Issue 02

ARUP

AI for Future Cities

Energy

Arup
May 2025

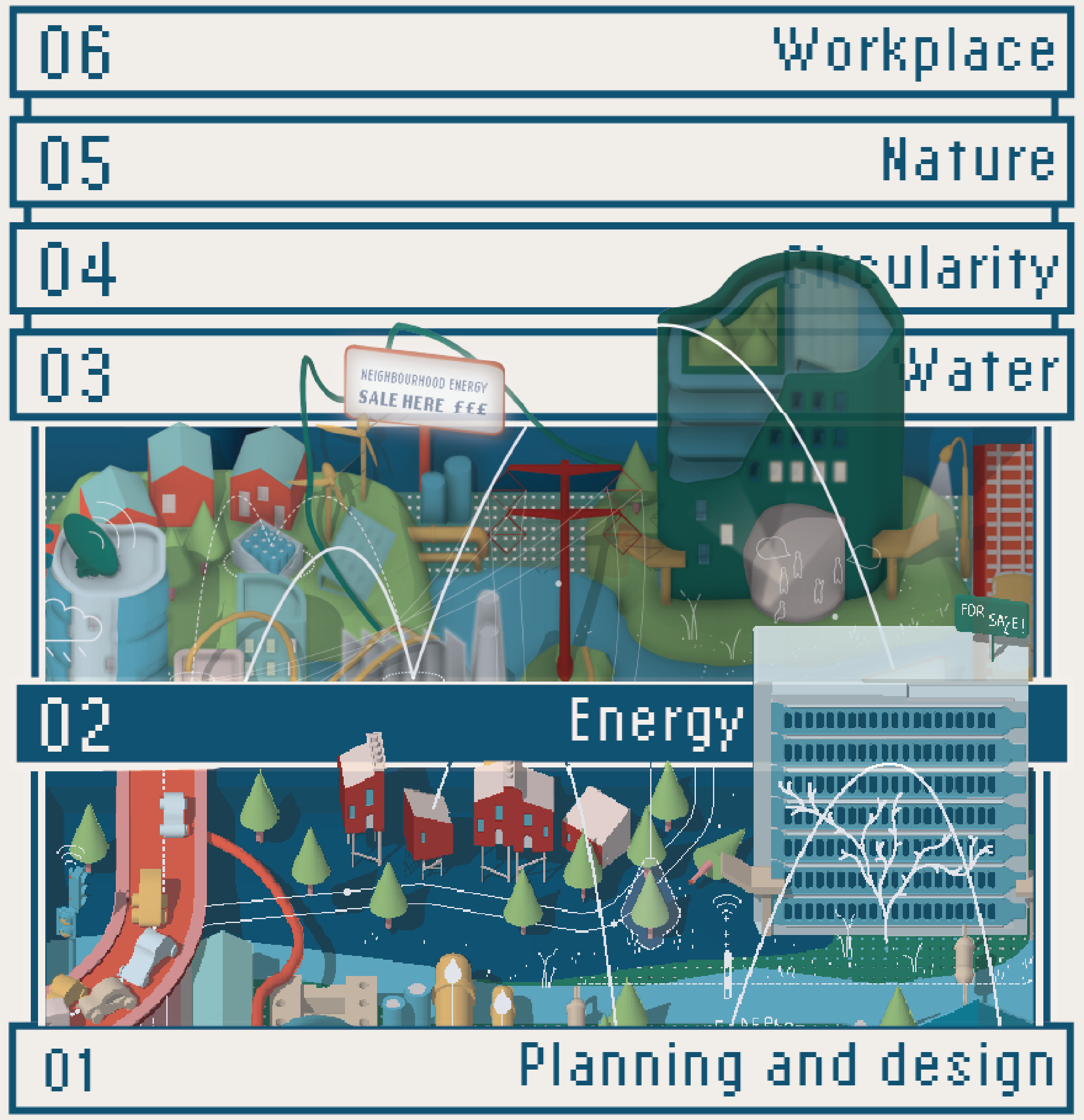
AI for Future Cities Series

The rapid evolution of artificial intelligence (AI) promises to enhance efficiency, speed and innovation. But what does this mean for cities: for how they are planned, designed, built and managed? What are the opportunities and what are the risks? Amongst the hype and speculation, how do we ensure that these technologies support us in achieving our shared goal of creating cities that are better for people and the planet?

Compiled by Arup's Foresight team, **AI for Future Cities is a series of critical reflections and expert insights on the uses and impacts of artificial intelligence across all aspects of our cities** – from planning through to running them, from infrastructure through to the flows of resources. Rather than an in-depth and comprehensive report, the issues are designed to be read as expertise-led explorations and provocations. It will give you a rich understanding of how AI already operates in the urban context today, what trends are shaping its use tomorrow, and informed speculation on the long-term possibilities.

This is issue 02 of ***a series*** on AI for Future Cities. Upcoming publications will focus on Water, Circularity, Nature and Workplace.

Explore other issues here.



