Rebooting the system

An Energy Geeks approach to achieving digitalisation

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Contents

There has been substantial effort focussed on the role digitalisation will play in enabling the energy system to deliver good climate, economic and social outcomes, but progress has not matched the ambition or expectations. The Energy Digitalisation Framework seeks to respond to this, recognising the need to do more. In this report, the Energy Geeks set out actions to deliver the right outcomes at pace. This is complemented by insight from CGI on turning words into action.

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About The Energy Geeks

The Energy Geeks are an independent team of experts who combine whole systems experience with deep specialist knowledge in energy digitalisation. All are highly regarded in the sector for their contributions to energy data, policy, regulation, and system transformation.

Eric Brown

Eric Brown is an independent consultant in energy systems, working with a variety of organisations through his company Grid Scientific Limited. He is also Professor of Practice in Energy Systems at the University of Strathclyde. He is the former Chief Technology Officer at the Energy Systems Catapult and remains engaged with the Catapult as Executive Adviser. He contributes to the work of the Energy Geeks in a personal capacity only.

Maxine Frerk

Maxine Frerk is a consultant and thought leader with strong background in energy regulation. She spent fifteen years at Ofgem including as Senior Partner for Networks and a member of the executive board. She holds advisory roles including independent director for SSEN Distribution and is a regular contributor to Utility Week.

Roger Hey

Roger Hey is a Chartered Electrical Engineer with over 30 years experience in the energy sector. He has held senior leadership roles across engineering and digital domains, leading the research, demonstration and deployment of smart grid techniques with the UK's largest Distribution Network Operator. Roger chairs the UK National Committee for CIRED, the international community for Distribution Grid professionals, and sits on the organisation's General Assembly.

Simon Harrison

Simon Harrison FREng is a Fellow of the Royal Academy of Engineering and Group Head of Strategy at Mott MacDonald. He chaired the Royal Academy's Working Group on Rapid Decarbonisation of the GB Electricity System, served as a Clean Power 2030 Commissioner, and is an IET vice president. Simon contributes to the Energy Geeks in a personal capacity.

Laura Sandys CBE

Laura Sandys CBE has been working in energy transformation for 20 years and chairs The Green Alliance, The Food Foundation and British Standards Institution Advisory Board on Net Zero. She was awarded a CBE for services to UK Energy Policy in 2019. She chaired the UK Government's Energy Digitalisation Taskforce and now works globally to spread best practice in energy system digitalisation.

Steven Steer

Steven Steer specialises in developing complex data ecosystems and works at Zühlke Engineering. He was Head of Data for Ofgem and a member of the University of Cambridge Energy Policy Research Group. He created Ofgem's standards for Data Best Practice and Digitalisation Strategies and authored Ofgem's first digitalisation strategy and action plan.

Introduction

Energy Geeks

The UK is deploying clean energy hardware at remarkable pace. Billions are flowing into wind, solar and grid infrastructure. But we are building the most complex machine in British history without writing the operating manual. The digital governance, data architecture and coordination needed to operate this system safely and efficiently are dangerously behind.

The problem is fragmentation, not inaction. Across the sector, brilliant individual digital programmes are undermined by the absence of a coherent whole-system design. On a single day in December 2025, three major energy institutions published separate and uncoordinated digital strategy papers within hours of each other. A Tower of Babel is emerging.

The value at stake is enormous. Electricity network flexibility services alone delivered over £300 million in savings to billpayers in 2024 (according to the ENA), with projections of more than £3 billion in cumulative savings over the following three years. The government's own modelling suggests flexibility could save £10 billion per year by 2050. Meanwhile, the cost of failing to act is already visible: in 2025, the UK incurred approximately £1.46 billion in wind curtailment and replacement generation costs, paying wind farms to switch off while simultaneously paying gas plants to fill the gap. Without reform, these constraint costs alone are projected to reach £4-8 billion annually by 2030. Digitalisation is the essential enabler for capturing these savings and avoiding these costs.

This report sets out what must be done. We argue for:
A Modernisation and Digitalisation Unit (MDU) to architect and oversee delivery of a coherent digital energy system. One body, four functions, three years, then dissolved. Independent of existing institutions and able to move with the intensity and urgency usually associated with startups.

A Digital Energy Highway Code setting out the rules of participation: who gets access, what data must be shared, and how physics always trumps economics. Built on three pillars: an Energy Passport (digital identity for every device and consumer), a Digital Spine (lightweight connectivity layer), and Data Rules (mandated, contracted and voluntary sharing).

A fundamental rethink of smart metering to deliver the data the system needs, alongside clear rules enabling a flourishing competitive market at the grid edge to develop the services and insights the system requires.

Whole-system risk governance that recognises risks do not respect organisational boundaries and lurk among the interfaces where responsibilities overlap or underlap.

Our North Star is simple: the customer does nothing, meanwhile the system works for them.

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Over the last two decades Britain has made tremendous progress in decarbonising its physical electricity system. The energy transition is well underway. But, as NESO stated in its 2024 advice to government, delivering clean power by 2030 requires "several elements to deliver at the limit of what is feasible."

This report collates six months of articles by the Energy Geeks. Through the series of thought pieces, they trained their collective experience on the challenge of delivering a smart, clean energy system by 2030. Whilst the focus is on what it will take to digitalise the energy system, their thinking extends beyond the technical challenge to address the commercial, governance, cultural and delivery challenges.

The energy transition requires collaboration between all system actors. This includes policymakers and regulators to create an environment that attracts the necessary investment and incentivises the cultural shifts in terms of attitudes to risk, collaboration and sharing learning needed to make this happen at pace. But the transition extends the system boundaries and, increasingly, supply chain partners have a key role to play too.

The Energy Digitalisation Framework (see p.10) marks important progress and provides much needed direction. But publications don't reduce bills, manage constraints, or secure consumers' trust and deliver the benefits of the energy transition. Delivery does. And delivery must be effectively coordinated if the use of finite resources is to be maximised and the pace necessary to deliver by 2030 achieved.

Data, as the Geeks put it, is the "lifeblood of a digital energy system." Data is essential to provide visibility across the system and deliver actionable insights to decision makers: for planning, for operations, for maintenance, for market coordination and for consumer propositions that people might actually choose.

Both the physical and commercial dynamics of a transitioned energy system will be fundamentally different from today. The Geeks address the need for new approaches to governance and a new user manual (or, as they term it, a "Digital Energy Highway Code") to help system actors navigate these energy highways.

Delivering the clean energy mission is not just a technology challenge. The challenge is to coherently integrate technology, governance, commercial incentives and culture to deliver seamless customer journeys and enable millions of assets and actors to participate safely, simply and profitably.

To paraphrase former President Barack Obama, in his final address, "We can and should argue about the best approach to solve the problem." Whilst you may not agree with all of the Energy Geeks thinking, through this report they challenge us not to accept the current approaches and find better ways of delivering clean power by 2030.

Rich Hampshire
Vice president, digital utilities,
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Executive summary

Turning a digital vision into a reality

We published our digitalisation manifesto in December 2025 and believe that while our manifesto is clear, government and energy organisations need more than a list of requirements. They need support through clearly described actions and an implementation plan. We also suspect that some stakeholders still treat deep digitalisation as a post-2030 issue and do not consider it as integral to a safe and stable system or that it underpins meaningful system flexibility. We want to rectify this and to bring everyone along with us on a shared journey of change. Let us be mindful that the Digitalisation Taskforce's report was published five years ago – and there's not a huge amount to show for it.

We need to rationalise and co-ordinate the current digital initiatives and also understand that the "customers" of these programmes are having to navigate the lack of coherence. For example, in one day, on 12 December, 2025 three major energy institutions published digital strategy papers. On the same day. Within hours of each other.

At 9am, Ofgem launched Enhancing Asset Visibility – yet another consultation asking distribution network operators to consider "options" for how they might store and share data on a fragmented, region-by-region basis.

By 11.30am, RECCo had released proposals for a consumer consent portal – a centralised destination website where 30 million households would supposedly log in to ultimately manage permissions for their heat pumps and EV chargers.

At 2.45pm, DESNZ announced a new Distributed Energy Resource (DER) registration programme via a government press release.

Each was building their fragment of the digital energy system, speaking different languages, defining different data standards, assuming different governance models.

In this report we put forward an actionable plan to address our manifesto asks. We will translate from 'what' into 'how' - going into detail on critical success factors and how to achieve them to ensure that we get a digital capability that unlocks the potential of a smart and safe energy system.

Have we lost sight of the destination?

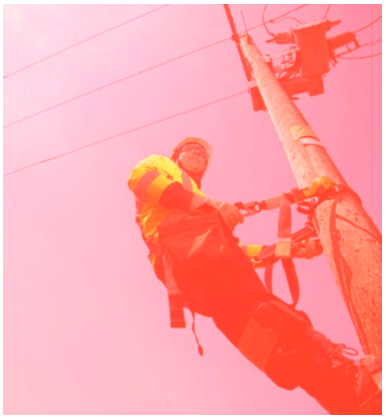
It feels that there has been a loss of direction and that is why we have so many disparate programmes, pulling sometimes in different directions, with limited coordination or integration. One of the key distractions to date has been the focus on technology rather than governance and rules of the game.

There is a Tower of Babel emerging that is creating confusion, costing a lot of money, siloing solutions that will need retrofitting and all delivering point solutions but not addressing the fact that this is a whole system.

There are four key objectives that must contribute to:

- **Exciting, tailored consumer propositions**
- **A stable and resilient system**
- **Whole system optimisation**
- **Accelerating decarbonisation.**

These need to guide all the programmes and in this series we will dive deeper into the destination. Importantly these are not separate issues; they all need to be accommodated in one system – the whole energy system!

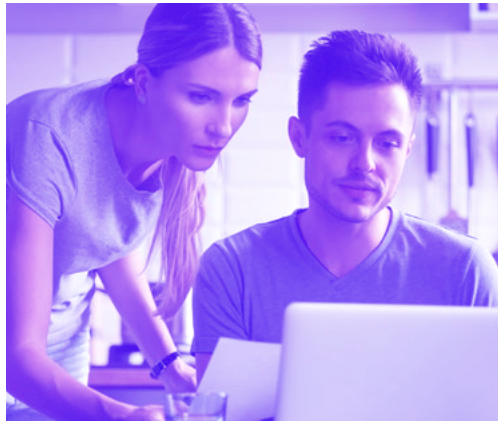


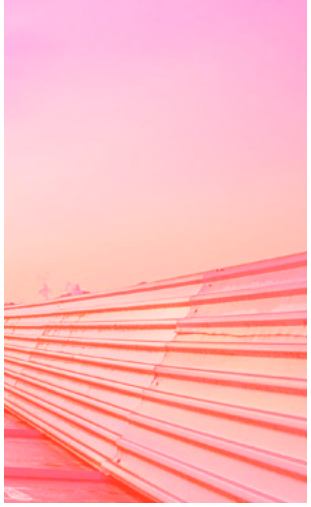
Areas of focus

This report tackles five key themes:

1 Governance of system access

There will need to be rules about access to the system and its use that deliver benefits to the system and all sector actors. We propose a 'Highway Code' and show how it should be designed highlighting its three key components: a "driving licence" and "tax disc" for all actors, a very lightweight digital spine linking the actors, and rules around access requirements, operating parameters and hierarchy of control.





2 Data Creation

The energy sector is home to a wealth of information that uniquely arises from within its sectoral borders. Some of this data is not digitalised at all, sometimes the fidelity and quality of the data at the point of creation is insufficient. Much potential digitalised energy data is currently not understood, nor utilised. While data creation isn't free, its costs can be justified by its potential to deliver huge benefits. We propose how data, including from new sources such as electric vehicles, domestic equipment and industrial metering, could best be captured for public good and consumer benefit.

