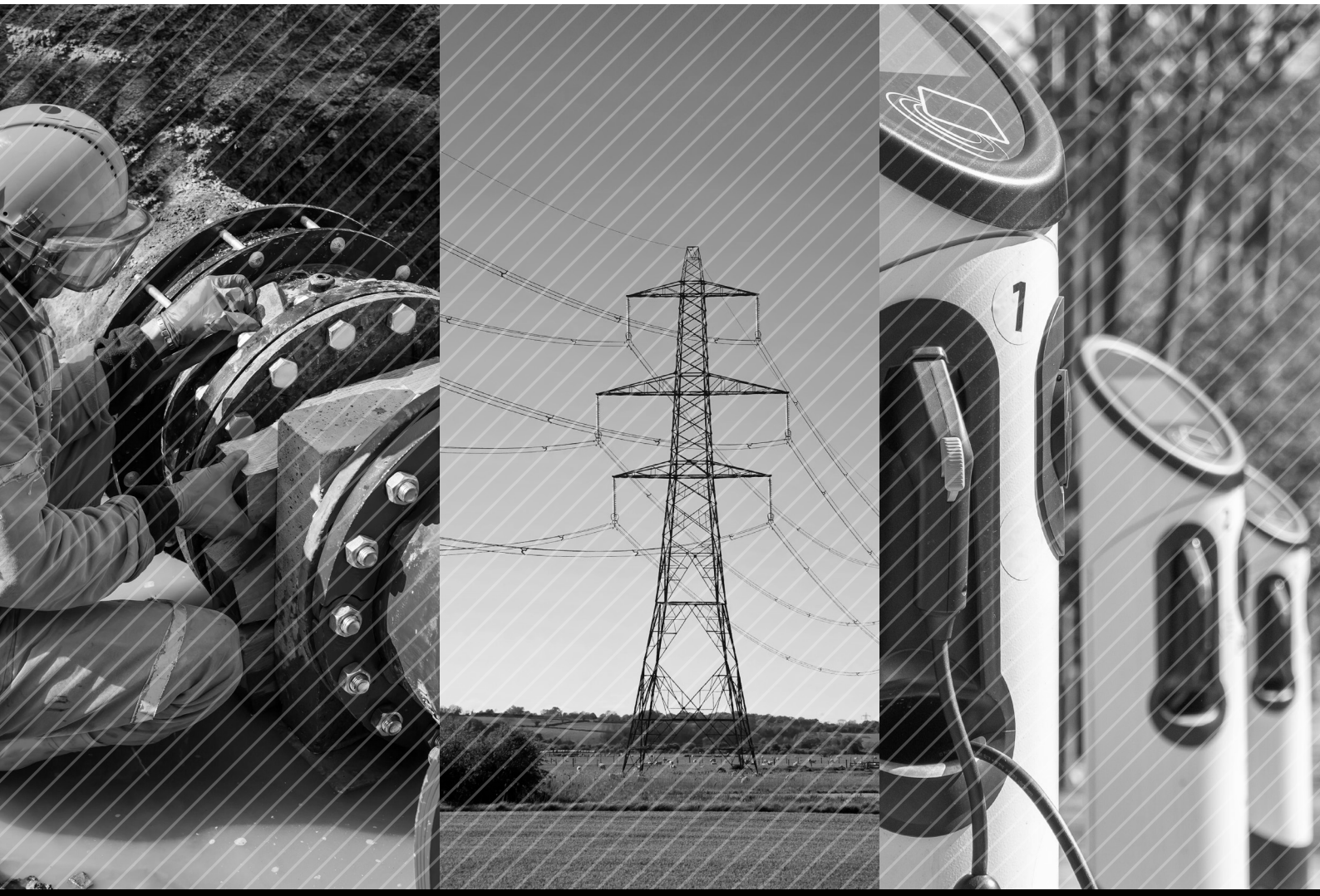
Pioneering cross-sector change and collaboration

How high-frequency data is driving the transition to net zero



Innovating with data to drive performance.

Contents.

Guest Foreword.

Nigel Watson
Chief Innovation Officer at
Northumbrian Water Group

Resilience in the face of uncertainty

In 2020, the water industry embarked on Asset Management Plan (AMP7), the seventh investment cycle in which all water companies in the UK set out their business plans and objectives in line with regulatory aims. AMP7 saw the traditional focus on CAPEX and OPEX solutions shift towards the adoption of a TOTEX model – observing the whole life cost of an asset (capital expenditure and operational expenditure) – while driving forward industry innovation to reduce costs and boost efficiencies.