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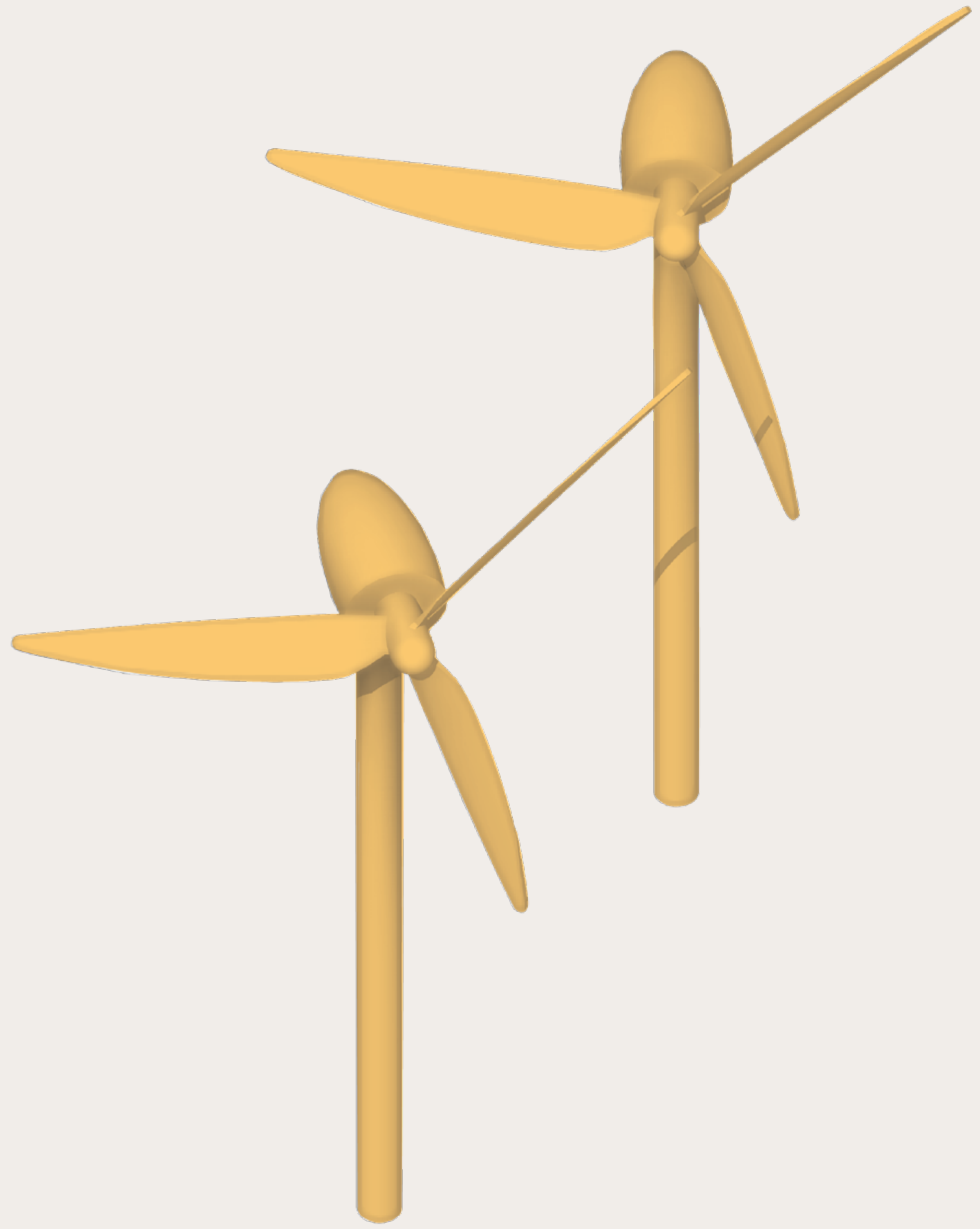
Contents

This second issue in the series focuses on **energy**: How is AI changing the way that energy is consumed and produced in our cities? How might new, AI-enabled energy systems change the physical fabric of our cities and the lived experience of their residents? What new competencies may future designers require for creating and working with energy systems that have been augmented by AI? And how do we ensure that AI remains a tool we use intelligently?



Foreword
Meeting our energy challenges with AI

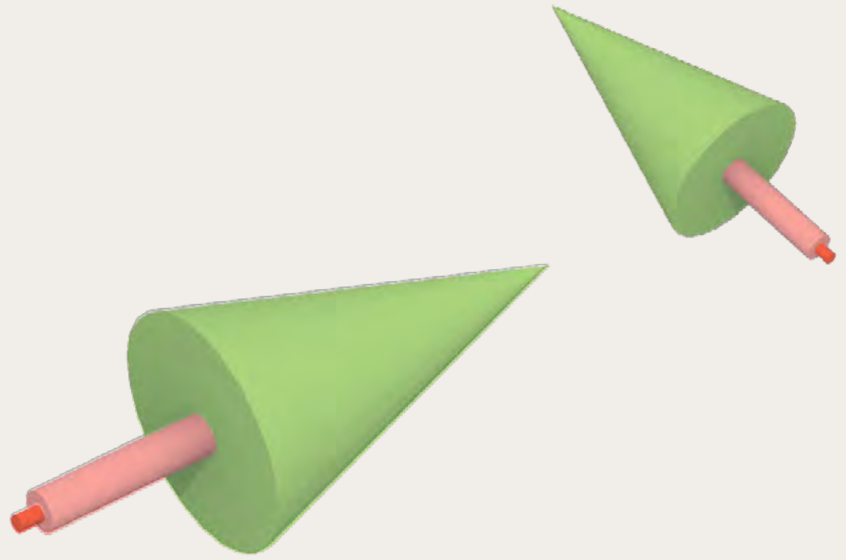
Nearly three years have passed since the explosion of excitement around AI, sparked by the emergence of ChatGPT. Since then, surging investment has triggered a proliferation of different AI models that can improve how we work and what we deliver.

Applying AI to the real world is the opportunity

This series by Arup University's Foresight team explicitly focuses on applications of AI that have tangible, real-world benefits in accelerating decarbonisation and supporting climate resilience. This issue focuses on urban energy, a topic at the crux of two trends shaping our future world, electrification and urbanisation. AI can play a significant role in new ap-proaches to energy generation and distribution in cities, and we are already using it to plan, site, and operate energy infrastructure. We've worked on feasibility studies that prepare the UK's grid for the integration of AI, and we've used machine learning to reduce energy consumption in buildings at scale. Our work on the UK's Virtual Energy System Programme and datasharing infrastructure is laying the foundations to implement AI into our grids and, in so doing, helping to incorporate renewable energy and the large amounts of storage they require to balance the grid. In transport, AI enables the vast quantities of batteries in our electric vehicles and bus fleets to be used as back-up energy storage for our urban energy systems, while supporting better transport demand management, passenger flows and transport network operation and maintenance.

We face huge sustainability and resilience challenges alongside the ever-pressing need to deliver infrastructure and prosperity at pace for communities around the world. It's difficult to imagine how we can meet these demands successfully without the power of AI to enhance human innovation, creativity, and productivity.

Will Cavendish
Global Digital Services Leader
Arup



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Foresight Perspective: How can AI help us manage the rapidly changing shape of the grid and the needs of the city?

