No change? It’s all change!
A perspective from the UK on tomorrow’s energy supplies
Very briefly

My background:

- Electricity Distribution & Transmission planning and operations
- Manager of the GB National Control Centre
- Engineering Director of National Grid Company in UK
- Technical Director for Ofgem, the GB Energy Regulator
- Director, Network Innovation for KEMA Consulting Ltd
- Independent Consultant, Chiltern Power Limited
  - Institution of Engineering & Technology, Energy Policy Panel
  - Visiting Professor – University of Bath
  - Non Executive Director - Smarter Grid Solutions
  - Senior Technical Advisor – Pearlstone Energy
A structure for today:

1. A round up of UK energy developments
2. UK government & regulatory policy shifts
3. The Future Power System Architecture project
4. FPSA’s agile working approach – a lesson in itself
5. Some key learning: R&D gaps and emerging challenges

and some pointers for New Zealand
A round up of UK energy developments
Transformative Change is ahead

A recap...

- Traditional ‘centralised’ architectures are no longer fit for purpose; the future will likely be a hybrid of centralised / cloud/ distributed systems

- Integration will be needed across Generation + Transmission + Distribution + Active Consumers + …

- ‘Edge Technologies’ result in variable power sources, reversed power flows, & substantial new demands that are creating serious changes on many networks

- “Generation follows Demand” will be replaced increasingly by “Demand follows Generation”, calling for new flexibility

- New commercial parties, models, and business platforms are now appearing

- A growing focus on communities, peer-to-peer trades, local markets, new services with attractive customer choices

- The old deterministic ‘givens’ are no longer valid: data analytics, statistical analysis & social sciences will be needed
The Changing Grid in Britain and Ireland

- Winter peak demand c.60GW and not visibly growing, 380TWh annual energy
- **Currently 27GW of Distributed Generation, and not visible to the SO**
- Comprising 15GW of Wind & 12GW of PV
- Latest high wind record on metered wind farms is 8.3GW – connected capacity of 9.9GW (84% of theoretical max output)

**To maintain national system inertia** the SO instructs multiple part-loaded large units (when high renewables & low demand)

**Need for new EFR** (Enhanced Frequency Response) services market; recent auction was a success for battery investors

- SO demand forecasting errors are rising owing to unmetered distributed generation

**Ireland proposes to increase the System Non-Synchronous Penetration (SNSP) limit from 50% to approx 60%**

- This will underpin an eventual increase to 75% SNSP (supported by investment under their DS3 programme)
- Recent conditions have resulted in near 60% SNSP arising in practice

- EU Network Code has new requirements:
  - ”…with regard to information exchange… power-generating facilities… [>1MW]… shall be capable of exchanging information with the TSO in real time…..
  - **A significant data task;** is it wise to ‘simply centralise’ this – might a change from DNO to DSO roles be a better way forward?

For EU Codes see:
https://www.entsoe.eu/major-projects/network-code-development/requirements-for-generators
The Changing Grid – a new SO market product

- National Grid’s new ancillary services product **EFR: ENHANCED FREQUENCY RESPONSE**
- This recognises insufficient ‘free governor action’ now available from traditional large generators
- Very fast acting ‘continuous control’ for matching generation and demand (100% output in 1sec)
- Procured by a £66m auction – with large take-up (200MW) by battery project investors

...but at a low average price of only £9.44/MW, was this a loss-leader by big incumbents (**and unfair to SME innovators?**)?

- NG was also criticised for only offering 4 year contracts, yet the installations will have a much longer asset life (again very unhelpful to SME’s who have to raise funding from the market, rather than off their own Balance Sheets)

Similarly, auctions in the GB Capacity Market offer generation 15 year contracts, while DSR is offered a 1 year contract.....

**Strong calls can be heard for more innovation & flexibility, but is commercial thinking loaded against SME entrepreneurs, commonly the most creative?**
Solar PV deployed in Britain, MW

- 7.6TWh generated in 2016
- 2.5% of national consumption overall
- On occasions, PV delivers some 15% of national capacity
- 815,000 installations
- Largest field array is 48MW in Kent
- Government expect 22GW by 2020

- Largest UK roof installation is at Jaguar Land Rover in Wolverhampton
- 6MW peak output
- Supplies 1/3 of the building’s energy
- Presented as ‘green credentials’
- Local Authorities may expand roof PV

In 2016, renewables in total contributed 22% of GB electricity

On Christmas Day 2016, renewables contributed 40%

PV now nearly 12GW, but growth slowed by withdrawal of government incentives

**Electric Vehicle sales**

**USA**

**Monthly Sales to Dec 2016**

550k total

Note, 24 available models in USA

In the US 400,000 people have paid $1,000 to be on the Tesla Model 3 waiting list.