Smart meters are a very substantial source of data in the energy system, but this data is hard to access. As a result, the system is not delivering the value that it should and could. We outline what benefits could be realised by reform of the smart meter programme and additionally show that there are other sources of data that, if created, could have significant value for the system – all while providing control and privacy for customers.

We could have the most data rich energy system, but we need action to make this a reality.

3 Risks and Opportunities

Both digitalisation and a lack of it present uncertainty that needs to be understood and managed.

We propose how to approach uncertainty head-on both to mitigate risks and to take most advantage of opportunities as we digitalise the energy system.

We look at tackling existing and emerging threat vectors, bad state actor interventions and how these affect the approach to Artificial Intelligence. We also explore the risks from interacting algorithms and cascading effects.

4 Value for all Actors

We articulate and highlight how digitalisation really does benefit customers and is designed around their needs today and into the future. To date the sector has been designing its digital tools around its own needs but we must hear more from customers of all sizes. This also recognises that customers will have "agents" for their energy needs and actions, and it is important to include them into the design.

Digitalisation can play a strong role in unlocking customer value – and it is extremely important that they get their fair rewards.

5 Delivery

Much of the digitalisation effort to date has focussed on "what" must be done; here we address aspects of the question of 'how'. Delivery describes how to get things done: it puts principles and policy into practice and seeks to maximise value for money. To date there has been significant effort to instigate deep digitalisation and progress has been made, but a lack of effective coordination has resulted in fragmentation of effort, resulting in delays and inefficiency.

There are some very important gaps in delivery which would realise real benefits if addressed effectively: architectural coherence, deliberate integration, institutional stewardship, disciplined commercial boundaries, and structured learning.

Key Implementation Principles

Throughout this report we reiterate key principles that should guide digital definition, design and delivery. These include:

One system, lots of actors: There is one energy system with many actors, each with unique roles that need to be integrated to function cohesively as a whole. Every actor needs to play their part, but just as importantly, the system needs to "serve" them too – responding to their respective needs in a way that succeeds best when it works for everyone.

Designed around customer needs: The digital revolution will enable a shift in perspective from one in which design focuses on the system to one where it is customer-centred.

Drive cultural transformation: We are building an energy system that may feature billions of actions by millions of assets; this is nothing like the energy system we have known. This requires a fundamentally different approach to system design, operation and usage, demanding significant culture shift as a difficult but essential task.

Establish clear modern rules for system participation: There will need to be rules that define the terms of access to the energy system. Participation must deliver benefits to the system as a whole and to its actors. This theme is addressed in the proposed 'Highway Code'.

Deliver simplicity: We need to avoid over-engineering the energy system. We should adopt well-proven approaches where these help to reach our goals – reuse by default, deviate only by evidenced exception.

Prioritise coordination over control: The many actors in the energy system have different priorities and financial incentives influencing their interests and decisions. There must be coordination but there must also be room for actors to flourish, both individually and collectively. This requires clear and trusted processes to govern the design, build and operation of the overall system.

Embrace evolution and agility: We do not know what changes might arise in the future or how the system needs of the 2030s, 2040s and beyond will develop. We need a highly adaptable approach to allow for extraordinary future system needs to be safely accommodated.

Anticipate risks: Digitalisation offers great opportunities to identify and mitigate traditional risks, but it introduces new risks. Digitalisation should be used to provide more advanced oversight of crucial system services, and to address emerging new risks, such as algorithm cascades and increasing cyber threats.

Technology as a consequence, not as a driver: One of the key distractions to date that we have observed is an excessive focus on technology rather than requirements, foundational governance, energy data and establishment of the 'rules of the game'. It is critical that the outcomes of energy system digitalisation are clear, well communicated and shared by stakeholders.

Plan in architectural coherence: We fear current implementation plans reveal that sight of the end game has been lost. This is why programmes have become so complex, fragmented and lacking in confidence. We are convinced an architecture capability is needed to achieve coherence and support coordination of effort. Ofgem's open letter in November 2025 on architectural coordination offers optimism that this role will be established with the right mandate to act for the benefit of all. The appointment of NESO to prepare an architecture is a critical first step.

What is the government's 'vision' for energy digitalisation and who is going to do what?

Ofgem and the government released their inaugural Energy Digitalisation Framework in March 2026. This revealed that three bodies will become key technical data 'coordinators' in Britain's energy digitalisation journey.

The National Energy Systems Operator (NESO), RECCo, and Elexon will handle a specific category of energy data each, with Elexon also provisionally in charge of an extra category.

The report described the current digital energy landscape as becoming "increasingly complex" with different organisations initiating different digital activities.

It said: "The system now reflects high levels of activity but low coherence, with limited clarity around how different programmes and systems interconnect or where roles and responsibilities sit."

It added that this lack of integration would risk creating duplications, raise data security concerns, lead to unaligned datasets, and ultimately increase overall systems cost, slow the energy transition, and result in a poorer customer experience.

To tackle this, the report suggested that the energy system should shift from an initiative-led approach, where organisations launch their own digital projects without coordinating with other bodies, to a domain-led model.

A data domain is a defined category of related energy data, and each of them will have a domain coordinator.

The domain coordinator is responsible for setting consistent data standards in their domain, meaning they will ensure that all the stakeholders in their domain are collecting and reporting data in a standard way.

Beyond their own domain, the domain coordinators will also ensure that their data is interoperable with other domain coordinators.

However, this does not mean that the domain coordinators will hold data directly; instead, they will only coordinate the stakeholders holding this data.

NESO will be the domain coordinator for core energy system data, which involves network operational and systems data, asset and infrastructure data, and planning and forecasting data. Its current Regional Energy System Planning (RESP) responsibilities already align with this role.

Importantly NESO has also been given the task of delivering a energy system digital architecture by the end of August 2026. If well-executed, this will be a key contribution to moving digitalisation forward. However substantial and sustained effort will be needed in its preparation and its introduction to use as the reference for the digitalisation ambition.

Elexon will be the domain coordinator for behind-the-meter asset data. This includes ownership, registration, and usage data related to asset types such as heat pump, EV charge points, etc.

Data related to meter reading and consumption of electricity and gas by domestic and non-domestic customers will also be handled by Elexon. However, this is a temporary role that will be revisited later on.

All consumer consent-related data will be under RECCo's coordination. Under RECCo's domain coordinator role, it will look after energy tariffs, suppliers, and consumer cost data.

RECCo must also ensure that the energy digitalisation journey gains consumer trust by getting consumer consent early on in the process.

In phase one of the framework, the domain coordinators manage their domains and escalate issues, including cross-domain problems, to the Digital Delivery Group (DDG), which provides oversight. The DDG is chaired by Ofgem with members from the Department of Energy Security and Net Zero (DESNZ).

In phase two, the new Digital Coordination Function takes over the cross-domain collaboration responsibilities from the domain coordinators. And domain coordinators will now report to the function instead of the DDG.

The function will also report any issues from the cross-domain coordinators to the Digitalisation Board, which includes members of DESNZ, Ofgem, NESO, RECCo, and Elexon.

Chapter One

The Missing Governor: Why we need a digital system architect

As we have already highlighted, there is a Tower of Babel emerging across our journey to a digital future that is inhibiting the acceleration we need to unlock and manage the hundreds of millions of actions and assets on the energy system going forward.

It is also the case that many of the programmes in train are digitalizing existing processes rather than harnessing the real opportunities of transforming how and what we do.

We are also seeing that the potential solution providers of these great transformations are confused and muddled by what is the destination, what are the key digital assets being developed and most importantly how they all fit together. As we have shown already, each part of the energy governance system is describing data differently. Worryingly, if users had to comply they would end up spending all their revenues moving data around a system that doesn't have clarity of what it wants to do with the data.

So now is the time for a step back and work out what is needed in terms of governance.

The Hardware Success

You can see the physical energy transition happening at remarkable pace every single day in the UK. We are world leaders in offshore wind, deploying hardware faster than most nations. The government's Clean Power 2030 mission is driving billions into steel, copper, and silicon.

Yet in our rush to deploy hardware, we have entirely failed to design the software rules to operate it. We are building the most complex machine in British history without writing the operating manual.

To put this in motoring terms: we are building the digital energy highways and byways and handing keys to millions of drivers (homeowners with EVs and businesses with batteries), but we haven't painted white lines on the road or agreed what a red light means. As we've said before, we need a Highway Code for the energy system.

Integration systems engineering is not just a think tank concern. At an Ofgem Architectural Coordination workshop earlier this year, the message from industry was striking in its coherence and vigour: private companies are begging for someone to define and enforce the rules of energy's digital roads.

Why? Because capital hates uncertainty. Investors will take commercial risks, but not structural risks. Without a shared approach, we're heading for a Digital Wild West. A chaotic junction where no one can say who has right of way is not a "free market" or centralised control; it is a worst of both worlds, a pile-up waiting to happen. The industry knows that to unlock the next wave of capital, we need clarity. We need an unbiased rule-maker with authority to mandate compliance, not just coordinate aspirations.

At Energy Geeks HQ we believe this governance void is the single biggest risk to the electrification of the economy.

The Tower of Babel

The problem isn't a lack of effort. That hurdle has been crossed and individual brilliant work is now underway. NESO has explored a Data Sharing Infrastructure service, determining how to best route energy data technically. Elexon is working to align local flexibility markets. RECCo is unblocking responsible usage of consumer data. Energy networks are investing in grid monitoring and advanced analytics and the BSI has started standards development focused on aligning grid data.

Each initiative is technically sound when considered in its own bubble. The issue is that each is designing in isolation. There is no coherent target design for the whole system, there is no clear accountability for achieving coordination and, critically, there isn't a meaningful and agreed definition of what it is to be 'coordinated'. When these services don't add up and don't play nicely together it will be everybody's yet nobody's fault. Without clear accountabilities for achieving integration, consumers will be left footing the bill.

Who decides that all necessary components exist and that none are duplicated between different services? Nobody is responsible for this.

Who identifies, monitors and mitigates risks to the whole system? It's nobody's job, they are left unchecked.

Who ensures that physics always trumps economics? Nobody confirms that our end-to-end digitalised energy system respects scientific and physical constraints.

The fundamental problem is that despite laudable enthusiasm for delivering solutions, we have ambiguous overall requirements. There is no single body with the authority to define the overall design and command coordination from the sector's many incompatible initiatives before they commit to implementing disparate individual designs.

The MDU solution

What we need is a Modernisation & Digitalisation Unit (MDU) whose role is solely to architect and oversee delivery of a coherent digital energy system. It should exist with this mandate for only a fixed period of time.

The MDU would serve four essential functions:

1. **Digital System Technical Architect:** Create a target design for how the energy system's digitalised services will fit together, end-to-end. Rationalise the current fragmented programmes (NESO's DSI, RECCo's consent mechanisms, Ofgem's asset visibility requirements, DNO monitoring systems, Elexon's Market Facilitation, BSI's data standards, Networks' SIF innovations, and so on), creating one coherent set of activities for our digital energy ecosystem.

2. **Rules of the Road:** Define and mandate the digital rules that all participants must follow (the policies, protocols, and standards that ensure the system integrates safely and efficiently). This isn't just technical standards; it's setting the policy framework for how digital energy infrastructure operates, who has access, what data can be used for, and how conflicts are resolved. Just as the Department for Transport sets the Highway Code that all road users must follow, the MDU creates binding rules for the digital energy system that prioritize physics over profit and ensure consumer protection. The Energy Geeks have developed a detailed Digital Energy Highway Code as a technical blueprint for these rules (See p16).

3. **Programme Manager:** Develop, share and be accountable for a credible engineering implementation roadmap that grounds and holds to account the plans of those around it, by balancing (A) thoroughly stretching targets for implementation bodies to deliver to, and (B) the actual system implications and costs associated with the ambition implied by government and regulatory policies. It needs to keep all parties 'honest' in their promises and delivery.