Modern cities are unimaginable without electricity. Abundant and affordable energy has enabled us to build upwards and outwards. Electric lifts have shaped our skylines; electrified mass transit systems allow millions (if not billions) of people to live miles away from where they work and play, and abundant lighting has enhanced urban nightlife and safety.

Yet, while energy systems are fundamental to our lives and cities, the role of the city in the energy system has barely changed in a century: electricity is generated at thermal power stations and cities consume it. As a result, cities consume three quarters of global primary energy supplies.[1] They remain the main final node of an energy system that has been historically centralised and predictable.

Now, this is changing with the energy transition to net zero well underway in some areas of the world, and just beginning in others.

Technological advances in renewables mean that energy can be generated cleanly, in a decentralised way, at competitive prices; and it's becoming commercially viable to store distributed electrical energy thanks to innovations in battery technology. This means that achieving a net-zero grid and decarbonising our cities' energy is more and more a social and political challenge rather than a technological one. Progress will depend on our ability and willingness to integrate clean, variable, spatially-distributed energy generation as well as incorporating whole new areas of decentralised energy demand (from transport to heat to industrial electrification), to new forms of connected storage in private homes and cars — all the while balancing the grid and keeping it resilient in the context of a changing climate.

AI is already transforming urban energy

AI is emerging as the thread connecting these new energy assets and needs at multiple scales, transforming energy into a flexible, dynamic layer of the urban fabric rather than rigid infrastructure. At the national scale, AI can help to plan where best to install energy generation and forecast with greater accuracy how much electricity can be produced on any given day, helping to balance the grid overall. At the urban scale, AI turns cities and residents into active nodes in the electricity grid rather than destinations. The management of fluctuations through distributed, dynamic storage and generation in homes and workplaces is made manageable with AI: it helps to integrate buildings' BESS (battery energy storage systems) and EV (electrical vehicle) batteries into the grid, control rooftop solar panels, optimise heating and cooling networks.

1. IEA (2024), Empowering Urban Energy Transitions, IEA, Paris https://www.iea.org/reports/empowering-urban-energy-transitions, Licence: CC BY 4.0

Reimagining urban energy through AI

AI is the key technology that is driving the urgent transition from managing a century-old system of centralised and predictable energy production towards adaptation for decentralisation, where the city and its residents are both consumers and nodes.

Imagine a city where AI is fully integrated into the energy system, where buildings and neighbourhoods generate and exchange their own power autonomously as life ebbs and flows around them. In this city, surplus revenue from energy can subsidise poorer residents or be invested in community initiatives. Imagine a city where AI-enabled energy decentralisation makes consumers more resilient and where grid operators, drawing on cross-sector forecasts, have complete transparency over energy supply and demand to anticipate near and far-future needs. In this city, we will be able to contain disruptions caused by natural disasters, to blackouts or to cyber-attacks; backup energy supplies could be brought online more rapidly. And imagine the city grid using AI to interface with smart buildings and infrastructure to predict and direct supply and demand. These are just some of the possible future opportunities that AI in energy unlocks for our cities.

Accelerate, but beware of risks

But the integration of AI in the urban energy system comes with new risks. AI is itself a drain on power grids, and we must ensure that its deployment is net positive. Similarly, relying on AI for decision-making in the operation of critical infrastructure might introduce new cybersecurity vulnerabilities. Additionally, like any technology, AI can be misappropriated by actors who may use it to optimise for outcomes that run contrary to the benefit of the wider system and public.

How can we ensure the right data sharing and interoperability between assets and actors exists to enable AI's full potential in our urban energy systems? How can we use AI to make the most of investments into EVs, heat pumps, solar and home storage? What new skills and responsibilities do stakeholders in our energy system need to prepare for today?

> " Imagine a city where AI is fully integrated into the energy system, where buildings and neighbourhoods generate and exchange their own power, and it happens autonomously in the background."

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Horizon Scan Evidence:
Trends shaping the future of AI in Energy

This is just a small selection of key data we are tracking on how AI operates in the context of cities at present (now→), of emerging trends we are observing (near →), and of informed speculations we are making about long-term possibilities that stem from signals of change (next →).

Get in touch to explore our expanding database of trends, spanning across all issues of the AI for Future Cities series.

Data centre demand surge (02)

AI is accelerating demand for data centres, particularly those located close to urban centres that provide low latency. While uncertain, demand in 2028 could increase by 100% - 239%.

Semi Analysis, 2024; McKinsey & Company, 2024

NOW

Building energy optimisation (06)

New AI tools such as Arup's Neuron can analyse building occupancy and external data to optimise heating, ventilation and air-conditioning performance as well as cutting energy consumption

JLL, 2024

NOW

Decentralised grids (23)

Cities will become vital to electricity generation and storage through decentralised grids, with AI optimising the integration of renewables and batteries.

Mousavi et al., 2025

NEAR

Metamaterials (30)

AI enables the discovery of new metamaterials with properties rarely seen in nature. They can improve energy harvesting (thermoelectrics and solar) and energy storage (batteries). They could even enable wireless power transfer.

Bosman, 2024

NEXT

Small modular reactors (31)

AI might enable the integration of new energy sources such as Small Modular Reactors (SMRs) that could offer a more compact and flexible way to generate low-carbon electricity.

World Nuclear News, 2025

NEXT

Predictive maintenance (08)

AI is being used to predict when urban energy assets are likely to fail. Predictive maintenance helps to reduce interruptions, improve the efficiency of energy systems and lower overall energy consumption.

IEA, 2023

NOW

Smart grids (16)

Smart grids, powered by AI, can balance supply and demand in real-time, reducing energy waste and integrating renewable energy sources more effectively.

MIT Technology Review, 2023

NEAR

Virtual Power Plants (26)

Virtual Power Plants stitch together a group of distributed resources that work together to balance energy supply and demand on a large scale. AI is increasingly becoming the tool that manages such plants.

Calma, 2024

NEAR

Kinetic harvesting (39)

Connected kinetic harvesting captures energy from mechanical motion, like foot traffic, converting it into electricity for various indoor and outdoor applications.

Liu, L., Guo, X., Liu, W., & Lee, C, 2021

NEXT

Batteries on Wheels (42)

Autonomous EVs as 'batteries on wheels' might supply up to 9% of Europe's power needs by 2040 when managed through AI, enhancing grid stability and reducing costs.