**GB EV Sales**

- 35,000 registered in 2016
- Approx 1.3% of all sales in 2016
- 90,000 Plug In vehicles in GB

**Global Plug In EV Sales 2011-2015**

TOTAL 565,000

**USA**

Monthly Sales to Dec 2016

550k total

Note, 24 available models in USA

In the US 400,000 people have paid $1,000 to be on the Tesla Model 3 waiting list.

**GB EV Sales**

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- 90,000 Plug In vehicles in GB

**Global EV Market Shares for EV**

Source ICCT, 2015

2014 data - upper

2013 data - lower

Charger developments – watch out EDBs

'Supercharger for all': The first 150 kW fast-charging station comes online in Switzerland

That's a new demand equating to 100 homes…

2 of these at the local Mall?

A Classic Tipping Point risk?

Chiltern Power
... and there’s more to watch out for

Nissan’s UK European R&D Facility Installs Vehicle-To-Grid Technology

November 5th, 2016 by James Ayre

Nissan’s UK-based European R&D facility, Nissan Technical Centre Europe, has installed vehicle-to-grid technology, thus becoming the first Nissan entity in the firm’s European facility network to do so, according to a news email sent to CleanTechnica.

NISSAN GB

NEWS

Nissan and Enel launch groundbreaking vehicle-to-grid project in the UK

10 May 2018 | ID: 143748

Chiltern Power
Try some simple maths...

NZ is aiming to double the number of EVs every year to reach 64,000 EV’s by 2021.

If that rate of progress continued, by 2022 there might be some 128,000 EVs.

If, say, 75% of these are on charge at the same time, using a 7kW home charger, and if they are on a Time-of-Use tariff, which moves from a high price to a low price period, these EV chargers will switch on simultaneously.

The step change of load will be $0.75 \times 128,000 \times 7 = 672,000\text{kW} = 672\text{MW}$

On today’s power system, this step change would exceed Transpower’s typical fast reserve holding and would endanger security of supplies across NZ.

There are many potential solutions to this, other than the expensive option of holding more reserve (e.g., randomised switching delays, low frequency interlocks) but they each require a co-ordinated approach designed-in to the cars/charging arrangements.

It’s a new type of challenge. It’s ‘whole-system’ and spans many ownership boundaries. So, whose job is it to resolve this? In GB the answer is ‘nobody’… is NZ likewise?
POWER SECTOR INNOVATION

Read the direction of travel

Look for the footprints

R&D papers published

Field trials & demonstrations

Government & Policy interest

First commercial products

The hardest step?

Laboratory findings reported at conferences

Media interest. Informed blogs. Venture funding…

Wide-scale adoption, expect Tipping Points

… beware of hidden obstacles to BAU roll-out if the context is power networks

… and institutional hazards for SME entrepreneurs selling to the established networks sector

Chiltern Power

Image acknowledgement smilingfootprints.com
The changing GB grid – a quick summary

- For a comprehensive review of the operational changes see National Grid’s System Operability Framework reports published annually
- Key drivers & changes are reducing inertia; concerns for RoCoF trips and voltage depression trips of DG; changing demand Q/P ratios; high system voltages; and periods of low fault levels insufficient to operate protection
- Many of these issues require ‘whole-system’ solutions & new flexibility

- Wider sector changes now appearing include the growth of Community Energy enterprises, Electric Vehicles, Smart City initiatives, and the Internet of Things. Also home and grid scale storage, new aggregation services, and parties providing home energy management services
- The government is promoting community heat - a cross vector opportunity

- ‘Whole system’ issues not only span traditional silos and ownership boundaries but also involve new parties operating ‘beyond the meter’
- Technical governance and change processes that worked well previously cannot respond with the necessary agility and stakeholder responsiveness

and at this page see also the Launch Event slides for further SOF details
UK government & regulatory policy shifts
Ofgem: Innovation and customer benefit

Ofgem has undertaken a comprehensive review of the value to customers of the Low Carbon Network Fund innovation incentives for the network companies. Their conclusions are supported by joint analysis from economic consultants Poyry and technical consultants Ricardo.

• This follows the completion of the 2009-2015 LCNF programme,
• It invested some £300m into 23 flagship and 40 smaller projects
• 37% of the projects could become business-as-usual now
• The discounted net benefits to consumers is between £800m and £1.2bn if projects are only rolled out in the DNO who trialled them
• If the projects are rolled out across all GB DNOs, the discounted net benefits are estimated at between £4.8bn and £8.1bn
• Ofgem propose to reduce funding from £90m to £70m pa for the successor Network Innovation Competition (NIC) to encourage cost-efficiency
• Ofgem is keen to continue partnerships with third parties, including new players.