4. **Assurance:** Hold implementing bodies accountable for their delivery of components for the overall system and its services, ensuring safety and efficiency. This will require challenging and aligning proposals before resources are committed, ensuring all programmes and policies align rather than fragment.

Critically, this body would not create detailed 'low-level' designs and certainly would not build the solutions itself. This would be excessive centralisation by far. Industry operators and their supply chain build infrastructure and services. The MDU has one purpose, which is to own and oversee delivery of the high-level design for a coherent digitalised national energy system to function.

The precedent exists

We don't need to invent from scratch. Proven international standards solve every component. California Rule 21 mandates smart inverter standards for grid stability. Australia's Consumer Data Right defines data ownership and portability without centralized databases. India's UPI routes billions of financial transactions through a thin coordination layer with no central data store.

The MDU would assemble these proven approaches into a Digital Energy Highway Code tailored for UK needs. The technical solutions exist. The implementation models exist. What's missing is the authority to mandate their adoption.

The MDU requires clear authority to mandate compliance across public bodies and regulated private services. This could be established through ministerial direction, licence modifications, or code changes. Realistically, the MDU's work can be progressed a long way simply through soft power, a collaborative mindset and a genuine 'can-do' attitude by the sector; formalities of process can catch up after. We have no time to spare.

Clean Power 2030 is fewer than 2,000 days away. Three years. Four functions. Then dissolved. We need a strike team with wartime urgency, not permanent bureaucracy.

Who should be in charge?

DESNZ has the policy mandate, NESO the technical capability, Ofgem the regulatory powers. What's missing is the MDU as a coordination body with authority to require digital and data engineering alignment and with no other responsibilities distracting it.

The MDU could sit between the existing institutions, either reporting to DESNZ or devolved within it via Mission Control; either way it would require genuine independence to ensure it can act without fear or favour.

Ofgem's recent open letter showed openness to architectural coordination. Industry responses were unanimous: "Give us certainty. Let us compete on service, not on whose proprietary standard wins." The industry has spoken. They're begging for stewardship. The technical solutions exist globally. The institutional will is swelling up.

We are at a crossroad. Down one path lies the continuation of the Tower of Babel (overlapping consultations, incompatible systems, billions spent on digital infrastructure that can't talk to each other, and a grid that remains blind to the assets connected to it).

Down the other path lies coordination, interoperability, and a secure digital foundation for Clean Power 2030 and beyond. The choice seems obvious. Yet without promoting engineering leadership among our institutions, we will continue building competing towers at the consumers' expense.

Rules of the road: The vision of the Highway Code

The Energy Geeks have developed the most comprehensive plan for designing, governing and delivering the key elements of a truly Digital Energy System in less time and at less cost.

The Highway Code blueprint outlines the key elements required to deliver the necessary public interest digital assets to unlock efficiencies, system resilience and whole system flexibility. There are three fundamental elements of the Highway Code that enable all actors across the system to effectively communicate, provide appropriate rules for system resilience, and offer the public the right levels of control over their energy data. This builds on the work of the Energy Data and Digitalisation Taskforces, the Public Interest Access Group and much of the work done by Ofgem, NESO and DESNZ over the last few years.

The key elements of the Highway Code are:

1. **The Energy Passport provides a digital identity for every connected device and its owner: a 'Tax Disc' for the asset giving the network real-time visibility, and a 'Driving Licence' for the consumer providing portable consent that travels with them when they switch supplier.**

2. **The Digital Spine is a lightweight connectivity layer that routes data without storing it centrally, establishing three tiers of data sharing: mandated safety data, contracted commercial data, and voluntary lifestyle data.**

3. **The Hierarchy of Control incorporates a priority order into every connected device: safety first, then system resilience, then consumer preference, then market optimisation. No algorithm or smart agent can override safety limits or system resilience signals, regardless of the commercial opportunity.**

The Energy Geeks have also outlined the approach to delivering this programme and the transitional arrangements required. We believe that through concerted focus the key energy digital assets can be developed and deployed within two years at less cost than currently anticipated and quicker than planned.

The Highway Code framework is summarised in the diagram below.

The Simple Customer Journey: Consumers would be prompted to scan a QR code, triggering a permission check that would set out their preferences for use of their device (ie minimum EV charge or temperature generated by a heat pump). This would incorporate the customer consent as part of the asset registration. The Energy Geeks propose that this could be done through a variety of applications, such as energy retailer or manufacturer's app, as opposed to creating two bespoke portals as proposed today adding friction to the customer journey.

Comment

Rich Hampshire
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In the first part of our report, the Energy Geeks train their headlights on the need for clarity about governance and how the plethora of initiatives across the energy sector must be coordinated for clean energy by 2030 to be deliverable and for consumers benefit from this radically different way of sating their energy needs.

The Geeks nail this challenge in their second paragraph – digitalisation, in the context of the energy transition, is more than digitalising the way the system works today. An increasingly distributed energy system has fundamentally different dynamics. If we are to realise the opportunities created by this transition, then innovation in system governance, in the market architecture, and in the business models of the system actors are all essential. But that requires clarity on the architecture of the system.

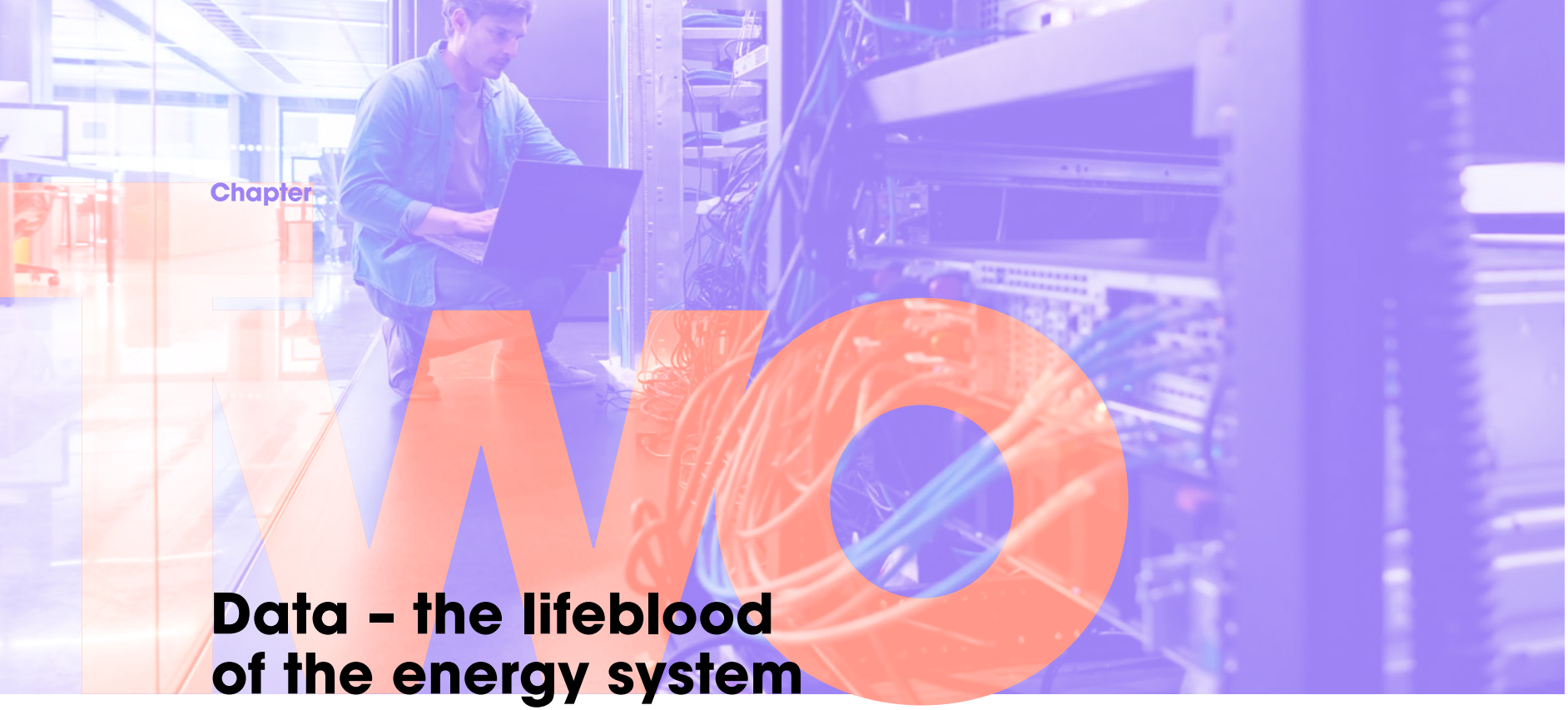
The laws of physics and engineering are givens, but the governance and the different obligations placed on system actors are choices applied to the physical system is a key insight. The system is evolving too fast to spend years theorising about a perfect design – the challenge is to identify the critical points of control around which the system has the freedom to evolve and system actors can invest and create value. Therefore, a change process that is able to respond to opportunities, and to manage emerging risks effectively, is essential.

Over the last 18 months it has been fascinating to follow the evolution in the Energy Geeks' thinking. They have shifted the discourse from digitalisation towards data. The importance of "clarity of what [system actors] want to do with the data" is one aspect. Knowing what to do with the data requires understanding of what needs to be done – which determines the data required to make informed decisions. Back to the Geeks' primary call for clarity.

It's clear that there is an immense number of invaluable initiatives underway. Each of these are vital pieces of a jigsaw puzzle that, when complete, will provide the foundation for Britain's energy transition. The roadmap, the picture on the top of the puzzle's box, must enable identification of duplicate pieces and, more importantly, whether any pieces are missing!

> **"The system is evolving too fast to spend years theorising about a perfect design – the challenge is to identify the critical points of control around which the system has the freedom to evolve."**

The Energy Geeks have started the ball rolling with their blueprint for the Digital Energy Highway Code. Once the proposed Modernisation and Digitalisation Unit (MDU) completes its 3-year mission, the question that remains is, how will the system governance be maintained as it responds to the continued evolution of the system? The one thing of which we can be certain is that the pace of technology change will continue to accelerate, and system governance will need to respond if the opportunities created are to be embraced.



Chapter

TWO

Data – the lifeblood of the energy system

The sector still has a lot to learn about how to integrate data into its day-to-day operations. Data is the lifeblood of a digital energy system. But in some case the data is not being captured and in others there are unnecessary restrictions on its use.

A crucial source of granular data is smart meters, which are essential for customers to participate in flexibility markets but where the rollout is struggling. A fundamental review is required. The rules for who can access smart meter data also need updating. Distribution network operators (DNOs) should be able to access customer level consumption data to help them in their vital task of running the networks and keeping the lights on.

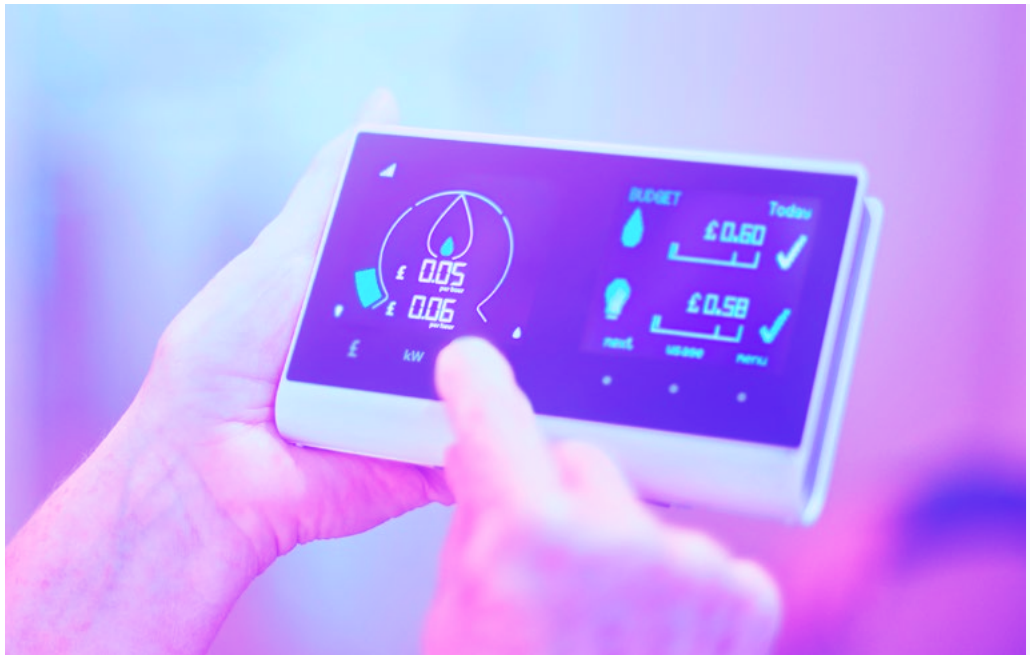
Finally, action is needed to take advantage of the explosion of data available from increased network monitoring and a proliferation of smart devices in homes and businesses. Building on Ofgem's Data Best Practice Guidance for open data sharing, this needs rules set out in the energy Highway Code that we have called for.

