The impact of new technology on electricity network operators

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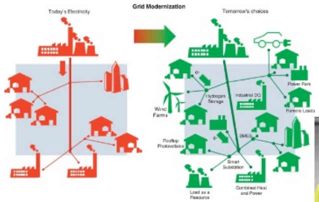
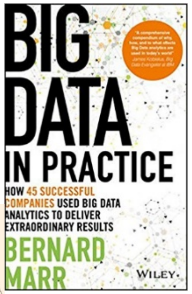
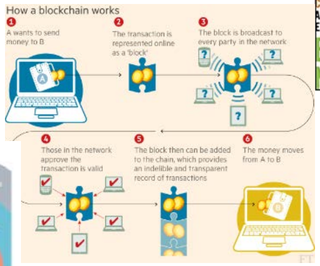
Energy and Digitalization

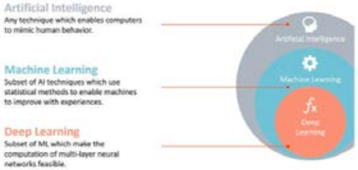
- Technologies that are affecting energy:
  - Distributed Generation
  - Electrical Energy Storage
  - Electric vehicles
  - Smart Meters
  - Big Data
  - Blockchain
  - Artificial Intelligence





  - All related to digitalization.





Source: KDNuggets

Why energy is different…

- The value of time and quality is high and important for some services.

- The average UK adult spends (Ofcom, 2018):
- 3 hours per day on smart phone.
- 3.4 hours per day watching TV.


- The average time per trip spent shopping (UK from Hart et al., 2014):
- 98 mins in town centre
- 38 mins online

- Value of time savings (UK Department of Transport, 2015; Arup and ITS, 2017):
- £5.12 - £11.21 per hour for non-business (in 2015)
- Elasticity of this with respect to income 0.5.

Why energy is different…

- The money on the table is different.

- £56 average cost per night of AirBnB room in London
  - (https://www.finder.com/uk/london-airbnb-statistics)
- £20 median taxi trip cost in UK
  - (Roughly, Taxi and Private Hire Vehicle Statistics, DoT)
- £50 average spend per shopping trip in UK
  - (Hart et al., 2014)
- £2900 average merchandise value per seller on Ebay, globally
  - (Source: https://www.digitalcommerce360.com/article/ebays-sales/ and https://smallbiztrends.com/2018/03/ebay-statistics-march-2018.html).

- £587 Average annual spend on electricity (3360 kWh, 2018, BEIS)
- £568 Average annual spend on gas (12937 kWh, 2018, BEIS)

- £11.29 per week on electricity
- £10.92 per week on gas

Why energy is different…

- These numbers imply that:

- A technologies which impacted the quality of 6 hours of time per day were going to be revolutionary (e.g. Facebook, Netflix).
- A technology was saved 60 mins per shopping trip was always going to be revolutionary (e.g. Amazon).
- A technology which monetises an asset worth £56 per night is revolutionary (e.g. AirBnB)
- A technology which monetises an asset worth £20 per journey is revolutionary (e.g. Uber)
- A technology which allows the resale of £2900 of goods per year is revolutionary. (e.g. Ebay)

- A technology which saves 10% of your electricity or gas bill (i.e. £59 or £57) per year is ***not*** going to be revolutionary.

Technical progress and technological disruption

- Even in the UK there is some technical progress.

- The whole UK economy exhibited total factor productivity growth of 0.62% p.a. from 1990-2016.

- In networks we have seen productivity growth (Ajayi et al., 2018):
- 1.1% p.a. in electricity distribution (1990/1 - 2016/17)
- 1.6% p.a. in gas distribution (2008/09 – 2016/17)
- 5.6% p.a. in gas transmission (2007/08 - 2016/17)

- Technical progress happens most of the time but technological disruption is unusual and takes decades to have its full impact. Energy has seen much more rapid technological disruption in the past in the UK, than it is likely to see in the near future.

Prospects for energy digitilization

- *Prospects (see Brown et al., 2019):*
- Better asset use optimisation (particularly on demand side)
- Better predictive maintenance and asset replacement
- Better cooperation and coordination within energy communities
- Micro payments possible and peer to peer trading possible
- DSOs and TSOs under more pressure to make use of competitive mechanisms for smaller purchases, to more providers.
- Some limited parts of the value chain could be radically impacted (e.g. platform costs which move to blockchain).

