and manage their own energy, and become more efficient in its use, and as self-sufficient energy communities develop, the grid may evolve to become an enabler of intra and inter community trading, providing the means to address local real-time imbalances between generation and demand and providing the necessary system strength to ensure integrity of protection schemes and adequacy of power quality. The current unit-based distribution use-of-system **(**DUoS) charging regime would seem inconsistent with such a role.
- **Integration across energy vectors** – much more sophisticated integration across electricity, community heating, gas and possibly liquid fuels and hydrogen, enabling sophisticated management of energy and carbon across the vectors, with consequential effects also for networks
- **Smart meter data** – which might encourage new data driven entrants into home energy management – or could (thorough its limitations) drive new entrants into provision of home energy management via the internet, with consequential impacts on networks
- Possible provision of **open voltage and power flow data** on networks – which could encourage innovative thinking around how large scale and distributed devices connected to networks could be operated to create enhanced value for networks
- **Internet of Things** – much more sophisticated data and analytical techniques, already seen in sectors such as retail, reaching both the consumer energy economy and also power network applications, leading to new entrants finding new ways to enhance customer experience and value
- **Smart Cities** – an area of active development internationally and implying a much more holistic approach to city development, with consequences for energy systems. Being promoted by GB government, and by a new international standard, ISO 37120
- **Local Markets** – the ability for consumers to buy and sell peer to peer
- **Local Authority Engagement**, with private networks, ESCOs and potentially innovative ways to circumvent constrained utility systems
- **Energy becoming an IT application**, part of the ever increasing reach of IT providers to home and business
- **New Consumer Engagement Approaches**, which could range from the enhanced consumer experience provided by learning Web enabled thermostats controlled from phone apps, to currently "frontier" ideas such as use of heated clothing

- **Aggregators exploiting demand response,** potentially using existing equipment such as storage heaters and new ideas such as domestic storage batteries
- **Energy Storage,** which can support many different elements within the value chain, and potentially provide a wide range of system services
- **Microgrids,** which potentially bring advantage in facilitating integrated renewables deployment, storage, community usage, ability and island and inherent resilience
- **Drivers we don't know and can't anticipate today** - as the pace of change in the technology sector continues to accelerate, and to drive its way into energy provision, we can expect new technologies, models and consumer expectations to emerge

Underpinning all these are the potentially substantial changes to the roles of distribution network operators, as they become local integrators rather than supply conduits, and the rapidly emerging importance of engineering systems integration, which becomes a vital enabler if the above are to reach their potentials.

## Section 3

*Has Ofgem described the NTBM environment accurately – has anything been missed?*

This section provides a good summary, with the important exception of community heating (CH), which is central to DECC's plans for urban areas but is hardly mentioned. Even within Ofgem's current remit CH is important because it could have a profound effect on the economics of gas distribution. Indeed, it may be necessary to find ways to drive consumers proactively towards using community heat to give it the local scale needed, and hence to make the investment case sufficiently attractive. Regulation could be a way to bring the investment certainty required, and CH would most logically fit within an extension of Ofgem's remit as an energy regulator, especially given the ever increasing importance of systems integration.

More work is needed on what models could emerge for CH and its integration with other vectors including electricity, gas, waste etc.

The multi-service providers mentioned in 3.20 could develop to deliver control of the domestic energy system via broadband networks, with no linkage to the electricity network, and hence risk of overloading of networks.

## Section 4

*Future and current regulatory issues*

We support and agree with the various issues highlighted in the paper, and would suggest the following additions and developments:

- Ofgem's formal remit potentially needs attention to address:
    - community/district heating to the extent it needs regulating;
    - potentially, a recognition of the need to ensure that current incumbents do not act as barriers to innovative new entrants;
    - potentially, an obligation to support and enable consumer engagement.
- The increasingly intertwined nature of technological innovation and the regulatory model, with most new technologies challenging the regulatory status quo, and systems becoming vastly more complex and integrated. We would suggest

technology needs to become more central to regulatory thinking, potentially via a system architect function, or otherwise

- A need for agility in making adjustments to the regulatory model, balanced of course with the need to show consistent behaviour for reasons of investor confidence. This could be achieved by the type of forward looking review being addressed in this consultation becoming a regular exercise.