Why data really matters

Flexibility markets have been positioned as a centrepiece of a modern energy network, but they do not work without fluid data sharing. Electricity grid capacity is set to double under clean growth plans, but without detailed data on regional demand trends, distributed generation and network utilisation, system planning is impossible.

Electricity affordability is a key issue, both for individuals and for the businesses vital to the economy, and is therefore a priority for government. Yet a key tool for reducing costs – actionable insight through granular data – is not receiving the attention it deserves. With the right data there can be multiple wins:

- Consumers, both domestic and non-domestic, can cut their bills by playing fully and automatically in providing system flexibility.
- Network companies can squeeze more from their existing assets, reducing the amount they will need to invest in future.
- Suppliers can engage more closely with their customers, tailoring their offerings and potentially accelerating the heat pump transition.



As electricity evolves to a more distributed system with tens of millions of smart devices, we need much more granular data – at a geographic level and through time – to manage that system for the public good.

As sensors become cheaper we can put monitoring equipment across the system as the networks are now doing. But to understand what is happening at the individual consumer level, and to deliver flexibility, we absolutely need to make better use of smart meter data and also to exploit the data that sits within the smart appliances themselves.

Smart metering – yesterday's tech and a stalled rollout

The smart meter programme has been running since 2011 and as of the end of 2025 last year coverage had only reached 71%. Moreover, 8% of installed smart meters were not operating in smart mode and need to be fixed.

In their Clean Power 2030 report, NESO states that 86% to 90% operational electricity meter coverage needs to be achieved by 2030 to "unlock the full value of flexibility".

There will also be a need in the coming years to replace comms hubs, and in some cases the meter itself, for the 12 million SMETS 1 meters (and also some SMETS 2 meters) ahead of the 2G/3G switch off in 2033.

In contrast, in France where the rollout started after ours, Linky electricity smart meters are now in 96% of homes with an expected life of 20 years. It also came in 15% under budget.

In our original Waste and Inefficiencies report we argued for a Task and Finish group to carry out a fundamental review of the smart metering programme, to bring fresh eyes to the issue. In our end of year report we highlighted this as the one recommendation where we had failed to get any real traction – but we remain convinced that this review is needed to meet Clean Power 2030 and to deliver savings for customers.

In its recent consultations on the next phase of the smart meter rollout, DESNZ stresses the important link to CP30 but still essentially advocates the same basic approach of putting obligations on suppliers to drive the rollout. This won't deliver the step change in uptake that is needed. Fresh thinking is required.

As a part of a new direction, specific ideas that we want to see taken forward are:

To focus the remaining rollout on electricity smart meters which are critical to supporting consumer led flexibility, an essential pre-requisite for Clean Power 2030. Gas meters cost more than electricity meters and are more complex to install. Focussing the installer resource on electricity would deliver much wider system benefits and help meet CP2030. While gas smart meters can help customers better manage their usage, this only works if customers are interested, so suppliers should only have to fit them on customer request.

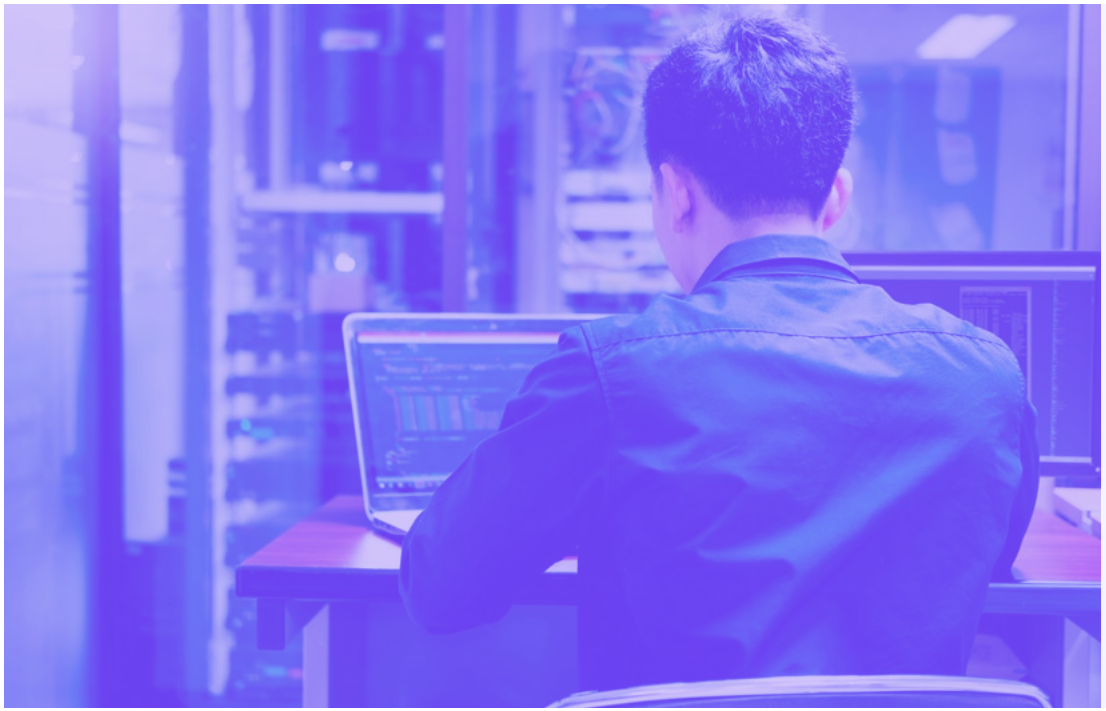
To involve DNOs in supporting the rollout. One key difference with the rollout in France is that it was DNO-led, enabling an area-based approach. We have debated whether this approach would work here and there is still some support among the Geeks for that idea. However, we recognise that DNOs already have a lot on their plate and that unpicking the mass of related industry code obligations and data flows would take time. That said DNOs have a strong interest in the rollout progressing and should be asking themselves how they can help, perhaps as part of their potential new role in co-ordinating home upgrade activity or by prioritising areas where flexibility would be of particular value to the DNO.

To make smart meters standard. At the start of the rollout there were real and valid concerns that requiring customers to have a smart meter would prompt a backlash. As a result, ministers gave firm assurances that customers would have a choice. However, with the move to more renewables and more low carbon technologies there is a much stronger case for smart meters to be treated as standard. We are starting to see the first signs that DESNZ thinking is shifting. For example, the recent DESNZ consultation on the arrangements for small businesses proposed that to be on a fixed-term rate going forward, customers would have to have a smart meter. DESNZ must be bold in pursuing these and other ideas. For example, customers should have to have a smart meter to be eligible for grants to install a heat pump, where currently they are simply given advice on the benefits. And in France customers who refuse a smart meter now have to pay a €39 surcharge which seems to have focused minds there.

Getting full value from smart meter data

As well as a focus on accelerating the rollout of smart meters there is a need to revisit the rules around access to the smart meter data. Privacy remains vitally important but where there is a clear wider "public good," consent should not be needed. The Public Interest Advisory Group (PIAG) project led by Sustainability First and CSE set out a number of recommendations on how more use should be made of smart meter data in the public interest. These recommendations should be followed through and in particular:

DNOs should have access to individual smart meter consumption data. In France the DNOs have full access to all smart meter data and have been using it from the start to plan and run their networks. In contrast, here networks can only access consumption data that has been sufficiently aggregated to overcome any privacy concerns. With DNOs now having a much clearer sense of how they could use individual data, this is a source of growing frustration. They would only be entitled to use the data for a regulated purpose ie to discharge their licence obligations around maintaining a safe, efficient and reliable electricity supply. Planners and policy makers need access to more granular consumption data: Currently NESO, DESNZ and Ofgem are all reliant on annual consumption data (from sources like NEED) to inform key planning and policy decisions. Without access to better data the PIAG report concluded that they would be "flying blind" into the energy transition. There are different routes to obtaining this data (and linking it with socio-economic data that is also key for policy) but it needs to happen.



Market-wide half-hourly settlement (MHHS) should not be optional. Again, as a result of privacy concerns, Ofgem has taken the view that customers should have the ability to opt out of providing their half-hourly data for MHHS. Given the cost of MHHS and the time it has taken it seems folly to operate it on that half-baked basis. If we are moving to "market wide" half-hourly settlement it should be truly market wide.

De-sensitised smart meter data should be more widely available. Many players have an interest in smart meter data – from innovators to consumer bodies and local authorities. Considerable work has been done by Elexon on building a data repository accessible by third parties, using the half-hourly consumption data they collect for settlement. This is a potentially valuable resource but the current focus seems to be on providing access to commercial players who have consumer consent. The value of statistical data or synthetic datasets that could be available without consent needs to be explored as well.

Other data sources – a proliferation of data in an IoT world

While we have put a particular emphasis on smart meters as a key source of customer data, with increasingly more smart devices in the home there is a proliferation of data that could help in building an optimised, digital energy system. In its work on Smart Secure Electricity Systems, DESNZ has been looking at standards to ensure these appliances are secure and interoperable. As of 2025, all EV chargers sold in the UK for home or workplace use must be fully smart and meet an enhanced set of minimum requirements. These regulations focus on connectivity, privacy and security, off-peak charging, staggered charging times, and V2G integration. However there has been no real discussion around whether, and if so how, the data might be made available to support the wider system.

This is a difficult area given both the potential privacy concerns and the commercial value of that data to the players in the competitive market who are rolling out the appliances. However, for public charge points the regulations require that data is available in digital form to government and relevant network operators, which provides a helpful precedent.

When organisations choose to share information in a world of datasets, databases and web portals there need to be processes to determine what to share, with whom and how to share it differently with different audiences. This was introduced formally from 2021 when Ofgem made compliance with the Data Best Practice Guidance a licence requirement on energy network companies. Ofgem has now extended this requirement to apply to code bodies too.

What is needed going forward is a comprehensive set of rules that apply across the sector and that set out where and how data must be shared. This would build on the Data Best Practice Guidance and is part of our proposed Highway Code.

As highlighted in our previous articles, what we see currently is a siloed governance structure and a fragmented set of solutions. RECCo is developing a Consumer Consent Portal solely for smart meter data (at least initially); DESNZ is considering a Distributed Energy Resources register; while Ofgem is consulting on new obligations on DNOs to maintain an asset register and Elexon is developing a Flexibility Markets Asset Register. Our proposal for a Modernization and Digitalisation Unit is intended to address this lack of co-ordination.

And at the detailed level getting visibility on voltage levels from EV chargers has highlighted that this is different to voltage as measured by the smart meter. Definitions need to be agreed – and differences explained. Standards play an important role in our vision for the future.