As we near the halfway mark on AMP7, we are now starting to shape and share what our plan will be for AMP8. We have already set our own ambitious target to reach net zero by 2027.

The whole sector is aiming to be there by 2030, which is great for an industry that uses so much energy. The UK government's recent consultation on the Strategic Policy Statement for Ofwat has shone a clear light on the need to prioritise asset health and resilience whilst enabling the efficient delivery of net zero carbon emissions.

What is increasingly becoming clear, is the need to collaborate on how this is achieved and how we understand and utilise the tools that will deliver on our bold environmental ambitions.

The power of open data

We've already seen the power of open data. We led the initiation of the project now referred to as the National Underground Asset Register (a common underground map for the country). All utilities currently have their own version of their own networks. However, the pipes, wires and cables are usually buried in the same trench. Imagine being the person with a jackhammer in your hand and trying to assimilate all of that information, which is in different formats, granularities and quality. We got the major owners of underground infrastructure in our North-East region together, and we resolved to solve this. We were able to initially build a map of four areas of Newcastle, closely followed by an underground city map with Sunderland City Council.

The Geospatial Commission then took over the sponsorship of two whole region pilots. They are now bringing this to life as a full production-ready platform and we can't wait to put our data on it. It will make our employees safer, and it will eliminate planning inefficiencies. Moreover, in time it will reduce service outages because we often disrupt each other's services. This is independently estimated to be worth £1.2bn to UK Plc.

Building on what we learned in that initiative, we've gone on to lead a water-sector wide open data initiative. We've recently submitted a bid for Ofwat innovation funding, so we are keeping our fingers crossed. If we do get this off the ground, we are confident that it will help to improve the industry across a wide range of measures, including leakage, flooding and pollution. Perhaps most significantly, it should help us to learn from each other as we drive towards net zero.

We are currently looking at some other potential use cases for open data. The drive to net zero rightly commands the headlines, but we are in fact already dealing with the climate change that is baked in from prior carbon emissions. Warmer air holds more moisture. This manifests itself in longer dry spells and more sudden downpours. We can already see that in our data. We need to make sure that our energy and water systems are resilient in the face of the changes already afoot. We are exploring if we can draw together some large data sets regarding weather, land use, consumer behaviour and asset performance to see if we can more accurately predict where the next incident is going to occur. This could really help us to plan operational interventions and make better investments. It could also open up a more informed debate with customers and regulators so we can get ahead of the risk.

Driving industry collaboration

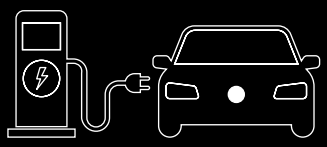
Storm overflows are clearly another issue that goes across sectors. In this case, the water industry and agriculture (in particular) need to work more collaboratively to solve the problem in a more cost-effective and environmentally friendly way. It is a systemic problem, so we need all of the data for the system. We are asking ourselves if we can make it easier for the farmer to do the right thing and still earn a good living. We are also thinking that this can help us to make more informed investment decisions, cognisant of the impact beyond our regulated boundaries.

Perhaps slightly further out on the horizon, we can see that we will have smart meter data available, and we have a hypothesis that we can use it to reduce water and energy consumption. This will help customers with their carbon footprint and their household bills. As I write, energy prices are going through the roof, so it is clear that we need to do something.

Open data is no panacea. It is akin to having better data in your own organisation. It will give us all more insight, but it is the actions that we collectively take that will truly deliver change. That said, a lot of the problems that we face in society today (poverty, inequality, the climate crisis) are complex and beyond the remit of any one organisation to solve. Sharing data will help us to drive systemic responses. I'm incredibly optimistic that this can lead to a fairer society, better able to cope with the shocks that will come its way. I commend this report for shining a light on it and I urge you all to engage and be brave. It is not easy, but things that are worth doing rarely are.

Introduction.

The utilities sector is at a watershed moment. Sectoral challenges around cost-efficiencies, waste reduction, and the implementation of net zero are spurring on a culture of change and collaboration within electricity, water, and gas companies. Industry leaders have listened, and understand that the priorities for consumers, policy makers and investors centre on driving down operational and delivery costs, while simultaneously delivering against ambitious environmental targets.