- More consideration of how the "network operator" role (especially for electricity) might evolve either in response to or as an enabler of NTBMs. The migration of the DNO business model towards say "DSO" or "DSPP" thinking would appear to be an important matter to address at an early stage. This would encourage the DNOs to develop new value-added services to consumers and avoid a slow drift towards the undermining of their financial models. We understand that Ofgem has a formal obligation in this area, which is of course important to investor confidence and the management of DNOs' risk profiles. We describe the issues involved in more detail in Appendix A.

## Section 5

### *Costs and Benefits*

Benefits are mostly around releasing and easing the deployment of innovative technologies at consumer level, and allowing the focus on local solutions especially to be realised. Costs could potentially be significant to network companies (and hence consumers) as network companies could become obliged to simply respond to changes as they occur, without having visibility of the underlying changes. At the other end of the scale, the risk exists that consumer self-sufficiency could evolve to the point where network company business models would be undermined.

Local solutions, involving mass produced elements driven by heavy technology investment globally, have a strong chance of radically reshaping the energy system, perhaps in ways we cannot yet imagine. Major generator-suppliers across Europe are suffering badly with stranded assets, a problem that seems likely to get worse not better. Given this, it may be that the best chance of future resilience is to foster models supporting change at local level, where new and more community-based investment models can emerge. There is perhaps also a linkage here to demographic change and pension provision. Could a concept develop of local energy solutions as virtual pension funds?

We believe further issues are also relevant in assessing costs and benefits, as follows:

- NTBMs are as likely to apply in the commercial and industrial sectors as the domestic sector, and are also a possible source of value to network operators (e.g. provision of large scale storage)

- NTBMs may also drive low carbon solutions, effectively helping the UK meet its $CO_2$ reduction targets, minimising long run cost to consumers (but not necessarily lowering short term costs)

- NTBMs could lead to unexpected additional network costs if not fully assessed and understood, and need to be assessed in a whole system context

- NTBMs could potentially add (or reduce) resiliency risk, again pointing to a need to explore the whole system context.

- We would generally expect encouragement and development of NTBMs to drive greater levels of product and service innovation. This is turn is likely to drive more NTBMs potentially creating a virtuous circle, hence the benefits of NTBMs, especially early NTBMs may be greater than they appear.

- NTBMs may also act as a catalyst to some market incumbents who will only innovate in the face of real competition
- Similarly to NIA and NIC, could a smaller fund be created for the design and development of NTBMs where it can be shown to likely deliver system benefits?
- NTBMs could be a source to stimulate new thinking into addressing fuel poverty
- NTBMs or even the existence of a regulatory environment that openly supports them would be likely to change the external image of the energy sector from being un-innovative and structurally resistant to innovation to one actively seeking new ideas and solutions to meet industry challenges. This could have multiple benefits including:
    - Encouragement of creative thinkers from other sectors to look at energy.
    - Helping to resolve skills shortages in the energy sector through making it a more appealing place for the best people to make careers
- For private companies with NTBMs, the route to revenue and profit will need to become clearer through simplified (or reduced) regulation

*Challenges*

The challenge here seems to be around having regulation become as light as possible for NTBMs. The concept of customer switching may also become less appropriate under some circumstances – for example if a customer were a user of community heating – or if we were expecting long term connections between customers and locally-developed energy assets.

## Section 6

*The challenges of complexity, integration and interfacing*

Ofgem's discussion paper has, we feel, been very helpful in setting out the many ways in which new business models could emerge in energy, and we hope our comments in Sections 1 - 5 above have helped to clarify and stretch this thinking.

However as set out, the engineering dimensions of the future electricity system in particular are not so developed. We have accordingly developed a narrative that seeks to explore the engineering challenges arising at whole system level and, in particular, to highlight the importance of engineering interfaces in enabling new business models, as below:

*Challenges to the present arrangements*

For the past 100 years, the GB electricity system has been based on the principle that a grid control centre schedules generation to ensure a rough balance between load and supply. This balance is "fine-tuned" by a proportion of the turbo-generators on the system having control systems that vary the steam flow to the turbine as a function of turbine speed in order to maintain the 50 Hz frequency. In this model of operation, the DNOs play no routine part in managing the frequency but provide a significant part of the connection between the generators and the loads. Distributed generation (DG) is not treated as generation but largely as a negative load.