The energy sector is home to a wealth of information that uniquely arises from within its sectoral boarders. Some of this data is not digitalised at all, sometimes the fidelity and quality of the data at the point of creation is insufficient. Much potential digitalised energy data is currently not understood, nor utilised. While data creation isn't free, it can deliver huge benefits. This key attribute of the system receives too little focus. We need to put the data on our system to use, including data from new sources such as electric vehicles, domestic equipment and industrial metering.

Smart meters are a substantial source of data but a fresh approach is needed to deliver the next and final stages of the rollout. And consumers should not be able to opt out of providing data where it is needed to run the system safely, efficiently and reliably.

Where consent is needed there should a streamlined approach across smart meter data and other energy data, providing control and privacy for customers.

We could be the most data rich energy system, but we need action to make this a reality.

Comment

Rich Hampshire
Vice president,
digital utilities,
CGI

In my comment on the first chapter of this report, I quoted former President Barack Obama when he said, "We can and should argue about the best approach to solve the problem" and shared our objective to establish a consensus on the challenges and create a constructive discourse to find better ways of accelerating progress.

In this response, I'll provide a different perspective to that of the Geeks with the aim of stimulating discourse on the issues they raise.

The publication of the much-anticipated Energy Digitalisation Framework in March 2026 came at a timely point, midway through the writing of this report.

The framework's first line encapsulates the importance of data to a successful energy transition: "Digitalisation is about improving data use to efficiently manage an increasingly complex, and decentralised energy system."

The Geeks position data as the "lifeblood of a digital energy system", and there can be no doubt about the need for the right data at the right time to deliver actionable insights to decision takers. The need to understand what data is required to deliver those insights, whether it exists and, if so, who holds that data and how it can be accessed are challenges being addressed through various sector digitalisation initiatives.

The importance of smart meters to a transitioned energy system, where consumers are empowered by the opportunity to participate in flexibility markets, should not be in doubt. The Geeks' recommendations on how to complete the smart meter rollout will no doubt stimulate a debate.

Having recently had the privilege of facilitating a knowledge sharing event between market facilitators from across Europe, one thing stood out; a successful approach in one market must be considered in the context of that market's policy drivers and architecture if its relevance to another market is to be properly evaluated. For instance, Britain's established competitive metering market meant that the GB smart metering programme started from a very different place to the rest of Europe (and the world!). Equally, we should consider any changes to the delivery approach from the consumer's perspective. Dual fuel installations currently mean that gas smart meters are installed at marginal cost and time, minimising disruption for consumers.

In a report last year, The Flexibility Forum (established through a Utility Week-CGI collaboration) identified the need for system actors to be able to offer consumers compelling propositions that provide meaningful choices about how they meet their energy needs. Many of those propositions build on access to smart meter data. With 71% of homes already having a smart meter that operates in smart mode, the challenge in completing the programme is to ensure that any consumer who doesn't yet benefit from having a smart meter and chooses one of these compelling new energy propositions gets one of the ~18,000 smart meters that are installed every day.

The Geeks also highlight the value to the energy system of access to data generated by the plethora of smart devices and appliances connecting to the energy system. Ensuring system actors can discover and equitably access the data they need is something that should be considered to support system and market operations.

What can't be in doubt is that data is vital to successful delivery of the energy transition at pace and in a way that benefits consumers. How that data is generated, acquired, accessed and analysed requires an on-going constructive, discourse.

Chapter

Risks and missed opportunities: The sleepless nights of an Energy Geek

The next major disruption in the energy system is unlikely to be caused by the failure of a single organisation. It will more likely emerge from the gaps between organisations.

Many sectors manage risk very effectively across their complex supply chains. These sectors have realised that the weakest links lie between participants and that this needs rigorous and contractually shared risk management processes. As the complexity of the energy supply chain continues its rapid growth, we Geeks are not confident that the energy sector's current siloed organisational and governance approach is leading to adoption of the best practice in risk management for a much more digitally interconnected whole-system.

Risk management must also be seen as a key driver of efficiency, reducing cost and accelerating progress. Other sectors use digitalisation as an integral part of their risk management processes. We now need to embed these principles into the energy digitalisation journey. It is not just that we have to mitigate risk, we also have to use digitalisation to drive greater efficiencies, increased resilience and customer benefits through how and what we do. We can learn from other sectors on this.

In the eight years since the Energy Data Taskforce facilitated creation of the sector's ambition for modernisation, the sector has moved at pace. Existing processes and operations have been digitalised, flexibility markets tested and deployed, data opened as a valued market resource and sophisticated

software has begun to be layered over traditional physical infrastructure. As a result, the system is now more information-rich, dynamic and interconnected than at any point in its history. Development is continuing at an ever-faster pace.

This evolved system requires a new approach to risk and opportunity management that enables risk sharing, establishes strong common governance standards and has effective monitoring and scenario planning that can pre-empt vulnerabilities, anticipate impacts and address emerging trends.

Our greater capacity for creating and using information should make the energy system more resilient. But, while we are running ahead fast, adding greater capacity to know things and to act, we have been slow to match this with corresponding modernised governability and resilience.

Startled awake

Risks turned to issues can look like a classic disaster film. The Spanish blackout of 2025 showcased how a tightly coupled system failed on a short timescale - only well governed digital systems could have responded effectively. The winter 2021 Texas blackouts demonstrated how hard it is to integrate information relating to a conflagration of market design, incentives and sustained severe weather conditions that exposed weaknesses in mechanisms for reserves.

The 2019 UK loss of power to 1 million consumers should remain in memory as an example of how complex engineering policy can lead to static compliance requirements that no longer address system risks. It is also a painful reminder of the economic impact and disruption that can result from a loss of supply.

Finally, the 2021 SolarWinds attack evidenced the lengths to which foreign intelligence agencies are willing to go at deploying malicious software into another country's critical IT infrastructure.

The impacts of risk can also be seen in more subtle ways as well. Even if the system does its job, the lights can still go out home-by-home and business-by-business as costs push energy out of more and more peoples' reach.

This situation is rising as historic issues are compounding and adding up, each with underlying causes triggered by a lack of control over information. Take the over-generous Feed-in Tariff subsidies from 2011, which were set using data models that were inadequately stress tested. This could not be reversed so the government ended up being taken to court and losing, costing consumers c£100 million a year for 20 years.

Then there is the balancing mechanism, which has exacerbated exposure to international commodity markets due to automated 'skip rate' issues, again costing hundreds of millions pounds.

Leading up to a costly wave of supplier failures from 2022, Ofgem found its ability to govern the market overridden by information complexity.

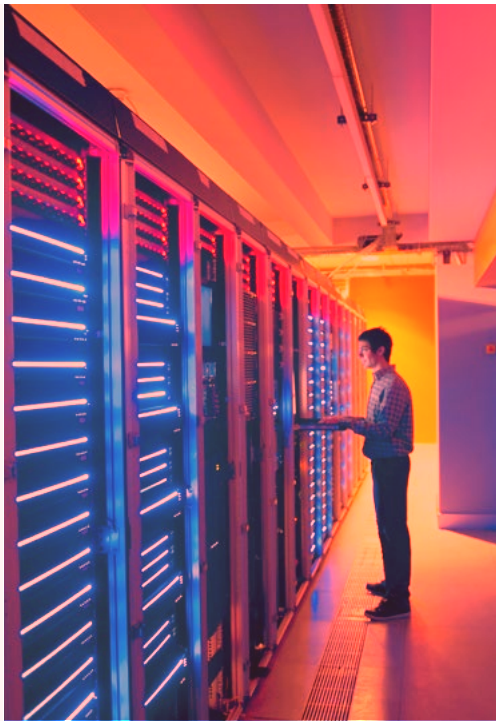
We can also observe indications that Regulated Asset Base costs have been inefficient where in 2017 a network voluntarily returned £480m of allowances it was entitled to keep; performance and regulated returns hint at ongoing challenges relating to information asymmetry.

And finally, the cost of delay to system changes, such as Market-Wide Half-Hourly Settlement, adds to the pressure people's pockets.

Individually, and certainly together, these costs add up to uncomfortably large, and for many people, unaffordable numbers. It is in no way an exhaustive list.

Fever dreams

The energy system's information risks have grown and evolved. Some are new and some are old, some are likely, some are not, some will crash the system, others will chip away at it. Further, we need to diligently capture the value digitalisation offers – we cannot afford to miss the opportunities provided by digitalisation – effective risk management is needed to overcome risks and to support the opportunities that lie ahead. The variety of modern information risks and opportunities are legion, here are a few:



Data & technology:

Monopolies: data and tech companies can be large and act as significant drivers of economic growth. However, we also need to manage monopolies, value capture and predatory business models.

Embedded spyware: We need to be hyper vigilant of malign software being installed into critical systems by adversarial actors who seek to monitor and discover further system vulnerabilities and exposures.

Destabilising new technology: Encouraging new innovations and technologies to help with the modernisation of the system will drive down its costs. However, rapid adoption of novel technology introduces the possibility of unintended and unexpected consequences that impact safe system operability.

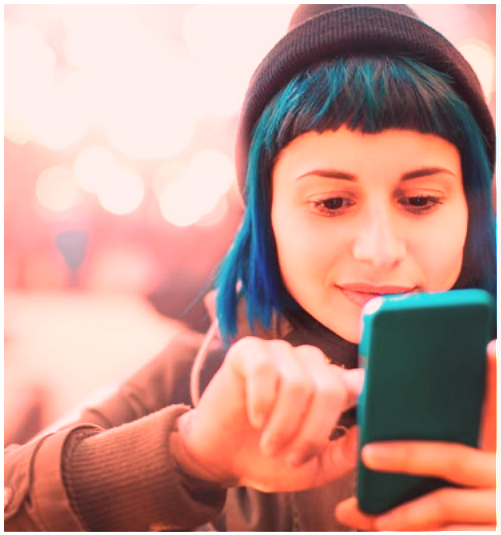
International competition: We can drive down the cost of clean power and so attract investment by the world's most responsible companies, but if we are slow to change, other countries will gain the right to clean growth in our place.

Algorithmic cascades: Our system requires a whole raft of new technologies and AI tools to manage its distributed structure. We should encourage this but it cannot be a free for all where millions of software-enabled devices make concurrent decisions that impact the system, but without coordination.

Consumer digitalisation:

Digital identity: We need customers to willingly share their data to optimise the system for their benefit and hence bring down the cost of energy for all. But, we must also manage the risk to individuals and whole organisations of exploitation or wilful system miss-management that can cause costs of various types.

Personal data: Use of personal data will make available tailored services to key customer segments providing much better outcomes, but we need to be very careful that well-intended mismanagement can never expose vulnerable people, such as by revealing someone's whereabouts to domestic abusers via time-of-use billing.



Policy development:

Planning processes: Information from data is needed to add vital nuance and specificity to critical planning designs. However, as planning becomes more sophisticated, it risks becoming opaque to local stakeholders, eroding support and losing trust. Good use of data can manage this.

Regulatory and legislative development: Policy development should be benefiting from deeply informative data feedback loops that ensure each policy is behaving as intended on the ground. In parallel, unless data is used effectively to bring clarity to our growing system complexity, policy-making risks becoming hesitant and naive just at a time when the market needs policymaking to perform confidently and fast.

Grid and system operation

Grid access: Clever use of data will allow us to predict a lot better where assets will be installed, but poor forecasting of EV, data centre or housing uptakes will trigger grid connection constraints, costing local jobs and services.

Grid controls: We will need much more granular controls to enable large-scale use of distributed assets at local levels to help balance the system, but partially informed balancing software could systemically optimise for one region at the expense of, say, brownouts in others as a new postcode lottery.

Complex grid transients: Digitalisation can open the door to moving away from traditional inertial generation to provide system stability using software-enabled methods, but this is novel technology that must be adopted with care or else we may lose our grip on the system.

None of these risks originate from a single negligent organisation. They lurk among the interfaces where responsibilities overlap or underlap, where systems and services integrate, where practitioners must take time-pressured actions, with or without sight of the wider system implications. The consequences of these risks are wide-ranging.