- *Limits (see Shipworth et al. (2019), Bashir et al. (2019) and Mountain (2019)):*
- If 20% of all electricity traded P2P by 2025, how much would this save?
- Time to verify transactions in blockchain very slow, VISA already at 3 sec.
- What is value added of new info? E.g. AGL can tell you what device is on.
- Sharper DSO pricing does not show up in retail offers in Australia.

Issues for the future

- Data is <u>not the new oil</u> in energy. <u>It is the new water</u>. It is everywhere and in large quantities and of limited value without processing. The external value of individual datasets is limited by its reproducibility through time, the accuracy of sampling and the presence of multiple providers/processors.

- Where data is produced by monopolists it should be made available free and its raw production cost should included in the allowed revenue.

- The regulator will still needed to oversee:
- Consumer protection from <u>mis-selling</u>.
- Data protection from <u>cyber-attack and data loss</u>.
- Price <u>regulation of average price and the tariff methodology</u>.
- Protection from bankruptcy costs due to <u>service provider failure</u>.
- Promotion of <u>competition in data processing</u>.

The impact of new technology on electricity network operators UK Power Networks case study

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Purpose

1. To provide an introduction to UK Power Networks
2. To discuss five case studies of new technology adoption at UKPN
3. To offer insights on factors that could determine how significant the impact of a new technology could be for electricity network operators
4. To evaluate the potential of blockchain in electricity distribution networks

UK Power Networks – A vast asset base

Three distribution networks:
- London
- East of England
- South East of England

Measure	Data	% of industry
End customers	**8.3m**	**28%**
Population served	**c.20m**	**-**
New metered connections*	**46,000**	**32%**
Distributed generation connected	**9.0GW**	**31%**
ED1 totex allowance (2012/13 prices)	**£6,029m**	**25%**
Energy distributed	**84.8TWh**	**28%**
Peak demand	**16GW**	**N/A**

* Average per annum 2010/11-2014/15

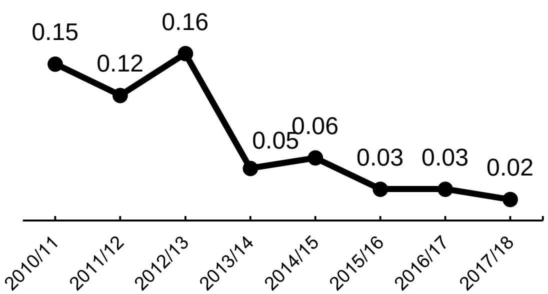
- **c.700,00 wooden poles and steel towers**
- **c.200,000 kms of cable**
- **c.140,000 substations**
- **c.111,000 link boxes**
- **c.200,000 generators (including domestic)**

- **In 2018, UKPN dealt with 45,814 network incidents, averaging to c.125 incidents a day**

UK Power Networks – Performance

UK Power Networks’ performance – since acquisition in 2010

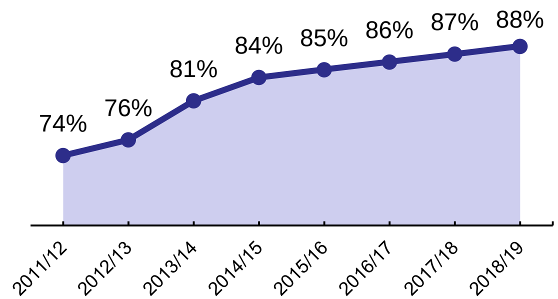
Best industry performance



Lost Time Incident Frequency Rate

87% Improvement since 2010/11

Significant improvement



Ofgem broad measure of customer satisfaction

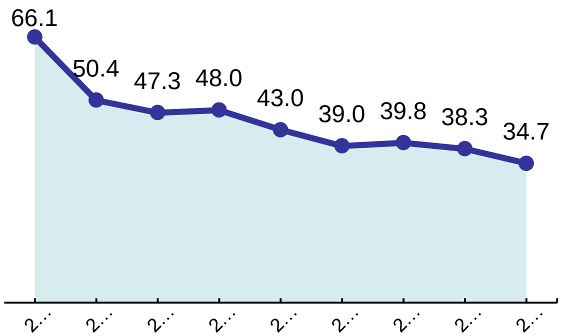
18% Improvement since 2011/12

The lowest cost

Average domestic distribution costs 2018/19 (£ 18/19 prices)