This model is under stress and is unlikely to remain viable as decarbonisation progresses towards 2030. We can expect to see increasing amounts of distributed generation connected either to 415 V feeders (for domestic rooftop PV and micro-CHP) or to 11 kV, 33 kV and 132 kV networks (for PV arrays, individual wind turbines or smaller on-shore wind farms). In addition there are increasing numbers of "community scale" networks consisting of CHP generators, micro-hydro, wind turbines and solar PV feeding local loads and, from time to time, being able to export power to a DNO. To date, these have mainly been based in industrial sites, universities, housing co-operatives and similar establishments but the "Smart Cities" initiative is likely to see a much wider spread of integrated energy zones with, as yet, an undefined relationship with the local DNO.

The challenge to traditional power system operation will be wider than these generation changes alone, as the power system evolves to include active consumers, automated energy management, smart meter services, time of use tariffs, distributed storage, and smart network devices such as real-time ratings, power electronic soft open points, and Active Network Management.

Some of the emerging "smart energy organisations" are likely to be able to manage their demand on different energy vectors in real time – thus a university campus could switch from using a gas-fired CHP generator to using grid electricity when the price of the latter is lower than the costs of independent generation and the on-site demand for heat is satiated. Control systems for micro-CHP could modulate the electricity and heat outputs to reflect the availability of local sources of renewable energy and the price of grid electricity. Demand and storage management would likely be a natural component of such a community energy system.

Apart from the technical challenges, market structures will become increasingly fragmented. Where consumers and DG providers are connected to a common community electricity network, they are likely to establish informal arrangements to trade surplus electricity, which are invisible to anyone outside that community. The last government encouraged the spread of small scale energy retailers in competition to the "big six". It seems likely that this trend will increase and there will be a diversity of trading relationships, including peer-to-peer markets. This arguably goes with the flow of wider trends that can be observed as part of the Internet of Things.

With the likelihood of greater electrical loads on some LV feeders due to the take-up of plug-in vehicles, government and distribution companies have a strong interest in the latter being able to manage the load at a "postcode" level to avoid the cost and disruption of replacing feeders in the street. It must be recognised, however, that such unilateral actions by DNOs to manage localised network constraints will have an impact on Suppliers' balance positions and hence exposure to cash-out payments. It follows that there needs to a means of reconciliation similar to that catered for by the BSC mechanism which protects suppliers from imbalances due to actions by NG to balance the system in real time.

With such a diversity of energy sources and energy management and market structures, many of which will be invisible to the grid control centre, the model of a central despatcher controlling all generation is unlikely to survive. Equally impractical would be the extension of traditional centralised network management to include tracking of the states of charge of thousands of electric vehicles and static storage devices, and demand management at community or household level.

Where existing business and engineering models are not fit for the future, or are too slow to adapt, we can expect to see third party providers by-passing the established sector, including its operational processes, commercial mechanisms, governance and safeguards.

### *A future structure?*

To meet the objectives of the 2008 Climate Change Act, it will be necessary to achieve almost complete decarbonisation of the electricity system well before 2050. (The CCC is arguing for 50 g/kWh by 2030.) Without large-scale adoption of CCS (which seems improbable unless there is a major and legally irreversible increase in the carbon price), achieving these targets is likely to involve a dozen or so large nuclear stations and several large groups of off-shore wind farms connected to the transmission grid. Most other generation would be distributed and connected at lower voltages (usually to a DNO's infrastructure).

At some times of the day in seasons with low demand, it is likely that the entire national load could be provided by renewable energy, much of it distribution-connected. From the point of view of $CO_2$ emissions, this would be a desirable situation, but the challenge it poses is how to manage voltage and frequency and provide adequate power security and quality in a new system architecture where active central control of all distributed generators and storage devices would be unmanageably complicated.