Untreated parasomnia

Interconnected data and digitalisation dissolve boundaries. Removing boundaries creates the opportunity to solve problems more easily, to learn, adapt and change. This is a key part of enabling the energy transition to succeed. But removing boundaries also creates greater opportunity for complicated mistakes to be made and for malign intent to pass by unnoticed. Safety and resilience require control and not capacity alone.

Increasingly, market platforms interact with network constraints in real-time; distributed assets are responding to signals generated far beyond their physical location. Remote software updates can alter operational behaviour. Tranches of data tables are populated, exchanged across the system and then trusted to shape dispatch, balancing and investment decisions.

The energy system is no longer the traditional collection of modular functions – production, transportation and retail – it is a tightly coupled machine with interwoven and integrated functions criss-crossing down a growing supply chain. Yet, we still govern the system as if it were a series of simple linearly connected modules.

Risk management is an opportunity

Risk management in the energy sector remains largely organisation-centric rather than system-wide. Compliance frameworks are designed to be inward-facing and do not recognise that risk management is one of the key drivers of efficiency, resilience and that it delivers customer benefits. While each actor diligently discharges its own responsibilities, there remains a critical need for system-wide visibility, control and accountability of vulnerabilities as they propagate across organisations and through the gaps between organisations. A system-wide approach is needed.

Traditional energy risks were more localised and organisations were designed to contain them. A plant failed, a storm hit, a substation reached capacity, spinning reserve proved insufficient. Our traditional system risks were visible, bounded and attributable.

Today's risks are different; they've evolved. They are systemic, nuanced and straddle old boundaries. Fortunately, today's opportunities have evolved too. Our path to drive down energy costs and to accelerate adoption of clean technology requires us to take an integrated system-of-systems approach to risk management.

Following routine will help us benefit from a good night's sleep

The energy system only works when the whole energy system works. Our new system design is to have millions of assets held in millions of peoples' hands. These all need to be safe, trusted and coordinated not just in aggregate, but at each location and at all times – otherwise the system is critically failing someone, somewhere.

Risk does not respect organisational boundaries and so needs integrated oversight; our risk management needs to adapt to keep pace with the realities of evolved risk – while not crushing the opportunities. Modern digital-physical infrastructure requires our market design to include a mechanism explicitly responsible for whole-system governability. Not just strategy. Not just policy positions and visions. We need a process for operational oversight of cross-boundary risk. Our mitigations will need architecture coherence and systemic observability, planning and programme management.

This is one of the key roles for which we Energy Geeks are advocating creation of a Modernisation and Digitalisation Unit (MDU). While its main purpose is to unlock the potential opportunities deeper digitalisation of the energy system offers, one of its key capabilities is to facilitate establishing new risk processes for whole-system observability, monitoring and management.

The MDU will need to use its time to help the sector to set into place integrations across assets, markets, data and physical and digital infrastructure. The resulting 'security architecture' will need to complement the system's overall architecture, all this is essential to achieving whole-system resilience. The MDU should help the sector establish:

- Clear ownership and accountability for systemic risk signals managed through a central whole-system risk register and sectoral oversight capability.
- Observability and monitoring of the whole integrated system-of-systems, including data about the assets, flows, and operational states across networks, markets, and supporting systems. This will Inform the sector about vulnerabilities, threats, and patterns for handling these.
- Threat modelling and adaptive planning informed by 'digital twins', sandboxes and scenario modelling that directly inform energy system design via continuous feedback loops.
- Security operations to provide live monitoring, active scanning and alerts and an integration of security operations not only across organisations, but in situ within the environments of the people and assets working all day, every day.
- A whole system security strategy, to set direction and hold all other aspects of risk management together so that they work in concert.

We can keep lying awake, hoping the noises in the dark are nothing. Or, we can turn the lights on and regain control. Every day we wait costs time and money that people cannot spare.

Comment

Rich Hampshire
Vice president,
digital utilities,
CGI

In this chapter, the Energy Geeks turn their collective intellect and experience to the challenge of managing risks in an energy system where system boundaries are expanded and system dynamics, both physical and commercial, are fundamentally different.

The article addresses a risk landscape that is being transformed by the energy transition. And that, in an increasingly interconnected and distributed system, risks emerge at the interfaces between system actors and in their extended supply chains. Whilst a more distributed system architecture can provide greater resilience, risks need to be managed effectively to ensure they can't compound and cascade across the system.

The Geeks balance these concerns with opportunities that outweigh the risks when effectively managed. They make the point that effective risk management drives efficiency and reduces costs. Implicitly, the reduction in costs will flow through to consumers' bills in a well-functioning market. Effective risk management should also give consumers confidence and increase trust in the energy transition, essential if progress towards a clean energy system is to accelerate.

The energy system can learn from and leverage best practices from other sectors. One key message is that, whilst digitalisation introduces new risks to the system, it also provides the visibility across the system that is essential to effective management of risk.

The 'Paving the way to net zero report',a previous collaboration between CGI and Utility Week, to which some of the Geeks contributed, highlighted that the energy sector has an excellent track record and culture for managing risks associated with physical assets. But the report also found that culture change and new attitudes to risk are required for a transitioned, digitalised energy system. This is a theme highlighted by the Geeks in this article. They call for a new approach to risk and opportunity management by establishing strong, common governance that enables risks to be shared (and, implicitly, therefore managed by those system actors best able to do so). Certainly, regulation has its role to play in providing the right incentives to encourage and reward that cultural shift in attitudes to risk management.

> **"Effective risk management drives efficiency and reduces costs. Implicitly, the reduction in costs will flow through to consumers' bills in a well-functioning market."**

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Chapter

Four

Value for Actors

It sometimes feels that the energy sector is rather blind to its customers. Culturally we need to change to understand that our role is to "serve" customers and not expect customers to design their lives or businesses around the energy sector.

This is why the digitalisation transition offers us a unique opportunity to build a design for the whole system that reflects the needs of the energy sector's customers. These customers are not just domestic or industrial but all "customers" throughout the sector from developers, aggregators, device installers and energy service companies.

Key to delivering a customer centric digitalisation pathway is to segment customers, reflecting deep understanding of their capabilities and constraints and greater insight into their behaviours, and then design digital capabilities around their journey that offer the least friction and greatest control.

This approach of putting your customers first is not just the right thing to do but is essential for the management of a highly complex system with the potential to have 100 million actions and assets. If it is not designed reflecting the customer's journey then there will be limited flexibility available, misuse of assets will create significant faults on the system, and misaligned business models will further exacerbate the resilience and management of the grid.

The economic value of digitalisation

The value of digitalisation is not abstract. It can be expressed in financial terms.

In 2024, electricity network flexibility services delivered over £300 million in savings to British billpayers, with projections of more than £3 billion in cumulative savings over the following three years as markets scale and participation grows (ENA, 2025).

Looking further ahead, the government's Smart Systems and Flexibility Plan projects that flexibility could save consumers £10 billion per year in energy costs by 2050.

The cost of inaction is equally clear. In 2025, the UK incurred approximately £1.46 billion in combined curtailment and replacement generation costs: around £363 million in direct payments to turn down wind farms and over £1 billion spent on replacement gas-fired power (Montel, Modo Energy). Without greater flexibility and grid investment, these costs are projected to reach £4–8 billion annually by 2030.

Digitalisation also shifts consumers from passive billpayers to active market participants. Over 2.6 million households and businesses participated in the Demand Flexibility Service in winter 2023/24, demonstrating real appetite for earning rewards by shifting electricity use at peak times.

Flexibility, underpinned by digitalisation, is not only operationally important but represents a multi-billion-pound economic lever across the UK energy transition. It is an important example of where digitalisation reveals value, but it is far from the only one.

So, reflecting our key principles on customer centric digital design the overarching design should deliver the following:

One system, lots of actors: Every actor needs to play their part, but just as importantly, the system needs to "serve" them too.

Drive cultural transformation: With millions of assets and actions, a fundamentally different approach to system design, operation and usage is required, demanding significant culture shift.

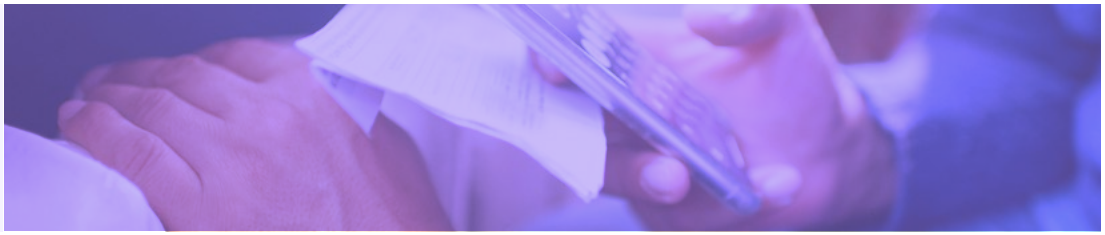
Deliver simplicity: We need to avoid over-engineering the digital component of the energy system. We should adopt well-proven approaches where these help to reach our goals – reuse by default, deviate only by evidenced exception.

Not cannibalise current business models: It is crucial that we don't cannibalise current business models that rely on existing or new data flows; business models should be enabled with the minimal amount of data flowing through the system.

Tailoring to different customers segments: Given the multitude of customers, new business models, and new large and small assets on the system, customer segmentation is key.

Prioritise coordination over control: Command and control is no longer the approach that will succeed to ensure a resilient system across the many actors with different priorities and financial incentives influencing their interests and decisions.

Technology as a consequence, not as a driver: There has been an excessive focus on technology rather than customer journeys with multiple portals and tools in development. Start with the customers requirements and then design around their journey.



Digitalisation offers the opportunity to provide a customer centric system design, segmented to deliver the right solution to the specific audience, simplify the currently byzantine participation approaches, and devolve actions to the most appropriate level of action and control.

The digitalisation journey for customers – a dream outcome!

Domestic Customers buying an EV or heat Pump or Solar PV: According to the Highway Code there would be only one digital entry point through a QR code on the product that would automatically link your asset to the relevant parties . The data, capabilities and functionality of the asset would be relayed to the DNO for visibility and registration and Elexon for flexibility possibilities. Data would also flow to the wider system in an aggregated format. Customer consent would be activated offering the customer control over what their preferences might be – streamlining the current approaches. This consolidation of the process would very much link to the concept of energy "agents" that are emerging.

Industrial and Commercial Customers: I&C customers who have multiple assets would be able to register these in an aggregated format, also stimulating the DSO or NESO to provide them with offers for energy services that they could provide, tailored to the customers capability and with clear rewards articulated.

Energy Suppliers, Energy Device Manufacturers and Energy Service Companies: As the link between customer and the system, their ability to have greater visibility of the needs of the system will enable them to offer enhanced system benefits building greater value for their customers.

Energy Asset Developers: Developers should have the benefit of much clearer connection times and communication of specification, and be offered direct access to multiple market options for their assets – all seamlessly delivered.

TO, DNO, DSO, NESO: Automatic communications between the key network and system players would provide a much more resilient system, with aggregated data flowing between the parties informing risk dashboards.

System Resilience and Security: the flow of data either mandated, which should be minimal, or through commercial arrangements will provide the whole system with much greater visibility of events that could risk energy security.

Carbon Reduction: It is in all our interests that we have visibility of the carbon flows across our energy system. Effective data flow of carbon intensity data will support both domestic customers but also commercial and industrial organisations where reporting is required.

Too Much Data: Value Eroded

It is important that mandated data flows are as limited as possible. The sector has a tendency to want all data and this is not necessary or desirable for many reasons:

Cost of holding and managing data: Data lakes are not the way forward. There are much simpler methods to convey the relevant information – not always the raw data.

Privacy: Customers are wary of centralised data pools and customer trust is key for the system to get the social license to collect the data that is really required.