Fraunhofer ISE & Fraunhofer ISI, 2024

NEXT

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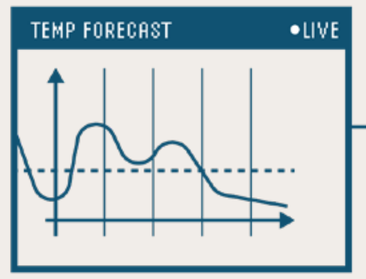
The City of 2035:
How might AI shape the city, and what new realities emerge?

Power beaming

AI supports the discovery and production of metamaterials that enable the relay of electricity wirelessly, thus beginning to reduce the burden of physical grid infrastructure.

The energy prosumer

Consumers are active participants in energy markets, with AI maximising their ability to trade domestically generated and stored electricity and shift their behaviour through incentives for efficient energy use.



AI-powered forecasting

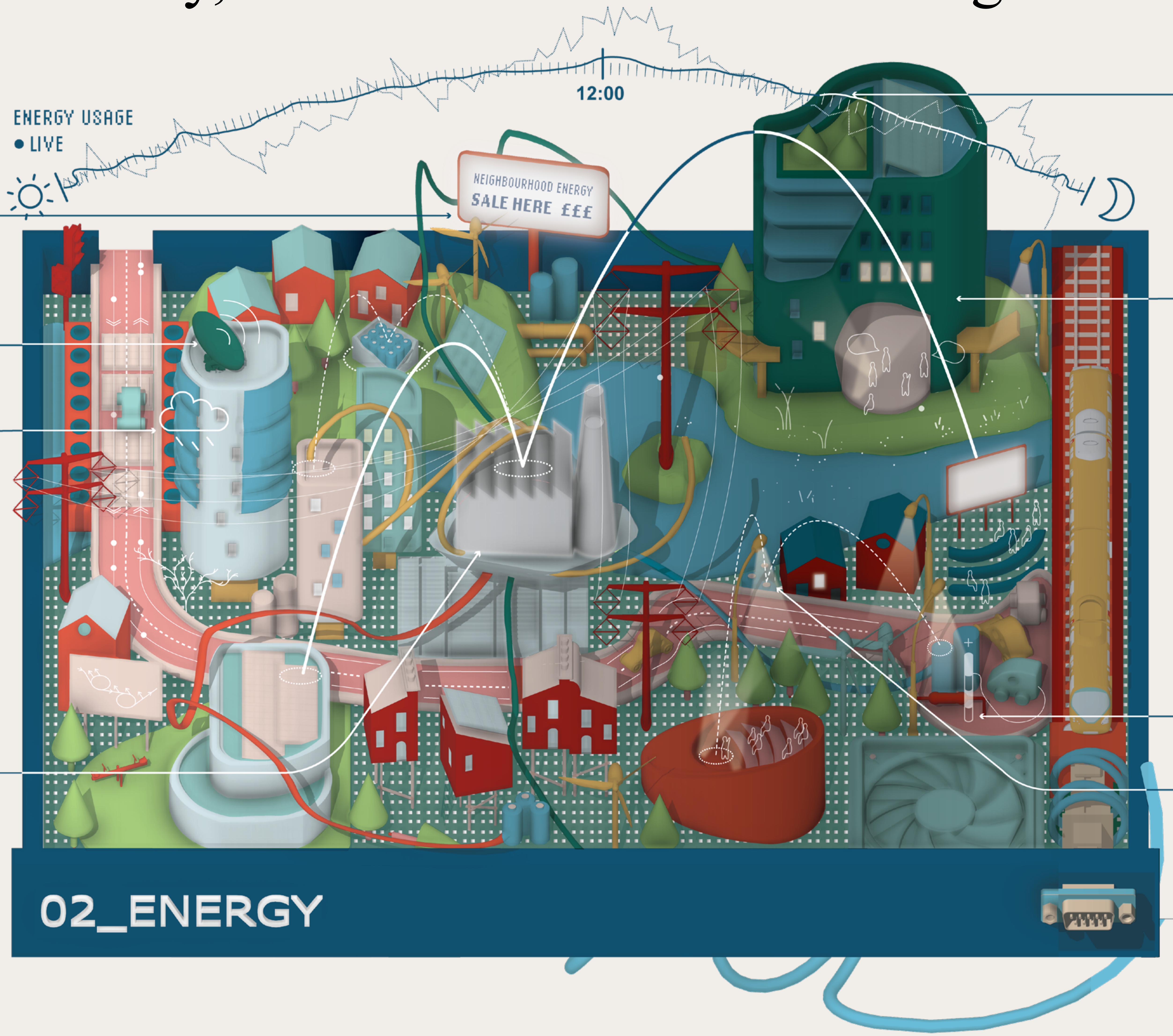
Weather and energy demand are forecast with greater accuracy, allowing for easier planning of supply and demand, and better management of price fluctuations.

Evolving renewables

Wind turbines find their place in cities with designs bespoke to the environment and significantly more efficient solar is used in the glass of buildings.

Virtual power plants

Increased real-time energy management capability enabled by AI further allows the uptake of small generation and demand assets to be grouped into a larger virtual power plant helping to balance the grid.



Predictive maintenance

AI is used to predict when urban energy assets are likely to fail. It reduces interruptions, lowers energy consumption and improves resource utilisation as well as the efficiency of the energy system.

Building energy optimisation

AI tools analyse building occupancy and external data to optimise heating, ventilation, and air-conditioning performance. These tools make decisions autonomously to limit and reduce energy consumption of new and existing demand sources when they are not needed.

Integrated battery electric transport

With autonomous electric vehicles connected to the grid and managed by AI, a new network of moveable batteries is enabled. As well as transporting people and goods, power can be sent to different parts of the city when needed in the form of battery vehicles. AI also optimises the management of energy and associated charging schedules of these vehicles.

Decentralised, bi-directional smart grids

Cities become key nodes in grids where generation and storage assets are distributed and decentralised and where electricity flow bi-directionally between them and AI optimises the flow of electricity generation balancing supply and demand.