Ofgem’s key findings

“...the innovation schemes are providing value for money and helping to create a more innovative culture in network companies..." (Ofgem)

The range of returns arises from the scenario assumptions, such as the take up of EVs and penetration of DER.

Graphs from the Ofgem consultation paper and the Poyry/Ricardo report.
The Innovation Landscape – a reflection

• The iPhone created a new product category.

12 key technologies make smartphones work:
1) miniature microprocessors, 2) memory chips, 3) solid state hard drives, 4) liquid crystal displays, 5) lithium-based batteries, 6) Fast-Fourier-Transform algorithms to convert analogue to digital signals, 7) the internet, 8) HTTP and HTML languages and protocols that access World Wide Web, 9) Cellular phone networks, 10) Global Positioning Systems - GPS, 11) The touchscreen, and 12) Voice-activated intelligence (Siri).

• Every one of these 12 key technologies was supported in significant ways by governments - often the US government (and commonly involving some arm of the military).

• Government supports funding and off-sets risk for entrepreneurs.

• So, with energy changing, is Regulatory/Government engagement needed to support those who deliver breakthrough innovation?

http://www.bbc.co.uk/news/business-38320198
Ofgem, looking ahead: Community Energy

A recent Ofgem report defines local energy as:
Energy arrangements led by (or for the benefit of) a local group and for the benefit of local consumers. A local group is a collection of people and organisations with shared interests in local energy outcomes within a common geographical area.

“We believe that the viability of local energy models should be founded on improving consumer outcomes.”

Ofgem’s view: What’s driving local energy?

• **Devolution**: for some projects, the broader devolution agenda is an underlying motivation for a move away from the current centralised system

• **Consumer preferences and involvement**: a powerful motivation for some consumers may be the desire to be more independent and have greater control over their own energy affairs. More broadly, consumer involvement appears to be a crucial factor in the appeal of local projects; this is particularly so for local generation schemes, where the relationship between community engagement and reward is self-reinforcing

• **Trust**: general consumer dissatisfaction with larger energy utilities may mean a greater proportion of those disengaged consumers willing to engage with entities they trust (e.g local authorities).

Thinking ahead: Community Energy

Note that developments in Social Media, such as big data analytics, smart phone Apps, and crowd funding are enabling Community Energy in two models:

1) **Communities of Place**

   and

2) **Communities of Interest** (or Virtual Communities)

If left simply to their own interests these communities might be unaware of the problematic impact their aggregated action may create for local networks and the national power system… *Might some facilitation and timely intervention be helpful?* (but whose job would that be….)

For example a town, suburb, campus or business park, who want to create local energy engagement, investment & jobs.

For example, the members of a club or the owners of a brand of EV, offered ‘tailored services’ or businesses with energy assets located across multiple sites wanting to benefit from co-ordinated demand flexibility.
Community Energy focus: 2 examples from GB

The Community Action Group (CAG) Project consists of almost 60 groups across Oxfordshire. It is a community-led group, organising events and projects to take action on issues including waste, transport, food, energy, biodiversity and social justice. Started in 2001, the network is the largest of its kind in the UK.

Low Carbon Hub is “a pioneering social enterprise, working for a massive change in the UK’s energy system...we need to get much more local about our energy system, and much more renewable, so that the benefits...strengthen local communities. We develop community-owned renewable energy in Oxfordshire and re-invest 100% of our own surplus.” (Founded Dec 2011)

http://cagoxfordshire.org.uk/cag-network-infographic-201516/
http://www.lowcarbonhub.org
UK government developments (i)

A fundamental policy shift, spurred by Brexit?
exploiting the impending removal of EU state aid rules

Theresa May said the new Industrial Strategy
represented a “new approach to government”
of “not just stepping back but stepping
up to a new, active role”.
… “it does not mean government telling
business what to do…” (Greg Clark, Minister)

Under David Cameron’s leadership, the
government pursued a more hands-off approach.

The Modern Industrial Strategy is based on ten “pillars” including:
skills, R&D, upgrading infrastructure, affordable energy and clean
growth, effective institutions, and improving public procurement.

http://www.wired.co.uk/article/industrial-strategy-uk-government-theresa-may
building-our-industrial-strategy-green-paper.pdf
https://www.gov.uk/government/speeches/greg-clark-speech-at-the-opening-of-london-
taxi-companys-new-electric-taxi-factory
UK government developments (ii)

The Smart, Flexible Energy System consultation
“Our ultimate objective – clean, secure and affordable energy – is clear, but a number of possible pathways lie before us. In this Call for Evidence we ask open questions about these strategic choices…

“…The approach set out here is aligned with the development of the Government’s Industrial Strategy…. in Spring 2017 we will set out specific actions to remove barriers, sharpen price signals and shape roles and responsibilities in the shift to a smart, more flexible energy system….