The road to net zero

The foundation of our mission to reach these ambitious targets should be user-centric models trained on data sets from diverse sources in order to optimise benefits for the end-user. With new energy infrastructure such as domestic heat pumps and electric vehicle (EV) charge points set to revolutionise our energy economy, patterns of consumption will inevitably grow more complex.

Still, we ought to be confident that industry and public visions for utilities are aligned. Recent polling from Copper Consultancy suggests that 40% of the public believe that the pursuit of this aim will deliver better energy services, and it has been identified as a top public priority for several years now[1]. What we need are predictive models developed from machine learning with high-frequency data to optimise our existing systems to deliver a sustainable future.

Basing our strategic thinking and targeted infrastructure investments on behavioural data will ultimately reduce cost, drive efficiency and deliver a positive ROI for utilities companies and their investors – all while leading the charge in delivering net zero carbon emissions.

To be clear, this will not be the panacea for reaching our shared aims. Using data intelligently and innovatively, however, will provide far clearer solutions to the challenges posed in our shared mission.

[1] Public attitudes to net zero and infrastructure (copperconsultancy.com)

Challenges ahead

This approach is far from radical - with shared ambitions to reach net zero and reduce waste, industry and consumers alike are near totally aligned in their vision for the sector's future.

We should be honest about the scale of the challenge posed by delivering a low carbon future. To reach the target, utilities companies, their investors, and the Distribution Network Operators (DNOs) must be prepared to re-think their approach to optimising multiple KPIs when sustainability is of paramount importance – which means adopting a whole system model that gives them visibility of different competing aims across the network. This is a measure we must adopt to enable the energy sectors to properly assess alternative energy and investment needs to meet our net zero targets against other factors such as waste, efficiency and cost reduction. If our operators can better and more accurately measure the impact of different variables against the output of specific energy sources, we can better adapt to integrating novel technologies such as hydrogen into our energy mix smartly and efficiently. Maximising sustainability KPIs will ensure that these investment opportunities are made clearer and put Distribution Network Operators on the best possible footing.

The core challenges that must be considered are:

1

Leak reduction – Water companies are continuing to face regulatory pressure to cut leakage without passing on the cost to consumers. To achieve this, we need a renewed focus on mitigating the impact and complications borne from shifting network characteristics and customer base composition.

2

Reducing effluent in rivers and streams – With the cost and practical issues around upgrading our mains infrastructure, water companies must embed new, innovative solutions to improve the resilience of their networks. The recent UK Environmental Bill (2021) has only heightened the need to implement these scalable solutions at pace.

3

Planning for shifting patterns of usage – The pandemic has ushered in a new era of unpredictability in planning and forecasting demand. We need integrated solutions that can accurately accommodate these shifting trends at both a macro and micro level to ensure and account for more complex variables that come from new patterns of consumption.

4

Welcoming a new energy economy – The rollout of new technologies such as hydrogen and heat pumps will necessitate new data models and simulation tools to ensure the grid can accommodate changing patterns of demand. Already, the Fraunhofer Institute for Energy Economic and Energy System Technology (Fraunhofer IEE) could cause annual energy bills to rise by 16 per cent if a 20 per cent hydrogen blend is mandated in the European Union (EU). Adopting the right tools that enable operators to readily identify inefficiencies in the network can ensure that utilities are able to keep hydrogen blend in the mix whilst still meeting regulatory requirements to cut overall costs to consumers.

The water sector

With pressure to meet the regulatory requirements as set out in AMP7 (Asset Management Period 7) competing against environmental factors, the challenges facing the sector are seemingly reaching their peak, but so too are the opportunities to remediate them.

Current projections are for household demand to reach 10,523 litres average per capital consumption by 2065. Environment Agency forecasts, however, highlight the need for domestic consumption to drop to 125 litres per day from the current 145 litres per day to meet national net zero and efficiency targets. This is a substantial step change for the sector to meet its environmental obligations whilst demand is set to grow - and we must set our course now if we are serious about fulfilling our shared ambition to reach a low carbon system.

Even under these projections, the sector continues to face problems in reliably forecasting total water demand whilst resource management plans only cover public supply. The problems of forecasting are made more complicated still by increased risks posed by aging infrastructure, driving efficiencies and meeting regulatory requirements whilst keeping consumer costs low.