06 Workplace
05 Nature
04 Circularity
03 Water
02 Energy
01 Planning and design

Expert Insight: Interoperability is vital to unlock AI's full potential

The emerging convergence of unpredictable demand, scarce resources, and the need for sustainable development is driving a significant reimagining of urban and industrial planning, including their energy needs.

Population fluctuations, economic and lifestyle shifts, and climate change present challenges that traditional planning models were not designed to address.

Lyndon Ruff
AI Centre of Excellence Manager
National Energy System Operator

Magnus Cormack
Senior Manager, AI & Analytics
National Energy System Operator

In this complex landscape, AI with its real-time data analysis and predictive capabilities is no longer a futuristic novelty but a vital tool for addressing current and future challenges.

Specifically in the energy sector, transformation is underway. The shift towards decentralised energy generation, driven by renewables like solar and wind, introduces supply variability. Simultaneously, demand patterns are becoming unpredictable, influenced by factors such as electric vehicle adoption and contemporary lifestyle patterns.

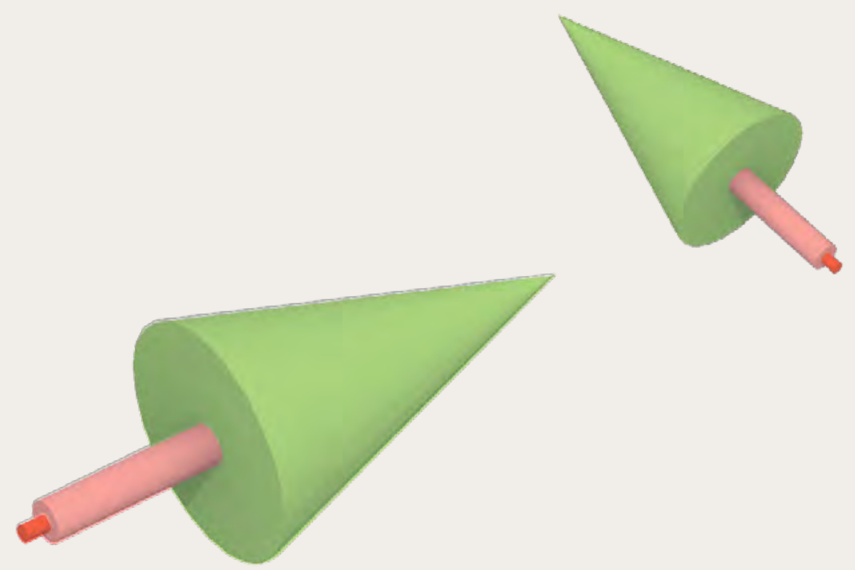
AI is essential for balancing this dynamic equation in energy and other areas of urban planning.

Unlocking AI's full potential

The true potential of AI depends on interoperability. When AI systems operate in isolation, confined to specific sectors or projects, they create and operate in silos of data, hindering comprehensive planning. Collaborative frameworks that enable industries to share data and develop compatible AI platforms are crucial for enabling a dynamic and responsive system. This interoperability fosters a holistic understanding of urban systems, facilitating optimised resource allocation and adaptive infrastructure development.

Intelligent grid management systems, powered by machine learning, can forecast demand, optimise energy distribution, and efficiently integrate renewable sources. This is not merely aspirational but a present technical and social necessity. Without AI, maintaining grid stability and ensuring reliable energy supply amid these challenges becomes exceedingly difficult.

The benefits of interoperable models extend beyond grid efficiency.



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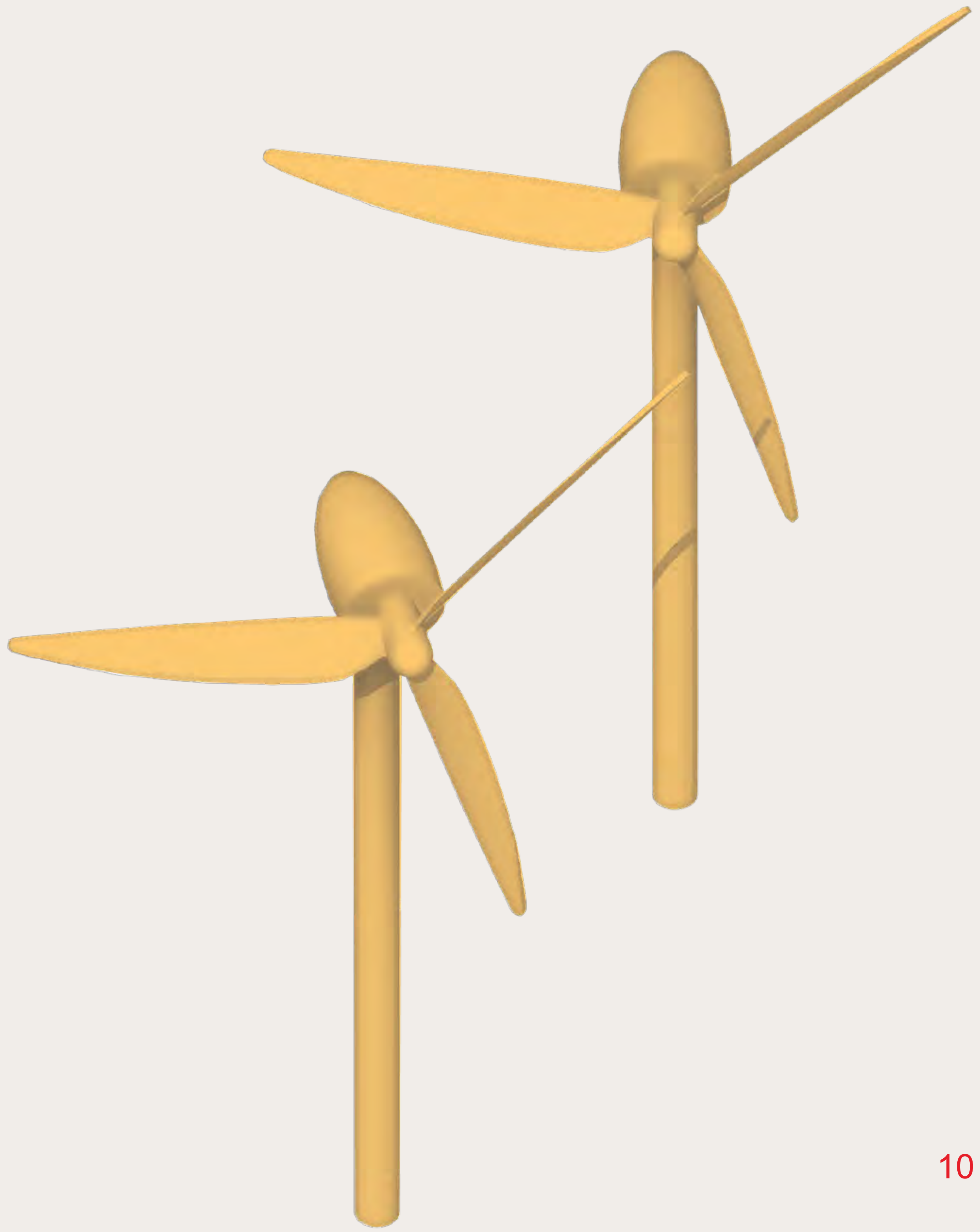
When different sectors seamlessly exchange data and insights, the potential for innovation and efficiency multiplies exponentially: supply chains can be optimised, resource consumption minimised, and circular economy principles more effectively implemented. For instance, integrating AI-powered logistics with smart manufacturing systems can reduce waste and boost productivity. Similarly, information exchange between the building industry and energy sector can lead to more efficient future planning, design and operation.