11% Below industry average

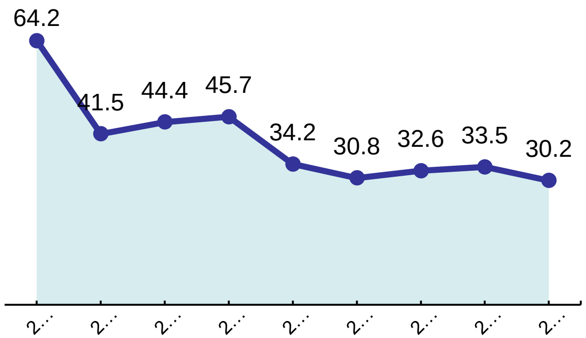
Reduction in the frequency of power cuts



Customer interruptions per 100 customers

48% Improvement since 2010/11

Reduction in the duration of power cuts



Customer minutes lost per customer

53% Improvement since 2010/11

An employer of choice

THE SUNDAY TIMES 25 BEST BIG COMPANIES TO WORK FOR 2019

INVESTORS IN PEOPLE | Gold

The most innovative

Community Energy Award

European Utility Week

Smart Grid Index

3rd from 45 utilities across 30 countries

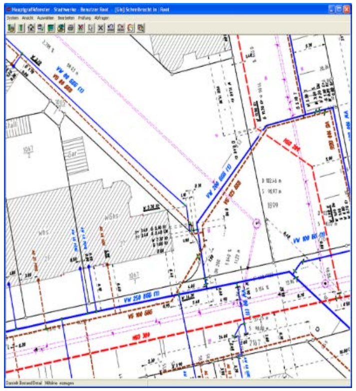
£130m Innovation savings

UK Power Networks – Resource Allocation

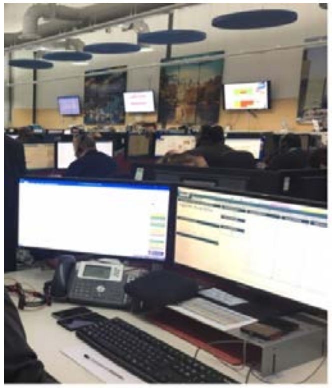
Source: Ofgem RIIO-ED1 17/18 report – DNO Spend 2015 – 2018

- Majority of resources focused on maintaining & upgrading the network
- HR resource allocation for UKPN. c6,200 employees (58% front line, 25% operational support, 17% back-office)
- UKPN's innovation spend intensity has grown from below 0.5% of total revenue before 2010 to c.2-3% post-2015 (£25m p.a).

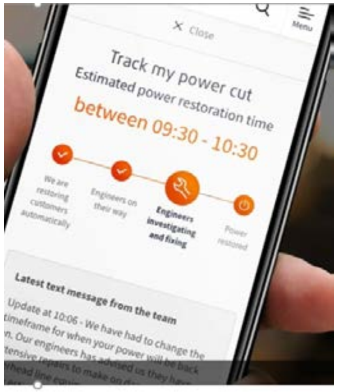
Three transformative projects at UKPN – The Past Tech



Introduction of GIS SPN (1997)



Centralisation of Control Centres (2007)



Enterprise, asset and customer management using SAP (2014)

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Common themes that arose from these cases:

1. **Efficiency, productivity and performance improvements were the main drivers.** This is in-line with the regulatory framework that incentivises continuous improvements.
2. **Significant budget been allocated** in the past where needed. However, these programmes are expensive and require a strong business case to go ahead.
3. As the **technology has become more complex**, there has been need for **retraining and upskilling** and that has been delivered successfully as part of the process. This overall **neutralised headcount efficiencies**.
4. **Potentially "transformative" tech has integrated well with the pre-existing fabric.**

Network Asset (Smart Fuse) – The Current Tech

Smart fuse = a device that can replace a blown fuse without the need of operator attendance, improving network performance