Regulatory bodies such as Ofwat in the UK can help broadly align outcomes from private companies to meet these challenges through setting target criteria during each new AMP (Asset Management Plan) period. Already, we have seen some successes with companies starting to fulfil new requirements such as rolling out new operating models to improve long-term resilience. Sustainability is highly likely to become a cornerstone in the setting of the criteria for AMP8 (Asset Management Plan 8). Ultimately, however, we need the right data platforms and technologies to ensure these regulatory criteria can be adequately met.

Building resilience through smart forecasting

Embedding resilience in the water sector can be accomplished through a digital twin at the design and planning stage. Simply put, they can enable operators to create a human-in-the-loop simulator that will advance understanding of 'what if' moments in the management and planning of new assets and then provide decision support tools during system operation. Forecasting new patterns of consumption against challenges posed by scarcity of supply can help reduce waste and therefore limit the need to reduce household consumption as markedly.

Digital twins are best integrated in operational application systems. By combining the technologies' capabilities with high-frequency data, planning and asset management outputs can be displayed in a more accessible user interface that can be referred to at all stages of the value chain. This visibility can enable stakeholders and industry specialists to better align risk and return, monitor and track past delivery and keep efficiency at the core of all management and new planning efforts. Crucially, being able to forecast trends in single interfaces can better enable the industry to further embed the importance of long-term resilience in their strategic thinking – keeping the principles of consumer-oriented sustainability firmly in place to build in necessary resilience.

Optimising Customer Journeys and Experience

Northumbrian Water Group adopted the Customer Experience (C-MeX) ODI measure as its main performance indicator for customer satisfaction within the regulatory period 2020-2025. C-MeX sits with a wider balanced set of measures which enables Northumbrian Water Group to focus on customer service at the same time as its environmental commitments.

During this period, Northumbrian Water Group committed to providing an unrivalled customer experience, focusing on excellent customer service and the quick resolution of issues.

This commitment is articulated through a variety of measurable outcomes, including:

- Best in class for the C-MeX ODI - A world-class net promoter score (70+)
- 50% self-serve customer interactions by 2022
- Answered 95% of calls received within one minute
- Resolved 80% of customer contacts right the first time

The joint CKDelta / Northumbrian Water Group initiative relies on methodologies that have been developed and proven across a number of industries. It innovates through applying them to new contexts, alongside cross-industry models. The initiative empowers companies working in the regulated services sector to draw on and develop customer service methodologies that might otherwise have remained confined to other industries, such as retail.

Operational Job Optimisation

Northumbrian Water Group aims to become a leading provider of sustainable water and wastewater services.

Northumbrian Water Group strives to achieve increasingly high levels of performance for each regulatory cycle and is held to account for service delivery against Performance Commitments. These have associated Outcome Delivery Incentives (ODIs) which incentivise companies to surpass their commitments, financially and reputationally.

Traditionally, jobs have been prioritised on the basis of cost, complexity and the availability of resources. This prioritisation process needs to change to properly consider ODIs.

One of the main challenges in outperforming ODI targets is evaluating how specific job types and operational activities impact performance measures. A lack of visibility of how job types impact one or more ODIs greatly reduces the ability to maximise ODI performance and entails opportunity cost.

This Proof of Concept project aims to:

- Prove that existing operational data can be leveraged and combined to create models that evaluate the ways in which different job types impact specific ODIs.
- Maximise ODI performance and minimise opportunity cost by re-prioritising the operational portfolio of certain job types.
- Assess the value of a rollout of an ODI-based job prioritisation methodology.
- Create a scenario modelling tool that allows planning teams to see how prioritising different ODIs can impact their job pipeline.

Electricity

Network resilience continues to be a priority for new strategic planning and asset management in the electricity markets. The demand for new renewable and low-carbon infrastructure compounded with the growth in the rollout of new Low Voltage (LV) infrastructure such as heat pumps and EV charge points has completely realigned the energy economy. With a renewed national target to implement a net zero electricity grid by 2035, adopting the right simulation models for the network can help drive greater efficiency and ensure that new capacity upgrade decisions are taken with these core objectives firmly in mind.

Integrated simulation modelling can help deliver this. Open-platform data gathered from surveying networks and monitoring devices can be modelled to simulate how power is distributed through existing systems – therefore reducing the need to physically upgrade the network to release capacity. A whole system model can help facilitate this by quickly and automatically incorporating data across the whole value chain into existing network models. In essence, these tools can directly draw from utilisation data to bring cost benefits to consumers and deliver on our shared net zero goals.