The need for shared standards

Achieving this level of interoperability requires concerted efforts from industries, governments, and research institutions, but establishing open and shared standards and protocols for data sharing, such as NESO's Data Portal and the energy Data Sharing Infrastructure, is key. Alongside interoperability of data, AI model compatibility is essential. Ultimately, the goal is to achieve connected digital twins representing the system as a whole, as envisaged by our 'Virtual Energy System Programme', or the UK's National Digital Twin Programme.

In conclusion, the challenges facing the built environment, energy sector, and urban planning demand a shift towards AI-driven solutions. However, realising AI's full potential hinges on fostering interoperability and compatibility across sectors and systems. This means greater collaborative efforts and a commitment to data sharing that can enable energy resilient, sustainable, and equitable urban environments for the future.



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Case Studies:
What is Arup currently doing to make cities better through AI?

Arup has worked with partners and clients around the world on AI-driven solutions for real-world application that deliver better outcomes for cities.

These cutting-edge projects give us powerful insight into how AI may shape the future expectations of practitioners and how these may be transferable to other domains across the city.

How might open data and data infrastructure introduce new opportunities for efficiency, sustainability and innovation?

Digital Spine Feasibility Study

United Kingdom, 2023

Read more

Arup collaborated with Energy Systems Catapult and the University of Bath to explore the concept of a 'digital spine' identifying the needs and challenges for the energy sector to facilitate data sharing through a digital infrastructure.

The report, commissioned by the UK Government's Department for Energy, Security and Net Zero (DESNZ) came as a result of the Energy Digitalisation Taskforce and its recommendations to develop a 'digital spine' for the sector. The study highlighted the challenges for the energy sector in facilitating data sharing and how these challenges could be overcome through an enabling infrastructure. This energy sector data sharing infrastructure will provide a secure and resilient method of sharing data, which is a vital component in the decarbonisation of Great Britain's energy system. Ultimately, this will reduce the barriers and friction of data sharing. With better, assured data-sharing and cross-network collaboration enabling a more efficient, responsive flow of energy around the network and more intelligent balancing of the system, a host of benefits will be unlocked for consumers, businesses, and energy companies.

The concept of data sharing infrastructure detailed in the study now serves as the foundation for Arup and NESO's Virtual Energy System Programme, which seeks to implement the data sharing infrastructure in the real world.

How might AI-enabled digital twins change the way we model and optimise energy grids?

Virtual Energy System Programme

United Kingdom, 2022 – present

Read more

Arup is supporting Britain's National Energy System Operator (NESO) in developing the Virtual Energy System Programme, the world's first ecosystem of connected digital twins for a national energy system. This will enable data-driven decisions and whole-system monitoring, as well as supporting operational optimisation, while ensuring an efficient and reliable energy system fit for the future.

Our work began at the organisational level, focusing on a framework that could power this large-scale transformation. Through research, expert interviews, and extensive industry-wide engagements, we developed a 'common framework': we identified 14 key socio-technical factors, across people, processes, data and technology that will be crucial to realise NESO's Virtual Energy System. The result is a pathway to collaboratively develop the governance, data standards, access policies, security, skills, and wider support required to efficiently deliver the range of use cases that comprise a working Virtual Energy System.

It was also clear from this work that the day-to-day operational insights and future planning that the system depends on – such as the location and change of supply and demand – will increasingly rely on a common, industry-wide Data Sharing Infrastructure.

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Expert Insight:
AI is key to the transition to carbon-free energy

AI is both a challenge and an opportunity for the energy industry. On the one hand, the boom in data centres to power AI models is leading to electricity load growth for the first time in years in the United States, Europe and other industrialised nations. This rapid pace of growth is challenging the traditional grid structure and the speed at which new generation can be brought online. On the other hand, AI has the potential to completely revolutionise planning and operation of the electricity grid, enabling truly right-time interactive models of distributed energy production and consumption that respect the complexity of cities and the needs for energy of buildings, vehicles, and more in a sustainable future.

Rob Best
Americas Digital Energy Leader
Arup

Simon Evans
Global Digital Energy Leader
Arup

The energy industry is at a point of inflection unprecedented in recent history. The rapid decarbonisation of everything means electrification of vehicles and heating systems is occurring simultaneously with a boom in energy consumption for data centres. This incredible confluence requires multiple solutions and there is no silver bullet.

However, with more solutions comes more complexity, and our traditional one-way power flow models may no longer be effective or efficient.

Enter AI

AI is already rapidly elevating how we model and optimise energy systems to take advantage of greater interactivity and more complex and intermittent sources of demand and supply. For the past 20 years, we have used machine learning models to both help plan demand and proactively identify grid conditions that could lead to failure.