Key topics: increasing Flexibility – DSR, Aggregators, new ancillary services; the Capacity Market; Storage; DNO to DSO; independence of the TSO; smart metering national roll out; Time of Use tariffs; D-charging reforms, Cyber security; TSO-DSO coordination;

https://www.gov.uk/government/consultations/call-for-evidence-a-smart-flexible-energy-system
On Ofgem’s radar: new connections angst

“Ofgem believes the solution will not always be new pylons and wires…..
Unlocking the Capacity of the Electricity Networks  
Ofgem’s report Feb 2017

“An efficient process to get connected to the electricity network is essential for the social and economic wellbeing of the country….”

“We are publishing this document to give you an overview of the status of constraints across the distribution and transmission networks and the changing interactions between them….”

“DNOs must be proactive in their approach to planning and forecasting and the choice of flexible connections they make available. They must understand what constitutes best practice, they must listen and respond to their stakeholders’ changing needs and they must manage their investments efficiently.”

Chiltern Power
Network constraints – big time!

China has twice the wind capacity of USA

But generates the same amount of wind energy

Figure 40: Installed capacity (GW)

Figure 41: Wind production (TWh)

Source: GWEC

Acknowledgement: Liberum
One DNO cites the following benefits

UK Power Networks says: “The roll out of Active Network Management of Distributed Generation has already allowed 330MW of generation to connect saving of over £100 million to DG customers. Research shows that a smart, flexible energy system has the potential to save customers up to £8 billion a year by 2050.”

Around 8.5GW of energy from renewable DG sources have now been connected across UKPN’s service area in total


John Scott has noted his NED role with Smarter Grid Solutions Ltd, an ANM provider.
In summary

*The UK Government and the Regulator are:*

- **Seeking to both promote network innovation and take steps to ensure it is rolled-out at scale as ‘BAU’**
- **Responding to increasing network constraints that are creating additional costs and delays for new connections**
- **Taking steps to be more forward looking**
- **Taking a joint approach to progressing government and regulatory thinking for energy, including cross-vector actions**
- **Re-launching the Smart Grid Forum as a Smart Systems Forum. This will “provide input, assistance and advice to BEIS and Ofgem on the implementation of the Smart Systems Plan …in the development of the electricity system”**
The Future Power System Architecture project

“The Future Power System Architecture (FPSA) project is an ambitious effort involving dozens of industry professionals, academics, policymakers and stakeholders to assess the challenges to be faced in the electricity system by 2030 and to identify new functionality required...

http://www.theiet.org/sectors/energy/resources/fpsa-project.cfm
IET Power Network Joint Vision

**FPSA** commenced 2015

**Future Power System Architecture project**

**Discussions prompted by IET’s expert group** (Power Network Joint Vision, PNJV) **concerning future power system architecture** resulted in the **UK government funding an evidence-gathering study**. This work, led by the IET in conjunction with the Energy Systems Catapult, completed in 2016 and all findings are public.

The follow-on FPSA2 is now running and will complete April 2017.
FPSA1 outputs were:

- Summary Report
- Main Report and appendices
- International Study
- System Engineering Methodology
- Functional Matrix Spreadsheet
- Function Sequencing Spreadsheet

All the reports are available at:
http://www.theiet.org/sectors/energy/resources/fpsa-project.cfm?origin=reportdocs
IET’s study of best practices in other sectors highlighted their use of ’System Architect’ roles

• Sometimes this is called System Designer, Consultant Engineer, System Authority, Systems Coordinator, or Strategic Planner

• These parties are neither the stakeholders that set the objectives for the system, nor organisations that design, build, own and operate the hardware

• They role is to ensure ‘systems of systems’ operate seamlessly to meet declared business objectives

**Key Point to Note:** The term System Architect should not be confused with ‘central planning’ – which categorically it is not.
Key Outcomes from FPSA1

• Substantial new or extended functionalities, both technical and commercial,
• Implementation challenges
• Delivery by 2030 is possible
• the whole system
• presents new challenges for today’s institutional arrangements
New or extended functionality

- **35 new or significantly extended** functions identified for the power sector
- Heavy interaction between these functions, so no simple prioritisation
- Incremental delivery would be risky
  - Extra costs
  - Breached engineering limits
  - Compromised system security
  - Policy objectives not met
- A coherent transformation programme is needed
- It’s a whole-system challenge, that involves many parties and crosses many boundaries.
Five examples from the 35 Functions

- **Investment planning in a fast moving world**: Monitor the energy landscape in a systematic way to enable the power sector to respond in an agile and coordinated way to continuous change, and ensure the timely introduction and implementation of investments and functionality.