Commercial business models being destroyed: the private sector is going to be the front line of delivering new business services and their business models need to be able to thrive without all the value of the data being consumed by the system. This is why we propose a Commercial Challenge Group as crucial to the design of the digital programmes ensuring that we are not destroying the value to their customers.

Effective risk management: Effective risk management is not about having all the data, it is about being very specific of what risks you are aiming to manage and designing the system around the least amount of data required for managing the risks.

These data and digital approaches are not new and exist across many other sectors. We would urge the sector to learn from other business sectors, adopt the minimal approach with simplicity at its heart to release the energy and ingenuity of the private sector to build customer facing propositions that ensure that value flows effectively to customers.

Comment

Rich Hampshire
Vice president,
digital utilities,
CGI

The Value for Actors chapter implicitly draws a distinction between consumers and customers; customers include the broader ecosystem of energy system stakeholders; developers being customers of the network operators' connections processes as much as consumers are customers of the energy retailers.

The Geeks go on to make the economic case for digitalisation. Analysis by the ENA showed that electricity network flexibility services saved around £10 per home in 2024. If the £1.46 billion in curtailment and replacement generation costs incurred during 2025 (expected to rise to £4bn-£8 billion pa by 2030) can be reduced through consumer-led flexibility, then there's big benefits for consumers' bills. But this will require demand-side flexibility to be able to compete fairly with traditional sources of system flexibility, something that the Utility Week and CGI Flexibility Forum called for in their May 2025 meeting.

It is however important that the value of flexibility and value of digitalisation aren't understood to be synonymous. Digitalisation plays a vital role in making flexibility economically accessible to the system. But, flexibility isn't the only value that digitalisation delivers, nor is the value of flexibility dependent on digitalisation.

The value of the actionable insights from digitalisation spans the system; from informing long-term planning and investment, to optimising operations and maintenance, to providing the visibility that enables effective coordination between the ever-growing number of system actors.

The shift to a smarter energy system that embraces consumer-led flexibility empowers consumers to become active price makers, rather than passive price takers by making their flexible demand available to the system.

Ultimately, digitalisation must abstract all the complexity that exists in keeping both the physical system reliable and the markets functioning well from consumers and simplifying access to the benefits of the energy transition.

The Geeks' position technology as an enabler to deliver customers' expectations. The question then becomes, what insights are needed to deliver the customers' journeys smoothly? Knowing what data is required informs the Geeks' points about not over-engineering (or under-engineering) the system and the associated implications for ongoing costs for storing, managing, and using the data.

> **"Analysis by the ENA showed that electricity network flexibility services saved around £10 per home in 2024."**

The **'Paving the way to net zero report'**, a previous collaboration between CGI and Utility Week, supports the Geeks' view that a significant culture change is needed in a system where millions of active assets create a complex web of interacting automated processes that run simultaneously, and where data is exchanged between myriad actors. The role regulation plays in providing the right incentives to encourage that cultural shift should not be underestimated.

The Geeks leave us with a sense that there are challenges to overcome, but the size of the prize is big enough to justify the effort. The lodestar is simplicity for the customer.

Chapter

Five

Delivering digitalisation

The energy system is undergoing profound transformation driven by decarbonisation as expressed in the ambition of Clean Power 2030 and the statutory commitment to net zero in 2050. Electrification, deployment of digital technologies and emergence of new market entrants will all play key roles.

Failure to acknowledge and respond effectively to the complex challenges of delivery will mean Clean Power and net zero will not be achievable at acceptable cost and with acceptable risk. Such a failure would be directly reflected in higher energy prices to consumers and compromised resilience of energy supply with serious economic and societal consequences.

Effort and debate on transformation have largely concentrated on what must be achieved: net zero emissions, security of supply, affordability, resilience, and consumer empowerment. These objectives are well established within the energy community but now the more pressing question is how to achieve them in practice.

Delivery will be the decisive factor. Delivery is the discipline that converts statutory targets, regulatory reform and technical promise into operating networks, functioning markets, investable propositions, and reliable services for households and industry. In the energy sector, where asset lifecycles span decades and system stability is paramount, weak delivery capability does not simply result in inefficiency, it creates systemic risk.

Digitalisation will be fundamental in how the energy system is designed, operated, regulated, and evolved and is therefore central to delivering good outcomes.

Digitalisation is often described in technological terms: smart meters, advanced operational management systems, real-time data platforms, artificial intelligence, automated flexibility markets, and enhanced cybersecurity. Yet the central challenge is not the procurement of these digital tools; it is ensuring that digital capability is embedded within the energy system's physical, commercial, and regulatory architecture, rather than layered onto it as an afterthought.

Significant effort has been devoted to digitalisation and progress has been made. However, coordination has frequently lagged ambition. Initiatives have emerged within silos. The result has been fragmentation, duplication, limited integration and uncertainty for investors.

To move from aspiration to execution, the Energy Geeks have identified five delivery imperatives that must be addressed explicitly: architectural coherence, deliberate integration, institutional stewardship, disciplined commercial boundaries, and structured learning.

Digital architecture as core system design

The energy system is increasingly a cyber-physical system: electrons and data move together. Distributed generation, electric vehicles, heat pumps, storage assets, and demand-side response all rely on real-time information exchange. Price signals, constraint management, forecasting, and settlement processes depend on digital infrastructure. In this context, digital architecture is not a support function; it is a core element of system design.

A coherent digital architecture must define:

- Common data standards across transmission, distribution, suppliers, aggregators, and system operators
- Interoperable protocols for real-time telemetry and control signals
- Clear interfaces between operational technology and information technology environments
- Cybersecurity baselines embedded at the design stage
- Governance arrangements for data access, privacy, and stewardship.

If digitalisation is retrofitted, fragmentation will persist. Each network operator or market body may deploy bespoke solutions, creating a patchwork of incompatible platforms. This risks significant future migration, increases integration costs, and undermines system visibility.

Embedding digitalisation means designing physical infrastructure with digital capability in mind. New substations for example, should be specified with digital monitoring and control interfaces from inception. Flexibility markets should be architected with standardised APIs that enable participation by diverse aggregators. Settlement systems should anticipate granular, near-real-time transactions rather than relying solely on today's processes.

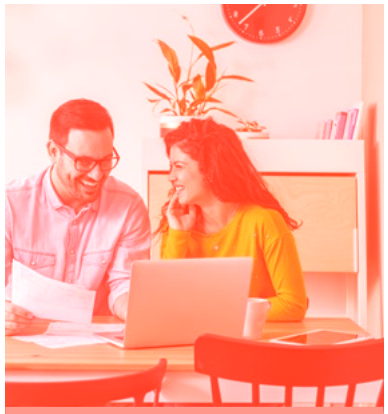
Crucially, architecture must support evolution. As electrification accelerates and distributed energy resources proliferate, the volume, velocity and value of data will expand significantly. Scalable, modular design enables adaptation without repeated system overhauls. This reduces cost and preserves security of supply.

There is also a need to acknowledge and accommodate the fact there has been digitalisation – use of data, computing, communications – in the energy sector for decades. Architecture must support the use, enhancement or retirement of legacy systems. Digital architecture, properly conceived, is the backbone of a modern energy system, not an overlay.

Integration: Aligning digital, physical, and market systems

Even the most elegant architecture fails without integration. Digitalisation must align with physical network constraints, operational practice, and market incentives. The challenge is not merely technical interoperability but systemic coherence.

Three dimensions of integration are particularly critical:

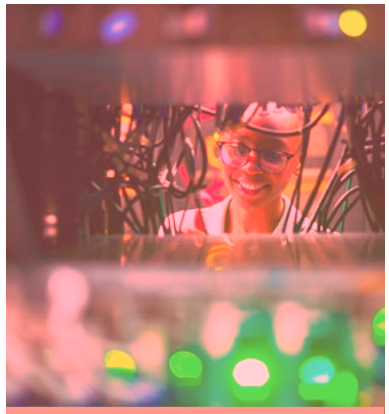


Customer journey integration

Consumers and prosumers increasingly interact with the system through digital interfaces such as smart charging applications or aggregator platforms. These services must connect reliably to system data and market signals without exposing users to undue complexity or cybersecurity risk. Digitalisation should simplify participation, not create technical barriers.

Physical-digital integration

Network operators require granular visibility of distributed assets to manage voltage, congestion, and balancing. Digital telemetry must therefore be accurate, timely, and secure. Control systems must interact reliably with physical infrastructure. Embedding digital capability means ensuring that network planning, asset management, and control room operations are designed around data-driven processes.



Market-digital integration

Price signals must reflect network realities. If flexibility markets are digitalised but disconnected from operational constraints, they may create perverse incentives or inefficiencies. Digital platforms for trading flexibility must interface seamlessly with system operator dispatch processes and settlement systems. Data latency, verification protocols, and metering standards must align with market design.

Experience suggests that integration is often reactive. Digital solutions are deployed within organisational silos, with integration challenges addressed later through costly workarounds. Embedding digitalisation requires integration to be engineered from the outset. End-to-end system mapping covering data flows, control hierarchies, commercial incentives, and user journeys must precede implementation.

Integration is the discipline that ensures digital capability translates into system-wide efficiency, resilience, and affordability.

Institutional stewardship

Embedding digitalisation requires institutional clarity. Fragmented governance structures where digital initiatives are dispersed across system operators, transmission operators, distribution operators, regulators, and government departments, risk inconsistency and duplication.

There are various possible ways stewardship of the energy system's digital evolution could be structured. Before establishing its form, it is necessary to be clear what functions need to be performed, what decisions have to be made, where agency resides; with these well understood, it is possible to progress to implementation. In any case, the mandate should seek to ensure coherence, accountability, and strategic alignment.

Key responsibilities of stewardship could include:

- Maintaining the reference digital architecture and interoperability standards
- Endorsing major digital infrastructure investments to prevent divergence from agreed design principles
- Overseeing integration across programmes, including market reforms and network upgrades
- Establishing risk, cybersecurity and resilience frameworks embedded across the system
- Publishing transparent progress metrics and performance indicators.

Authority is essential. If compliance with architectural standards is optional, fragmentation will re-emerge. However, the role and remit of stewardship must be clearly bounded in function and time. It should not displace operational expertise within network companies or override the regulator's economic oversight. Rather, it should support the need for delivering integrated systems that work.

By embedding digital governance within formal institutional structures, the sector signals that digitalisation is not experimental or peripheral. It becomes part of the system's core.

Commercial boundaries: Digital platforms and competitive innovation

Digitalisation inevitably raises questions about the boundary between shared infrastructure and competitive services. Some digital capabilities such as secure data exchange platforms or identity verification mechanisms may exhibit characteristics of natural monopoly or require universal interoperability. These justify coordinated, potentially regulated, provision.

Other digital services such as consumer engagement tools or aggregation platforms, are more appropriately delivered through competitive markets.

Embedding digitalisation within the system requires clarity on this boundary. The public or regulated sector should define and maintain the minimum viable digital infrastructure necessary for system security, interoperability, and fairness. This includes for example:

- **Standardised data models**
- **Secure communications protocols**
- **Core settlement and balancing platforms**
- **Cybersecurity frameworks.**

Beyond this foundation, private sector actors should be free to innovate. Overextension of centralised digital provision risks crowding out competition and slowing technological progress. Conversely, insufficient coordination of foundational infrastructure leads to fragmentation.

A structured commercial challenge process should test whether proposed digital interventions address genuine coordination failures. It should be constructed to encourage and enable business models that drive customer value or help ensure overall system efficiency and resilience. This disciplined approach ensures digitalisation strengthens, rather than distorts, market dynamics.

Learning and adaptation in a digital energy system

Digital systems evolve rapidly: cyber threats change, technologies mature, and user expectations shift. Embedding digitalisation therefore requires a culture of structured learning and adaptive governance.