Source: Camlin website, Bidoying picture

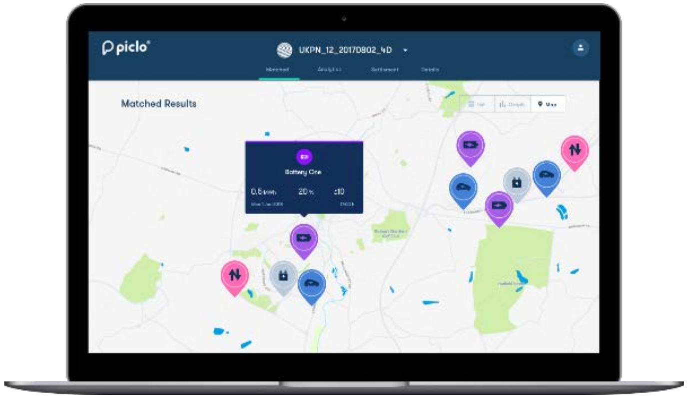
- Developed between 2006 – 2010 through IFI.
- First prototype was trialled on the live network in 2010.
- The host utility adopted the technology at the end of the trial (2014).
- Most of the other network operators adopted the technology within 2 years of trial completion.
- By 2017, there were over 10,000 smart fuses in operation in the UK (ENW, 2017).

Key observations from this case study:

1. A well-considered **business case with high financial benefits** and quick payback times drove this idea to success.
2. **Asset technology takes time to diffuse**. In this case, it took approximately 10 years to develop and scale the proposition. Once one network company adopts a technology which seems successful, the **others are likely to follow suit** (fast follower behaviour).
3. Process changes are required and its **DNOs might use the tech differently** (example: mobile nature of smart fuse).
4. The long lifecycle of the assets results in a **long replacement cycle** meaning that rapid changes in technology are unlikely (if it is not broken, why fix it).

Digital flexibility services platform – The Future Tech

Piclo = digital platform to signpost demand side response requirements for flexibility providers



Key observations from this case study:

1. **Innovation is now part of the UKPN culture**, a significant shift that has happened over the last ten years, fuelled by Ofgem's innovation funding incentives.
2. Offering **an exciting solution to an actual need or a problem is a good way for a start-up** to start working with an electricity network company.
3. **Starting small at the beginning in terms of scope and growing functionality is a credible approach** and allows for flexibility on both sides.
4. **Partnering to bring new capabilities (Software, UX development) and skills can yield faster results.** In this case, a robust prototype has taken a year and a commercial product has taken two years.

The case of blockchain

Three use cases that could be relevant to electricity networks:

1. **Asset registration and supply chain tracking**
2. **P2P Trading**
3. **Charging infrastructure for e-mobility**

Key observations:

1. Asset registration has potential to enhance the current role and DNO operation, however it has **high cost to entry and long-lead time** to maturity and delivering benefits.
2. The P2P and e-mobility use cases **do not affect the current DNO business model but they could have a role to play** in the new system/market operation roles. In the short term, there are **other technologies** that could deliver these use cases cheaper and faster.
3. Given the amount of pilot projects currently underway (Eurolectric, 2018) and the low benefits case, it appears **prudent to be a fast follower** in the adoption of blockchain technology.

Recommendation for DNOs:

Keep a watching brief on their development or participate in early stage trials to understand the technology. **Track industry progress and evaluate regularly** to assess for any changes in the development of technology or use cases.

Insights on technology adoption for DNOs

1. **The core business of DNOs is stable with long life assets. Approach to technology, innovation and evaluation of benefits reflects these characteristics.**

2. **DNO's focus is on where the returns are higher, this is dictated by their regulatory framework**. Given the resource distribution which the core function (network provision) dominates, it is expected that this would be the main area of focus of technology adoption (for now).

3. Given UKPN's industry leading position, **industry leadership and reputational benefits from technology implementation can also be an important complement** to the business case.

4. **The main driver for technology adoption to date in DNOs has been improved productivity and better performance. The low carbon transition has also been a key driver since 2010.**

5. In the electricity distribution industry, **first mover advantage is not always important, fast followers might fare equally well.**

6. **New roles for DNOs (system operation, market platforms, data platforms/operation) emerge that might drive higher technology diffusion and require DNOs to move away from their traditional *mondus operandi* in order to succeed. These roles are emerging now and there is significant interest in new technology as these capabilities are increasingly required.**

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