- **Black Start restoration in a system with widely distributed resources**: Enable timely restoration of supplies following a national failure - with an increasingly distributed and weather-dependent generation, storage and demand management portfolio.

- **Operating with Local Markets and Community Energy**: Provide a mechanism for peer to peer trading (intra and inter community) with appropriate charging for use of the power system, recognising both physical and virtual communities of users.

- **Recovery from local failures where network diversity has been lost**: Enable restoration of supplies following a prolonged local supply failure – that results in loss of both local generation and diversity in demand (e.g. where all Heat Pumps and all EVs are calling for power).

- **The active management of networks, generation, storage and demand**: Provide automated and secure management of demand, generation and an increasing range of energy resources and ancillary services, including smart appliances, and building and home energy management systems, while avoiding adverse T & D interactions.
The Future Power Systems Architecture project

Power Network Joint Vision
PNJV
Framed the issue
2012-2015

FPSA1
Defined future functional needs
Reported in July 2016

FPSA2
Fuller Stakeholding
Wider Implications
Enabling Frameworks

FPSA3
Proving Trials
Expanding
& on-going

Today
**FPSA2 Programme Work Packages**

These were competitively tendered.

**WP1A: Engage with Stakeholders**
- Establish a survey technique to identify the barriers being encountered, especially for communities and grid-edge technologies

**WP1B: Future Stakeholder Needs**
- Research future socio-political drivers on customer and stakeholders behaviour

**WP2: Review the Functional Analysis from FPSA1, Identify no-regrets actions, assess RD&D required to accelerate deployment**
- Check validity and completeness of Functions and options for delivery
- Progress no-regrets actions where feasible through today’s sector processes, including touch points with other vectors
- Identify RD&D and innovation opportunities to accelerate delivery

**WP3: Impact Analysis**
- Identify the barriers to developing and implementing the Functions within current sector processes and assess the impact of non or late delivery

**WP4: Enabling Framework Identification**
- Assess architectural options to remove institutional (regulatory, market, technical, cultural, etc.) barriers to delivering Functions
- Identify Enabling Frameworks and potential trials for development under FPSA3

**WP5: Synthesis Integration and Reporting**
- Ensure key findings are integrated between Work Packages
- Deliver final reports

**WP6: Dissemination**
- Ensure complexities of FSPA are appropriately briefed to diverse audiences
- Explore improved communication techniques

A key output from FPSA2 is the identification of “Enabling Frameworks” (WP4)
Improving Today’s Industry Change Processes
Some pointers for the way ahead?

An Enabling Framework for facilitating sector changes

- Assistance with Change Proposal formulation especially for new parties; wider representation of stakeholder interests in the change processes
- A Forward-looking capability including knowledge continuity for continually-changing topic areas
- Options for ‘lighter-touch’ processes to trial new alternatives and streamline the turn-around time
- Specialist Knowledge: Technical/Legal /Market /New Services /Policy/Regulatory /New Technologies/etc.

These skill areas will need to be much more integrated than today to achieve agility across people/process/technology. This is beyond today’s linear ‘manual’ processes.

In an agile world, what is a ‘Change Proposal’? Could it be a ‘publish - subscribe’ model as used in software messaging architectures?

1. CHANGE PROPOSAL FORMULATION
2. CHANGE DESIGN/ CONSULTATION/ APPROVAL
3. OUTCOME IMPLEMENTATION

LESS DISTINCTION BETWEEN ‘EXISTING & NEW’ - helpful and effective processes for all

TAILORED ACCESS POINTS FOR DIFFERENT SECTORS OR INTEREST GROUPS

 ACCESS for all parties on an equal footing and ‘with all options open for consideration

Established Industry Stakeholders & New Industry Stakeholders, including SMEs and those ‘beyond the meter’

New stakeholders could include Aggregators, Energy Service Providers, Community Energy enterprises, and in the future, other energy vectors such as heat, gas or hydrogen

In an agile multi-party world, what is ‘Consultation’?
Summarising - an Enabling Framework for new thinking

Assume change from manual 'linear' design processes

Assistance with Change Proposal formulation especially for new parties

Supporting disciplines must be integrated and agile for people/process/technology

A Forward-looking capability with knowledge continuity for continually-changing topic areas

Availability of specialist disciplines for all stakeholders

Options for 'lighter-touch' processes to trial new alternatives and streamline the turnaround time
The biggest challenge?