Predictive analytics powered by high-frequency data is the strongest asset for this. Machine learning models can be used for both planning purposes and for decision support during operations to help meet net zero targets. With EV charge points, for example, analytical data can be used by operators to understand which charge points will best be utilised and therefore guarantee a return on investment.

Combining multiple data sets will also naturally carry cost benefits to multiple stakeholders across the ecosystem. For Distribution Network Operators, leveraging predictive analytics across their entire network through a whole system model can allow them to align their service offering with RIIO-2 price controls. Predictive analytics can also be used on open-source platforms, meaning end-users can access to more accurate, up-to-date data on single-user interfaces to better plan their consumption. Sharing data with smaller energy cooperatives and energy groups can also better empower local communities to get involved in the planning process, an issue that has already been raised in the planning of new infrastructure. With this technology, consumers and operators alike can benefit across the entire value chain at a micro and macro level.

To facilitate the transition to a net zero electricity grid by 2035, we must look towards embedding intelligence in the network with a view to developing a whole system model. It is only through this approach that predictive analytics carries the potential to not only enable targeted investment into grid capacity, but also provide visibility on where tangible cost benefits can be made to consumers. By assessing the impact of each strategic decision to grow the network and deliver positive environmental outcomes against the impact on the consumer, we can use the art of the prediction to further consolidate our values-driven approach to reaching net zero in the sector.

Unlocking energy capacity

UK Power Networks' Envision project is simulating how power is flowing through its networks across London, the South and South East of England. From this data-led approach providing better 'visibility' of everything that is happening across hundreds of thousands of miles of network, the company will be able to run the network more efficiently and safely allow more low carbon technologies like heat pumps and EV chargers to connect.

Experts forecast Envision could release almost 70MW of electricity capacity by 2028, creating more space for EV chargers or low carbon heat pumps. This means engineers won't need to physically upgrade the network to release capacity, leading to significant cost and time savings: up to £4 million in total over the next five years.

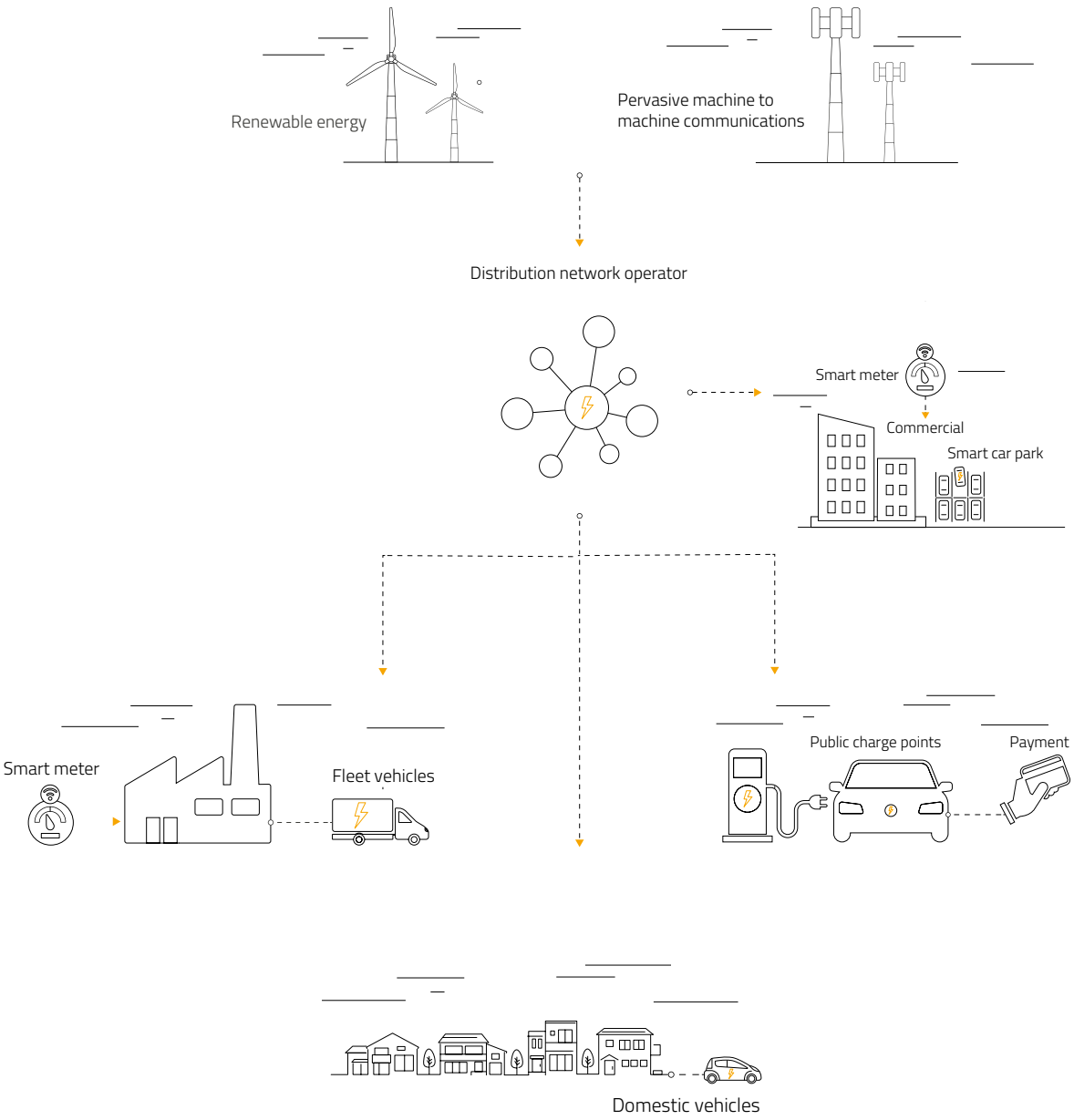
Connecting more electric car chargers and electric heat pumps is critical to tackling the climate crisis and reaching the UK's 'Net Zero' carbon emissions target by 2050. There are currently more than 150,000 electric cars and 20,000 heat pumps in the areas served by UK Power Networks, but its analysis forecasts over 2.6 million electric vehicles and 712,000 heat pumps by 2030. These need 'space' on the electricity network, so quickly and efficiently unlocking more capacity is a vital part of the network operator's strategy.