One option would be to adopt the principle of subsidiarity and also to emulate some of the features of how individual countries in mainland Europe operate in a synchronised grid area. In this model, much of the responsibility for load balancing would be transferred to the DNOs, comparable to the responsibility of national network companies in mainland Europe. There would be defined interfaces between the HV grid and the DNOs and a central market mechanism where central generators could bid to DNOs to provide a required level of demand. The DNOs would manage supply and demand in their areas and the loading on feeders by variable tariffs (with some similarities to countries in the European grid). In some discussions, this new role for the DNOs is described as a Distribution System Operator (DSO), or DSP (Distributed Service Provider). This role might be that of the trusted data provider, the demand and storage optimiser, and the enabler for community energy and smart cities.

The arrangements would allow a DNO to draw a boundary round a community energy scheme, university campus, smart city or similar and treat that as a single entity with an agreed technical and commercial interface. As in the relationships between the TSO and DSOs, as far as practicable, balancing actions would be taken at the lowest practicable level with community energy schemes incentivised to balance generation and load within their boundaries.

This model for the future also requires a governance role (explored by The IET's Power Network Joint Vision expert group) that will ensure a necessary level of interoperability, through open systems and data sharing, sufficient to encourage innovation (avoiding lock-in to bespoke arrangements), and assure the stable operation between large numbers of automated and intelligent energy devices and smart grid systems which, if uncoordinated, could jeopardise system stability and security. Furthermore, this governance role (in other sectors termed the System Architect) would ensure holistic, whole-system, development that delivers flexibility for the future and avoids a 'house of cards' development pathway that creates risk and from which it is very expensive to back-track.

*The interface*

Under the current arrangements the tariffs for electricity supply or feed-in concern only power (kW). In future, it is likely that arrangements between the TSO, DNOs and community energy schemes will have to include other engineering parameters, including reactive power, system inertia, voltage control and short-circuit level. Several of these parameters are location specific, which is why the market structure would have to be geographically linked (in a DNO), rather that nationwide (as with the existing energy retailers).

As an example, the contract between the DNO and a university campus that included both consumption and generation might include a series of technical requirements, such as:

- A 0.85 lagging power factor at the 11 kV supply point
- A minimum fault level of 50MVA at the supply point
- A system inertia contribution equivalent to a 0.5 second electromechanical time constant. (Whether the university achieves the last of these by a CHP system using a reciprocating gas engine or with a wind turbine using artificial inertia would not be the concern of the DNO.)

In the future, to contribute to frequency management, a DNO could contract with a windfarm operator to use frequency-sensitive control, when demanded, where the windfarm might be asked to provide, say, full available output at 49.8 Hz, dropping linearly to 60% of the maximum at 50.2 Hz and to zero at 51 Hz. The interface would thus be defined by the need to specify not only the power passing through the interface but also the characteristics of the electrical system, particularly on the downstream side. The tariffs for distributed generation would have to include recompense for providing services such as reactive power or fault-level (for example by an over-sized feed-in inverter and a capacitor bank). It is likely that frequency sensitivity would only be required under conditions of low load when the value of electricity generation would be low so that the costs would not be prohibitive.

To manage demand response and storage optimisation, there will need to be an exchange of data between participants - the owners of the equipment, the network operator, and third parties such as aggregators and community energy managers.

An important consideration here is that the development of interoperable open systems will need to be implemented in a context of continuing change. New governance mechanisms (whether a System Architect role or by some other means) must be not only enablers for further innovation but, critically, must not become barriers to it. This is a non-trivial problem and the balance between encouraging innovation and hampering it is a fine one. Interoperability and data exchange mechanisms which are designed around traditional devices and established operational and business processes are unlikely to be suited to the fresh thinking that is now emerging, including innovative customer products and services, and the future roles of third parties.

### *Consumer-level demand response*

In the model described above, large-scale demand response would be part of the negotiated agreements between the DNO and “agricultural scale” generators, larger commercial enterprises or community energy schemes. At the level of the domestic consumer or SME, the DNO could negotiate variable tariffs reflecting both wholesale energy prices and the need to manage the loading on LV feeders in particular streets. This would require a real-time interface with the consumer’s smart meter/energy management computer capable of modulating the demand of heat pumps, EV charging or time-shiftable white goods (e.g. dishwashers or freezers).