- ‘Meshed processes’
- Different ‘spin speeds’

Likely to require some form of ‘enablement organisation’ not simply a process?
FPSA2’s agile working approach – a kind of ‘enabling framework’ in itself?
FPSA2 project: Synthesis & Integration Approach

*Not* a traditional ‘waterfall’ project plan using PRINCE2 principles

- **Close integration** to ensure that the work packages exchange findings as they develop
- **A distinct Synthesis & Integration activity** to provide the framework and management to enable this to happen
- **Agile project principles** will ensure controlled, interactive development
- At the outset, a meeting with all the appointed consultants agreed the working arrangements; this included weekly update conference calls to set the ‘drum beat’ of pace.

**Agile software development is an established IT methodology.** It describes a set of principles under which requirements and solutions evolve through the collaborative effort of self-organizing cross-functional teams…. adaptive planning, evolutionary development, early delivery, and continuous improvement, and it encourages rapid and flexible response to change.
FPISA2: Synthesis & Integration
Using AGILE project methodologies

The world beyond the project

WP1A & WP1B: Stakeholders
WP2: Functional Analysis
WP3: Impact Analysis
WP4: Enabling Frameworks
WP5: Synthesis, Integration and Reporting
WP6: Dissemination

Enable necessary interactions between work packages to ensure iterative learning and integration

Align messaging with findings

Are there pointers here for more AGILE sector change processes?

WP = WORK PACKAGE (competitively bid by consultants)
Some emerging learning: R&D gaps and anticipated challenges

- **Data & Analytics**: suited to ‘many to many’ services; whole-system cyber secure
- **Optimisation of network outage plans**: including flexibility providers and DERs
- **Active Network Management**: ANM interactions and between T & D networks
- **DSOs**: Decision support tools for Decentralised Energy Systems
- **Optimisation of networks-scale batteries**: addressing their whole value stack
- **Markets for near-zero marginal cost energy**: valuing of other characteristics…
- **Protection devices**: able to respond at times of low fault infeed
- **Waveforms**: monitoring and cleaning techniques, especially at LV
- **Security of Supply**: inc VOLL reassessment in high DER systems; HILP events
- **Network charging**: including social equity, community energy and smart cities
- **Cross-vector energy**: modelling, investment support and R/T operational tools
- **Block Chain application**: including peer to peer trades, local markets & services

Some topics may warrant investigation/exploration as a first step, before ‘solutions’
Emerging learning – stakeholder responses

FPISA2 was tasked with establishing closer stakeholder engagement, especially the new, beyond-the-meter parties. Two influential strands of work are:

1. The dedicated Work Packages, contracted to separate consultants, to address (i) **today’s stakeholders** (WP1A) and (ii) **future stakeholders** (WP1B)

2. The work of the Communications team (WP6) that includes an analysis of **stakeholder segmentation**, and an examination of how issues look through their different “Lenses”. The five Lenses being examined are:

<table>
<thead>
<tr>
<th>Lenses</th>
<th>Stakeholder Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO, DNO/DSO, TNO</td>
<td>Large Generators, established networks vendors, key consultancies, technical media</td>
</tr>
<tr>
<td>Domestic / micro-SME customers</td>
<td>Suppliers, the smart metering community, smart home and energy services</td>
</tr>
<tr>
<td>Large I&amp;C Customers, Aggregators</td>
<td>Energy Communities, Smart Cities, DG Operators, Storage Operators</td>
</tr>
<tr>
<td>Policy Makers, Academia</td>
<td>Research Councils, and non-technical media</td>
</tr>
<tr>
<td>Vendors new to the Supply Chain</td>
<td>including grid edge products, data systems, and white goods manufacturers</td>
</tr>
</tbody>
</table>
Examples, the different views through the five Lenses

Business Drivers > Opportunities > Why are these important > Which of the ‘35’ new Functions are needed?

- **SO, DNO/DSO, TNO, Large Generators, established networks vendors, key consultancies, technical media**
  - Achieving a successful DNO to DSO transition. Managing a network that has demanding new characteristics.

- **Domestic / micro-SME customers, Suppliers, the smart metering community, smart home and energy services**
  - Delivering smart home services including system flexibility. Enabling these services to have whole-system reach/value.

- **Large I&C Customers, Aggregators, Energy Communities, Smart Cities, DG Operators, Storage Operators**
  - Enabling agile change to sector processes and systems. Integrating the technical, commercial and regulatory aspects.

- **Policy Makers, Academia, Research Councils, and non-technical media**
  - Ensuring scaling of solutions to deliver national policy goals. Enabling cross-vector opportunities, inc transport strategies.

- **Vendors new to the Supply Chain including grid edge products, data systems, and white goods manufacturers**
  - Enable access to data to support new products and services. Seamless implementation that delights & retains customers.
Some pointers for New Zealand?
Would there be value in ELBs/DNOs developing their roles to become DSOs/DSPPs?