Envision is building new predictive models which combine UK Power Networks' data with external and real-time data from monitoring devices connected to substations.

The machine learning algorithm will create a simulation of the electrical 'load' in specific areas and expand it across the entire network. Engineers will compare the simulation to real life physical monitors; feeding the software more and better data over time so the algorithm gets more accurate

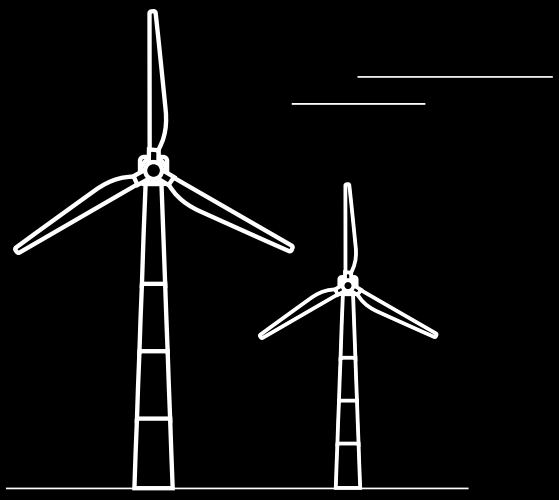
Simone Torino, head of product and business development at CKDelta, which is collaborating on the project, said: "The aim of the Envision model is to generate a 'virtual sensing network' that uses advanced data capabilities and machine learning to simulate the behaviour of the network at scale, accurately estimating changing network load profiles. In a world where the uptake of new distributed energy resources and the increasing electrification of transport are impacting electrical demand and distribution network constraints like never before, having this type of modelling and predictive analytics capabilities is a game changer for the utilities sector and has potential to reshape how we approach demand and supply in other sectors such as transport."

Energy Ecosystem



A chart showing how predictive analytics with machine learning capabilities can help ensure greater utilisation and meet end-user demand against shifting patterns of consumption.