Learning mechanisms should include:

- **Post-implementation reviews of major digital programmes**
- **Cyber resilience exercises and transparent reporting of incidents**
- **Engagement in the role and adoption of AI (in all its forms) with focus on associated risks**
- **Evaluation of market outcomes linked to digital reforms**
- **Open publication of technical standards and revision histories**
- **Explicit capture and sharing of information and learnings across the sector.**

Importantly, data generated through digital systems should inform policy refinement. For example, granular consumption and flexibility data can reveal behavioural responses to price signals, enabling more precise regulatory adjustments.

A non-punitive learning culture is essential. Complex digital transformations will encounter setbacks. Suppressing lessons for reputational reasons undermines systemic improvement. Clear differentiation between accountable failure and adaptive experimentation supports continuous improvement.

Over time, institutional learning reduces implementation risk and builds sector-wide capability. Digital maturity becomes cumulative rather than episodic.

Going forward: Digitalisation as systemic transformation

Digitalisation of the energy system is not a technology procurement exercise. It is a structural transformation of how energy is produced, transported, traded, and consumed. Treating digital capability as an add-on superimposed on existing processes will increase complexity and cost without unlocking flexibility, resilience, and consumer value.

The risks arising from failing to address the digitalisation opportunity at the right time are substantial. There will never be a perfect set of requirements for digital capabilities, nor a perfect plan for delivering solutions. This could lead to reluctance to act, and a desire to have clarity before engaging deeply. However, waiting for certainty will mean that it will be too late to act effectively.

In broad terms, there are two courses of action available:

- Act tactically: Accept the risks and rely on the sector's own direction of travel aligning with needs as they emerge, or where necessary, deliver specific measures to address anticipated requirements, and then mitigate arising impacts on carbon, cost, pace, resilience, security and consumer experience.

- Act strategically: Proactively evaluate the need in a strategic and systematic way, engaging with the right stakeholders to align interests and coordinate efforts; this will mean dependencies are identified and managed, and a coherent path forward can be prepared.

Acting tactically is unlikely to embed effective and efficient digitalisation in the energy system. Acting strategically will. Delivering on the promise requires good execution and:

- Coherent digital architecture integrated into physical system design
- Deliberate integration across networks, markets, and users
- Institutional stewardship through clearly mandated architecture and delivery functions
- Disciplined commercial boundaries that preserve innovation
- Structured learning and culture change to support adaptation in a dynamic environment.

The Energy Digitalisation Framework commits government, Ofgem the NESO and other key parties to the strategic path forward. However, it requires substantial and sustained effort to translate the promise of this commitment into reality in the sector at a pace which is supportive of Clean Power 2030 commitments. The details of the framework and its implementation will develop, but explicit inclusion of integration, approaches to learning and being clear on the distinction between shared infrastructure and competitive services will be important for its success.

The energy transition demands a system that is simultaneously decarbonised, reliable, and affordable. The Energy Digitalisation Framework acknowledges that digital capability is central to achieving these outcomes but only if it is intrinsic to the system's design and governance. It focuses on shifting from digital initiatives to digital system design. By concentrating on the "how" of embedding digitalisation, policymakers can ensure that technological advancement translates into enduring system value rather than incremental complexity. This is what it means to act strategically, not tactically; this is what the framework promises, but it must be pursued with vigour and pace if it is to be successful in achieving its promise.

Comment

Rich Hampshire
Vice president,
digital utilities,
CGI

Having taken deep dives into governance, data, and risks & opportunities, in their final chapter the Geeks turn their attention to making it happen. The imperative to achieve clean power by 2030, in NESO's 2024 advice to government, requires "several elements to deliver at the limit of what is feasible."

In a system where investment in assets covers decades, yet system stability is maintained in a sub-second timeframe, successful delivery is a truly whole-system challenge.

Access to data is fundamental for the actionable insights required. That means that the energy system must be digital by design - which presents commercial, governance and cultural challenges as well as the technical challenge!

The Geeks identify five delivery imperatives - architectural coherence, deliberate integration, institutional stewardship, commercial boundaries and structured learning. Elements of these themes can be seen in the evolution from the energy data and digitalisation taskforces' recommendations to the recent Energy Digitalisation Framework.

It is vital that the architectural design supports interoperability and enables the continual integration of new technologies as they emerge, without the need for costly system overhauls. Playing to the Geeks' proposed Highway Code for energy, 2030 is not the destination, it is a mile marker on the journey to 2050 and beyond.

The Geeks call for digital governance to be embedded within formal institutional structures to ensure it becomes an intrinsic part of the system. Digitalisation must be considered as a deeper, more fundamental systemic transformation that is not simply physical, but also behavioural and cultural.

The Geeks challenge us to consider where the boundary should lie between digital infrastructure that is delivered as a public good and well-functioning markets, where participants are able to bring forward innovative new services that provide consumers with meaningful choices about how they satisfy their energy needs.

The Geeks' final insight is the importance of embedding a culture of non-punitive learning to reduce the risks associated with delivering Britain's clean power transition at pace. It's a non-trivial challenge to create a culture where we're all able to collaborate and openly share learning as a springboard to continually improve, but the sector has had a head start in developing this type of culture through the various iterations of network innovation funding over the last 16 years.

"It's a non-trivial challenge to create a culture where we're all able to collaborate and openly share learning as a springboard to continually improve, but the sector has had a head start in developing this type of culture through the various iterations of network innovation funding over the last 16 years."

The Energy Digitalisation Framework and Sector Digitalisation Plan provide elements of the route-map to delivering a clean, digitalised energy system. The Geeks challenge us to translate this into operational ownership, disciplined design choices and delivery momentum. We can't afford to wait for certainty. It's time to get going with an initial architecture, learn from practical experience and iterate with transparency.

Conclusion

Energy Geeks

The energy transition is not short of ambition, effort or investment. Billions are flowing into steel, copper and silicon. Hardware is being deployed at remarkable pace. But we are building the most complex machine in British history without writing the operating manual.

This report has set out what is missing and what must be done about it. The problem is fragmentation, not inaction. A Tower of Babel has emerged across the sector's digital programmes, with brilliant individual work undermined by the absence of a coherent whole-system design. We are handing the keys to millions of drivers without painting white lines on the road or agreeing what a red light means. The result is not a free market. It is a pile-up waiting to happen.

The prescription is governance before technology. We have argued for a Modernisation and Digitalisation Unit to architect and oversee delivery of a coherent digital energy system: one body, four functions, three years, then dissolved. Not permanent bureaucracy, but a focused team with the intensity and urgency usually associated with startups. This unit must be able to move rapidly and freely, unburdened by the institutional constraints facing existing bodies. NESO has been tasked with producing the architectural reference framework by August 2026, but it is simultaneously absorbing nationalisation, delivering Clean Power 2030 and strategic spatial planning, and taking on new regional energy system responsibilities, alongside its system operation responsibilities.

That is an enormous amount to ask of any organisation, let alone one whose heritage as a transmission system operator naturally inclines it towards centralised, top-down thinking. The MDU must be independent precisely because the architecture it defines needs to serve the whole system, from transmission to grid edge, without institutional bias. The NESO architecture must be ambitious in its vision, technically robust, and above all useful, usable and used.

We have set out a Digital Energy Highway Code as the technical blueprint for the rules of participation: who gets access, what data must be shared, and how physics always trumps economics. These rules follow a simple principle: reuse by default, deviate only by evidenced exception. The international precedents exist. The technical solutions exist. What has been missing is the authority to mandate their adoption.

Data is the lifeblood of this system, yet we are flying blind. Smart metering needs a fundamental rethink, not another iteration of the same failed approach. At the grid edge, a new generation of competitive providers is already generating rich operational data from EV chargers, heat pumps and storage systems. This data has enormous value for system visibility and flexibility, but only if clear rules enable it to flow.

> **One body, four functions, three years, then dissolved.**

Conclusion

The Highway Code framework we propose would do exactly that: establish common standards and access principles while **allowing a flourishing competitive market** to develop the services and insights that the system needs. And risks do not respect organisational boundaries. They lurk among the interfaces where responsibilities overlap or underlap, and our governance must catch up with that reality before the next disruption arrives through the gaps.

We were encouraged by the Ofgem Open Letter on Digitalisation Coordination, which recognised the scale of this challenge. We have also been encouraged by the Energy Digitalisation Framework, which acknowledges the need for intentional coordination. Its proposed Digitalisation Delivery Group and Coordination Function have promise, but must move with far greater pace than currently envisaged if they are to have meaningful impact in a timescale that supports Clean Power 2030 and the path beyond to net zero.

Our North Star throughout this work has been a simple proposition: the customer does nothing, meanwhile the system works for them. Everything in this report serves that end. We can keep lying awake, hoping the noises in the dark are nothing. Or we can turn the lights on and regain control.

> **Reuse by default, deviate only by evidenced exception.**

CGI

Britain's journey to a smart, clean power system is neither a straightforward technical challenge nor one where digitalisation can be treated as a simple retrofit to the existing system.

The energy transition is a truly whole system challenge that requires collaboration between all system actors, including policymakers and regulators to create the environment that attracts the necessary increases in investment and incentivises the cultural shifts necessary to make this happen at pace. But the transition extends the system boundaries and, increasingly, supply chain partners have a key role to play.

A clean power system is built around millions of active devices in the consumers' homes and businesses. That fundamentally changes the dynamics of the system. The system's need for consumer-led flexibility shifts the balance of market power towards the consumer. As the Geeks identify, this places the customer at the heart of the system. If consumers are to continue to benefit from the levels of reliability they expect, that requires visibility across the system – and that means timely access to data – which is where digitalisation comes in. But the smart, clean energy system is not merely a cleverer version of yesterday's passive wires and pipes. It needs a new user manual (or, as the Geeks have termed it, a "Digital Energy Highway Code") to help system actors navigate these energy highways and know what they can expect of each other.

Conclusion

The first line of DESNZ's and Ofgem's Energy Digitalisation Framework encapsulates the importance of data to the success of the energy transition: "Digitalisation is about improving data use to efficiently manage an increasingly complex and decentralised energy system." Or, as the Geeks put it, data as the "lifeblood of a digital energy system". Ensuring system actors can discover and equitably access the data they need, when they need it, is essential to deliver actionable insights for decision makers: for planning, for operations, for maintenance, for market coordination and for consumer propositions that people might actually choose.

Whilst the Geeks may be having "sleepless nights" about managing risks in an energy system where system boundaries are expanded and system dynamics, both physical and commercial, are fundamentally different, they are also eyeing the scale of the opportunities. They make the point that effective risk management drives efficiency and reduces costs that, in a well-functioning market, will flow through to consumers' bills. Effective risk management should also provide the foundation for securing consumers' trust in the energy transition.

> **"Digitalisation is about improving data use to efficiently manage an increasingly complex and decentralised energy system.**

> **"Digitalisation plays a vital role in making flexibility economically accessible to the system.**

The economic case for digitalisation is compelling. However, it is important that the value of digitalisation isn't conflated with the value of flexibility. Digitalisation plays a vital role in making flexibility economically accessible to the system. But, flexibility isn't the only value that digitalisation delivers, nor is the value of flexibility wholly dependent on digitalisation. The value of the actionable insights from digitalisation spans the system.

Ultimately, digitalisation's value isn't just monetary. Automation will abstract all the complexity of a distributed energy system from consumers and simplify access to the benefits of the energy transition.

To deliver clean power by 2030 economically, the energy system must be digital by design – and that's not just a technical challenge, it also presents commercial, governance and cultural challenges. The Geeks identify five delivery imperatives – architectural coherence, deliberate integration, institutional stewardship, commercial boundaries and embedding a culture of non-punitive learning where we're all able to collaborate and openly share experience as a springboard to continually improve.

But 2030 is just a mile marker on the journey to 2050 and beyond. The successful transition will belong to those who can set a direction, share data, govern risk, design for consumers and learn fast enough to keep the lights on and bills affordable.

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