- This is clearly on GB, EU & US agendas: *regulators see benefits for customers*
- Perhaps local balancing & flexibility management roles; solutions for local networks and services to the SO; creating/enabling markets for non-traditional flexibility, addressing real and reactive power challenges
- Providing or enabling platforms for community energy, smart cities and distributed systems that in due course might link across energy vectors and transport
- Managing new kinds of ‘big data’ ensuring open systems, privacy and cyber security
- Increasing network visibility, and sharing this data with multiple parties as needed
- Interfacing to parties ‘beyond the meter’, including home energy management services, smart EV charging, smart city developments, commercial players in data and services such as aggregators…
- DSO roles should add value to ELBs. It might bring changes to risk/reward profiles and a need to consider owner and funder appetites. Associated changes could be anticipated in regulatory frameworks. There might be value in building evidence for these discussions. The FPSA lessons concerning different lenses apply here.

DSO = Distribution System Operator (GB/Ofgem and EU/CEER)
DSPP = Distribution Service Platform Provider (USA/REV project)
A recent ENA (UK) report remarks on DSO transition

Page 5: “The transition from DNO to distribution system operator (DSO) will require investment to increase the active network capability at distribution level to support both local and whole of system balancing, and ensure optimal use of assets.”

Page 9: “…There are gaps in existing systems, policies, processes, data & technology

Page 65: “The distribution network does not have the same level of automation, protection and control as the transmission network, and significant investment and development … will be required to enable the market-driven options so far identified.”

Page 42: Routine and Emergency: No framework exists for DNOs to manage and control customer reactive response within the distribution network. It is expected that changes may also be required to relevant industry codes. … an appropriate funding mechanism for payment to customers for services will need regulatory clarification.

The message is that transition to DSO is non-trivial. It requires investment, but would enable new customer choices, promote competition and offer cost-effective solutions.

Block chain technology isn’t going away...

“It is the emergence of the decentralised internet of value, represented by blockchain and distributed ledger technology, that will provide the platform for true disruption of business models globally, and the energy and utility industry will not be safe from this disruption...

Neil Pennington
ID2020 – Harnessing Digital Identity for the Global Community (United Nations)
London Business School

https://www.linkedin.com/in/theneilpenners/
He was formerly Director of Innovation for RWE npower, a large European Genterailer

September 2016: “Vector, and Australian blockchain energy company Power Ledger signed an MOU to deploy Power Ledger's energy trading platform, allowing people to buy and sell power without using a retailer...
A notable Block Chain development in energy

Much of the efforts to develop market models for blockchain, such as LO3 Energy’s Brooklyn microgrid in New York and Power Ledger’s Ecochain in Australia, have focused on peer-to-peer energy trading.

A new initiative, being pioneered by Quantoz Technology in the Netherlands, is focused on a local energy market model, such as those defined by a postal code area, using a distributed permissioned block chain solution.

The company behind this new concept is Rotterdam-based blockchain startup Quantoz Technology, sponsored by E.ON’s corporate accelerator and incubator programme. This was launched in December 2016.

“... a new market model at local level will offer incentives for residential prosumers to share flexibility and maintain grid connectivity services...”

NOTE – a Block Chain development that retains networks companies in the value loop, in a DSO role

Some thoughts about “engagement”…

Wider trends to consider:
- BREXIT surprise?
- TRUMP surprise?
- The language of ‘post-truth’
- We’ve had enough of ‘experts’…
- There are no ‘facts’…
- Fake news
- Populism
- Appeals to emotion, not logic
- Social bots/Twitterbots
- Only accept evidence that supports your own narrative
- "cheerfully shoot the messenger" if new evidence is contradictory

There appears to be a rejection of intellect in favour of emotion – if people feel they cannot rely on facts, they process information through the right side of their brains when they really should be processing through the left.
Some thoughts about “engagement”…. (ii)

Sam Woolley of the Oxford Internet Institute’s computational propaganda institute: “one third of all traffic on Twitter before the EU Brexit referendum was automated “bots” – accounts that are programmed to look like people, to act like people, and to change the conversation, to make selected topics trend”

If the ‘experts’ openly and diametrically disagree - and if experts views can be shown by events to be (apparently) wrong (at least in the short term) - then society can hardly be blamed for distrusting and ultimately rejecting expertise.

And it won’t matter who is right or wrong: the fact that the experts can’t agree means that probably none of them really know what they’re talking about…

Two thoughts to take away:

1. **As informed professionals** are we keeping a sufficiently close eye on worrying trends involving manipulation of public thinking / public emotion and democratic processes, eg fake news and Bots, and using our influence for societal good?