**Appendix A to IET Submission on Non-Traditional Business Models:**

## Future Evolution of DNOs

The future evolution of a DNO to a DSO might also be described as a 'non-traditional' business model. By way of illustration, a number of LCNF projects have explored the potential for non-traditional solutions (e.g. to address network capacity or security constraints) to also provide benefits to the wider electricity system. Some of these solutions challenge the normal boundaries of DNO operation (in a de-bundled market) in ways which impact aspects of regulation and the boundaries for licenced DNO activities. These solutions include a range of DSR applications, innovative connection arrangements for DG (involving active management of real and/or reactive power) and electricity storage. All of these solutions, once adopted at scale, will directly impact other parties in the electricity supply chain.

It will be important to ensure that potential synergies in solutions that serve more than one part of the electricity supply chain are fully exploited and not limited by one party 'locking-in' a solution through an exclusive contractual arrangement. Equally, it will be important to ensure that potential conflicts across the supply chain arising from one party applying a solution which adversely impacts another party are resolved (e.g. as noted in the consultation, a DNO using DSR to manage a network constraint might then put Suppliers out of balance). It is also important that providers of services are not over-rewarded (at the expense of consumers) through different parties contracting for the same resource. DSR is a good example as it can provide services to:

- the local network operator in managing constraints and ensuring security of supplies;
- Suppliers (in terms of mitigating imbalance risk and cash-out exposure);
- the System Operator (e.g. for Short-Term Operating Reserve (STOR) or Demand-Side Balancing Reserve (DSBR));
- and it also has a role in the Capacity Mechanism.

Electricity storage installed as a 'network' solution can provide an even greater range of upstream services such as Fast Reserve and both Dynamic and Fast Frequency Response, as well as power purchase tolling services to Suppliers. The question arises as to which party should own the electricity storage asset and be the provider of services. DNO ownership has the advantage that the storage facility (involving batteries and power electronics) is an integral part of the operational network and an asset that requires expert design, installation, commissioning and ongoing maintenance. On the other hand, if the asset is managed by (for example) a Commercial Aggregator then that party might be best-placed to leverage the full capability of the facility to provide services to all parties. (In so doing the CA would need to exploit synergies but also manage conflicts).

This is really at the heart of debate over the future DSO role. If DNOs, Suppliers, the System Operator, and other (including new) market players were to act independently to secure reserve and ancillary services, it is highly questionable whether that would secure, overall, the best use of such services and at the most economic cost for consumers. An extended function for DNOs that allowed 'non-traditional' network solutions to also serve other parts of the supply chain would help make the business case for such solutions and provide a basis for leveraging the full capability of that solution to the benefit of all parties and hence, ultimately, consumers. The question then is whether this is appropriate business for a licensed distributor and whether additional revenues secured from such services should be part of the DNO's licenced distribution business or a separate non-regulated activity. Whilst such revenue streams would be supplemental to traditional DNO 'regulatory income' they might be critical to the smart solution being economically viable. The key message here is that failing to accommodate DNO non-traditional business revenues (either as regulated or non-regulated income) could ultimately be to the detriment of promoting whole system efficiency.

Local generation and storage, micro-grids, community energy and smart cities are likely to result in a new relationship between local networks and the traditional power system. In the ultimate case this might be off-grid operation at a community level, or perhaps more likely a hybrid relationship that is sometimes on-grid, sometimes off-grid, and sometimes 'floating' (i.e. connected but with little net power flow). In the hybrid case there is likely to be a bias towards local self-supply. In this situation there is a significant range of regulatory implications to be considered: for example:

- Charging methodologies for DNOs providing a reduced volume of energy delivered (either to or from a customer), or an insurance service for back-up security and meeting local imbalance only;
- What would be the treatment of stranded assets, especially if widespread?
- What would be an appropriate security of supply standard to such communities?
- How would Quality of Supply be assessed and incentivised?
- How would an islanded network be re-synchronised with the DNO network? who would be responsible for this and bear the costs of the necessary facilities?

Overall this suggests a more holistic portfolio of output measures than currently embraced by RIIO. For example the concept of 'load indices' might become redundant and give way to network 'capability' measures that provide the necessary services to enable community energy schemes to provide affordable, secure and environmentally sustainable energy to consumers whilst securing maximum value for their shareholders (including community shareholders) as wider market participants.

IET
18 May 2015