Readying our energy mix



In the mission to reach net zero, identifying innovative and cost-efficient solutions to embed new energy sources into the grid should be the first consideration to reaching our targets. The combined unpredictability that comes from the installation of new heat pumps and electric vehicle charge points, present challenges both around the pace of the rollout and meeting end-user demand. With the BEIS target of installing 600,000 new heat pumps a year by 2028, we need more holistic thinking around how data is utilised to adapt to planned changes in the energy economy that can account for all the complex variables in demand, cost and efficiency therein.

Combined analysis of alternative data is the ideal mechanism for accurately forecasting future demand. Whole systems frameworks that can incorporate data on utility bill payments, telco data and mobile data can more accurately monitor and forecast patterns of consumption on the grid. It can also be leveraged to plan for potential capacity upgrades if needed.

With shifting patterns of consumption and the rise in low-voltage infrastructure, data-driven models which incorporate predictive analytics technology can also be trained to plan for more complex variables that Narrow Artificial Intelligence (AI) cannot. By accessing more diverse data sets to build these models, the industry can significantly strengthen the accuracy of its forecasting and build the momentum for innovation in other model-based design and operations.

Adopting whole systems models to process this data can also provide better visibility for competing KPIs (i.e. carbon reductions and network optimisation), which may run into closer conflict as we accelerate our push towards net zero.

CKDelta's view.

For all the fresh speculation on energy bills and the cost of net zero, it would be easy to forget the extent to which the ongoing challenges in the utilities sector mark a positive watershed moment. Incorporating behavioural data early can optimise holistic views of the market and existing systems. From there, the sector can lead the way in identifying areas for targeted efficiency savings, helping to maximise ROI for investors and returning the saved costs into the infrastructure cycle.

For this approach to work, we must ensure that the proper consumer interfaces and resources are in place to make important data equitable and accessible for all. Raising consumer and community interest in the sector can not only give the industry buy-in to net zero, but also strengthen the quality of new data models that can account for the complex variables to deliver it.

The final word.

Geoff McGrath,
Managing Director, CKDelta

Now is the time to act to secure our aims and objectives. With regulatory drivers now on the horizon – including the water sector's AMP8 cycle - ongoing discussions around keeping consumer cost low in the mission to reach net zero are beginning to define the long-term strategic vision of the sector. Now, we need the right tools and platforms to deliver it.

We do not have long to get this right. CKDelta believes that predictive analytics with machine learning has a significant role to play in enabling the sector to decarbonise. The potential to integrate this data across the value chain means we can re-conceptualise how we think about, and deploy, systems with both embedded and adaptive intelligence to optimise system performance without compromising the net zero goal.

1

The consumer must come first

Behavioural data often provides the most unique insight into patterns of demand and should always form the foundation of our simulation modelling and forecasting. Analysing trends in this data whilst reinforcing existing networks can bring tangible cost benefits to the consumer and build upon our collective ambition to reach net zero.

2

Use integrated data sources at all stages of the value chain

Maintaining open-source, whole systems data frameworks can enhance our understanding of consumer priorities and train more accurate data models. Making data more open and integrated can also encourage more active conversations between stakeholders around the benefits of low carbon technologies (such as hydrogen and heat pumps) and can better set expectations around delivery and its associated challenges.

3

Keep resilience at the heart of all strategic thinking

Governments and policy makers have long remarked of the importance of coordinated and strategic thinking to reach net zero, and the utilities sector is leading the way. Managing supply is a critical aspect of assessing climate impact and the viability of new net zero initiatives

Securing a viable net zero future, however, will also rely on keeping costs low for consumers and reinforcing our networks to accommodate fluctuating trends in demand and the growing diversity of our energy mix. Having the right data systems in place enables us to meet these aims and build the resilience needed to fulfil our shared aims.

4

Keep whole systems models at the forefront when deploying new utilities infrastructure on the network

As competition between KPIs increases in the push to reach net zero, only whole systems models can provide the visibility needed for systems operators to accurately forecast and deliver on the sector's strategic priorities whilst keeping costs low. Taking a holistic view of network trends through these models can also allow operators to better identify waste reduction methods (i.e. resource/efficiency/materials) and build the targeted investment frameworks required for alternative energy sources to meet public demand.

Contact.

Geoff McGrath
Managing Director

geoff.mcgrath@ckdelta.ie
+44 7445 321351

ckdelta.ie

CKDelta is actively engaged in **11 countries** and **one special administrative** region:

Australia
Austria
Denmark
France
Hong Kong
Indonesia
Ireland
Italy
Singapore
Sri Lanka
Sweden
UK