2. **In our dealings as a sector**, interfacing with stakeholders and the wider public, do we need to raise our game? Our ‘facts’ and ‘engineering logic’ will be of diminishing value if in the public eye ‘experts’ appear contradictory and lack common ground.

For a view on the wider societal trends see: https://www.theguardian.com/politics/2017/feb/26/robert-mercer-breitbart-war-on-media-steve-bannon-donald-trump-nigel-farage
“NZ energy policies are on the right track, but challenges remain” IEA says

New Zealand has the second-highest level of emissions per GDP unit of the 35 OECD countries and the fifth-highest emissions per capita

NZ has the second-highest level of emissions per GDP unit in the OECD and the fifth-highest emissions per capita “... the farming industry strongly relies on coal use (domestic lignite) for process heat...”

“The distribution sector has 29 separate businesses... with a range of ownership structures..... Concerns have been raised about the financial, technical and managerial capability of the sector to respond effectively to the challenges

“Concerns... about the governance and decision-making capability of the distributors and their capacity to manage this potentially complex transition in an efficient and timely manner ....to realise the potential benefits for consumers

“The government should encourage the development of more efficient structural arrangements...
At the Downstream Conference, Trustpower chief executive Vince Hawksworth acknowledged “the elephant is still in the room” in regards to the number of lines companies in this country and how well the smaller firms will adapt to change.

Suitable structural arrangements are needed if there is to be effective delivery of new kinds of role for EDBs/DNOs. The IEA report offers:

1. **The Value Adding Services model**

2. **The Platform for Services model, “neutral facilitators?”**

   Note this is *not* ‘no change’. CEER in Europe favours this, but… note their “grey” areas such as demand response, energy efficiency, distributed generation, storage and data management.

   Could new services and better outcomes for customers be delivered and new value created for companies? An opportunity to move away from the death spiral and social inequity issues associated with DER and volumetric pricing?

“These changes bring significant new complexity & requirements for entirely new skills.”
Would ‘sensible collaboration’ between the 29 ELBs be a simpler solution here?

I suggest it’s unlikely, just try these tests for new functionality such as providing data transfers that cross ownership boundaries while maintaining privacy & cyber security:

- Who is accountable, who keeps it working into the future, who is responsible when service isn’t delivered or adverse interactions cause a security problem?
- Where data is involved, who owns the analytics? Data usually has financial value: with $$ involved there can’t be woolly boundaries or fudged ownership
- Be wary, ad hoc is unlikely to be good enough (and it tends to exclude SMEs)

That said, once accountabilities are clear, compared to today a much more nuanced form of collaboration will be key to success. See how the mobile phone sector cooperates (through GSMA), e.g on new standards, yet competes vigorously for customers.

Who promotes nuanced cooperation? In Telco it’s the companies, not the regulator.
These recent reports carry consistent messages for New Zealand.

**Might ignoring this opportunity for change... *consign companies to decline?***

... no visible leadership (they’re dinosaurs)... too little too late (nice but missed the boat)... 3rd party actions relegate networks to ‘insurance role’

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**Are we close to a decision point that’s not to be missed, especially for the Networks sector...?**

**Don’t end up in the sidings...**

**If so, who leads?**

**Are you the person to mobilise this?**

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**A Go Hard, or Go Home moment?**

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Don’t end up in the sidings...

Barriers to a timely response:
- Networks tend to move slowly:
  - good reasons (safety, security...)
  - poor reasons (inertia, skills...)
- New sector functionality is needed
- Technical and commercial changes
- Change processes not agile
- Regulatory changes needed
- Power grid operation is changing
- Whole-system issues to address
- Data and its security are key issues
- ... and the conundrum of ‘the 29’

The drivers for making change:
- Global trends in energy & regulation
- Government energy policies, inc transport
- Improving technologies, and falling costs
- New products / services for customers
- Declining public & customer trust
- Rising customer expectations for service
- New 3rd parties, many ‘beyond the meter’
- Peer-2-Peer is now easy with Apps
- IoT, Smart Cities, Community Energy
- DSO could create new value for DNO
- Off-grid decline, volumetric spiral-down

In summary
1. **Nothing beats first-hand practical experience:** small scale network trials let you understand local conditions, build knowledge in house, and gain evidence for management decisions & regulatory submissions. It also ensures your early mistakes are small ones!

2. **It’s high risk to parachute-in power network solutions:** be very wary of the promises of a ‘fast follower’ approach, especially if in truth you’re close to a standing start.

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**And... it’s an amazing & challenging time to be in energy:**

Fundamental new thinking for society, new business opportunities... & new jobs. But we need to tune-in to how society is changing, especially for communications and the worrying shifts from **facts** towards **emotions**.
No change? It’s all change!
for power networks … their users…
and for whole-system coordination & governance

Thank you for your attention