For operators, use cases have included identifying demand signatures of appliances on the grid to inform projections of electrification and using data to proactively provide warning of potential transformer or grid equipment failure. We are now seeing these use cases expand to include computer vision to predict the risk of extreme events, such as wildfires that might damage grid infrastructure from remote sensing and drone imagery. This use of AI makes the grid safer and more reliable, with the potential to prevent tragedies such as the Camp Fire in California in 2018.

At Arup, we have used semantic interoperability and machine learning to help enable system flexibility and predict the most cost-effective ways of reducing energy consumption for buildings and cities even as they begin to electrify. In the US, our work with Whole Foods and National Resources Defense Council (NRDC) used machine learning to train models to search for novel combinations of energy conservation strategies to achieve deep reductions in building energy consumption within cost and deployment constraints. This work showed that machine intelligence coupled with human review and guidance could lead to up to 10% greater savings per building within the same budget. While this may sound small, an additional 10% savings per building means far less new generation required on the grid to meet surging electricity demands. In the UK, we have developed a semantic data model for energy flexibility markets that provides transparency and standardisation, supporting information layer interoperability that is required for scalable data exchange and effective use of AI.

Scaling positive impact thanks to AI

AI has the potential to exponentially scale this approach beyond buildings to infrastructure and vehicles to enable planning of demand coupled with distributed supply and storage across entire cities or regions.

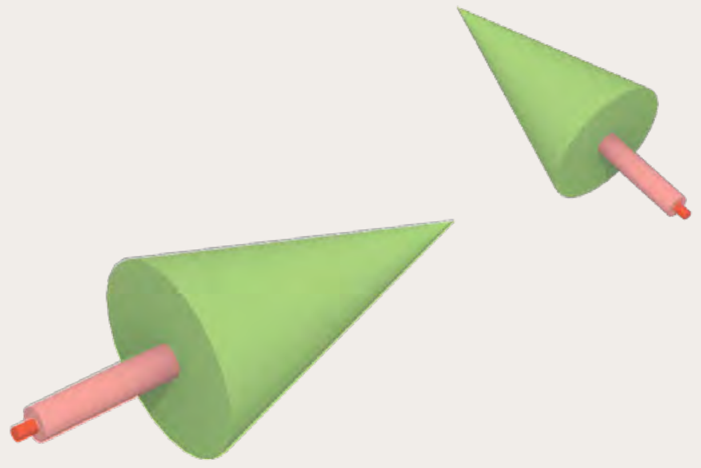
Demand modelling assumes perfect foreknowledge of the weather and conditions on the grid—conditions which are never met in operation. AI, coupled with sensors deployed in building thermostats, vehicles, solar panels, storage, and other distributed devices can effectively manage grid demand far more responsively than a human operator. Learning from historic data and identifying novel relationships between behaviour, external conditions, and the grid response, AI can help grid operators identify and deploy distributed resources at a scale that alleviates local distribution and transmission investment.

Zooming out, grids are experiencing significant delays in interconnecting new renewable generation. A core driver of these delays is the analysis and testing of a variety of failure conditions, but AI solutions are beginning to be deployed to support grid planners in more rapidly evaluating potential points of connection and solutions. This is increasingly important given that many utility grids are rapidly ageing and need to adapt quickly to meet the needs of the future.

The possibility of a carbon-free economy

With development and use of the right AI tools, in 20 years we could live in a world where the electricity and green molecular fuels that support an entirely carbon-free economy are dispersed throughout the energy grid, right-sized to meet needs without over-building, and operated across complex systems respecting end-users' needs, vehicle charging and transportation requirements, and the intermittency of solar and wind. This truly interactive and digitally interoperable energy system is within reach if we blend the creativity of human engineers with the expansive potential of data and AI.

> "AI has the potential to rapidly elevate how we model and optimise grid systems to take advantage of greater interactivity and more complex and intermittent sources of demand and supply."



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What if all buildings and projects across the city were optimised to maximise building performance?

Arup Mass Energy

United States of America, 2019 – present

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Creating energy models is a time-consuming process, and the effort involved in modifying these models often significantly constrains the breadth of options that can be studied. Arup's Mass Energy tool provided an automated, data-driven solution to this constraint. The tool leverages proprietary, AI-driven genetic algorithms to rapidly analyse the vast spectrum of design options and identify thousands of different ways to achieve project sustainability targets. Options are presented through an interactive interface that enables easy filtering and comparison. Among the many options identified that meet sustainability targets, project teams can explore and select the options that are optimized for other project criteria such as cost or conformance to preferred building systems.

The Mass Energy tool has been developed on several projects over recent years, including Colegio Village, NYSERDA, New York Public Libraries, City of Boston, and Whole Foods to run multiple EnergyPlus models programmatically that simulate and measure energy consumption, carbon emissions, and other metrics.

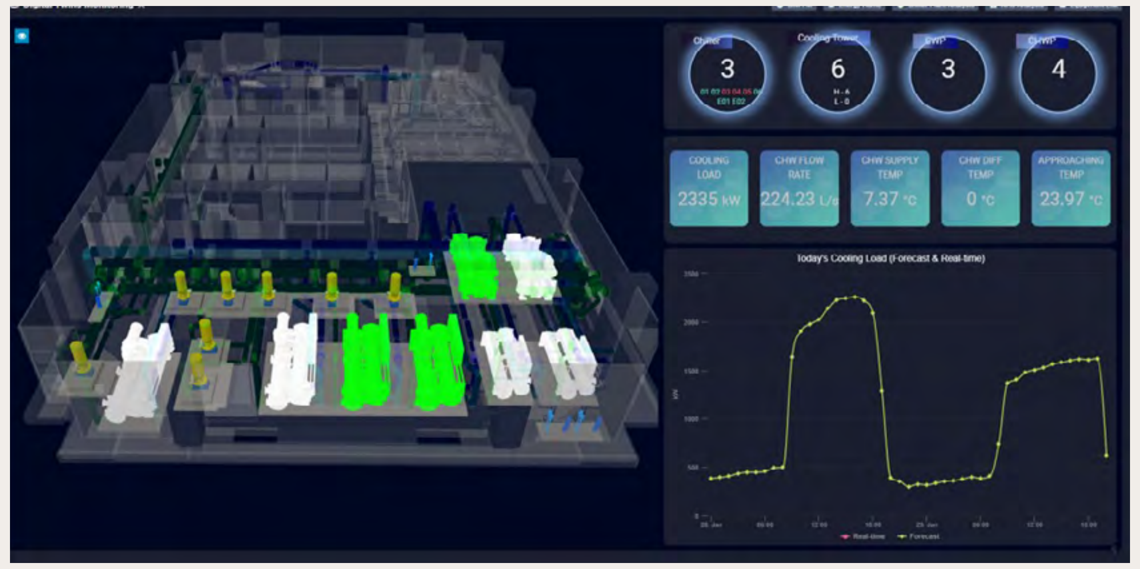
Additional examples of where Arup have leveraged digital technologies to achieve remarkable outcomes in energy projects can be found here:

SCALE
Offshore wind deployment — Read more

Carbon free Boston
United States of America — Read more

One Taikoo Place
Hong Kong — Read more

Flexibility Markets Unlocked Programme
United Kingdom — Read more



What if every building had an AI brain allowing it to communicate and share resources with other buildings across the city?

ELEMENTS, MTR

Hong Kong, 2025

Read more

Located above Kowloon Station and the Airport Express, ELEMENTS, an Arup and Neuron collaboration, is a one million square foot mall combining shopping, dining, an ice rink and cultural attractions. To enhance energy performance and thermal comfort, the Neuron AI Chiller Plant Platform was implemented, resulting in a 9% energy saving in air conditioning and mechanical ventilation (ACMV) systems within the first year, with an expected 15% following planned system upgrades.

Using Recurrent Neural Networks and Long Short-Term Memory networks, the Neuron AI model predicts cooling loads in 30-minute intervals, drawing on real-time weather forecasts, solar radiation and historical data. A digital twin enables continuous AI training through scenario testing and operator feedback, while reinforcement learning allows the system to adapt its operations based on performance outcomes.

Recognised for its integration of advanced engineering and intelligent technology, the project received both the ASHRAE Engineering Excellence Award and the Technology Award in 2025, marking a notable milestone in data-driven energy optimisation within East Asia's built environment.

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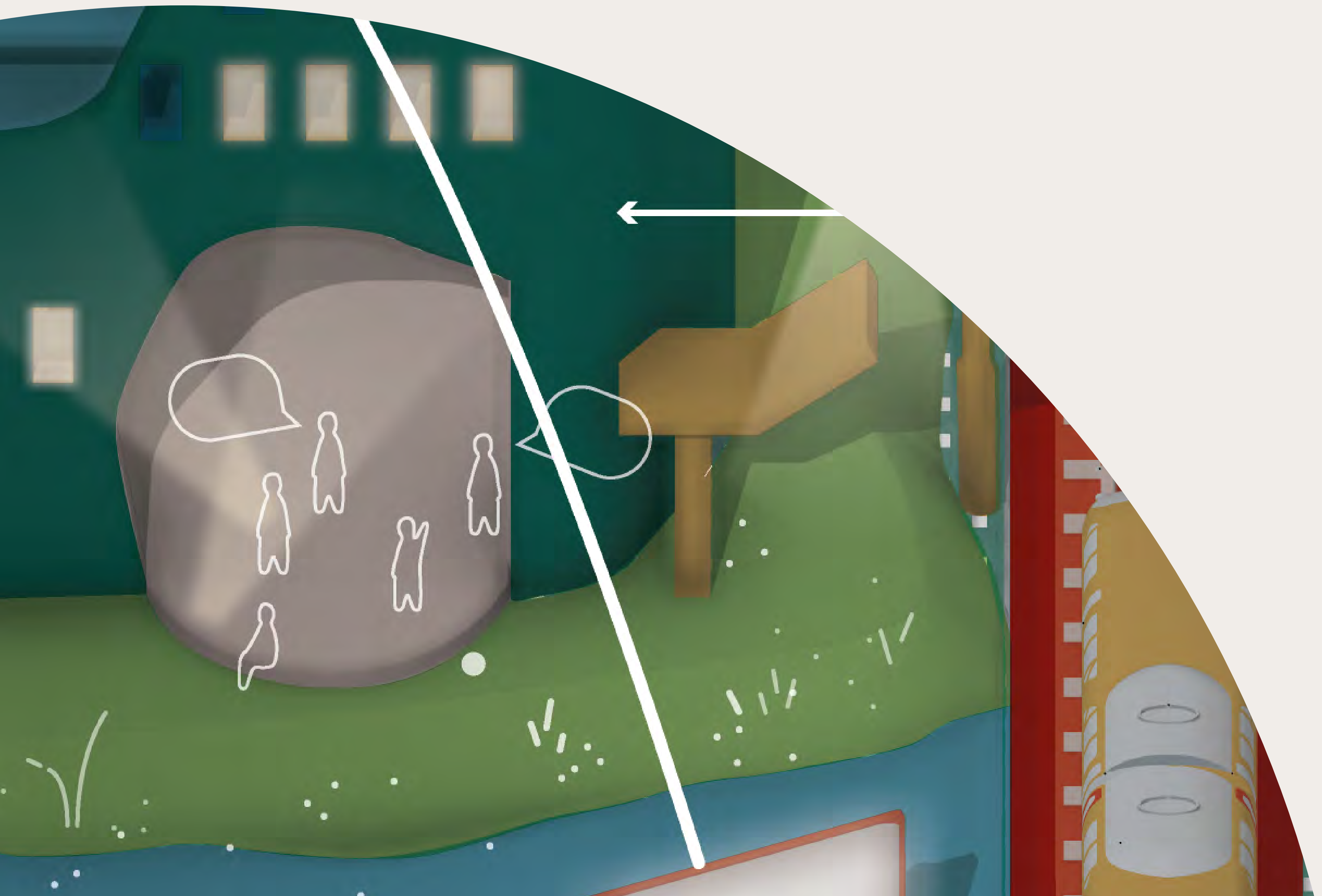
Recommendations: Practical steps for today's practitioners

AI will impact energy in cities in profound ways. Although we can't predict these impacts exactly, we can take anticipatory steps today to be better prepared for the future city.

These recommendations seek to provide the **foundational elements** and **enablers** that are required for AI fully to augment our energy system at scale, including interoperability, data quality, accessibility, regulatory standards and system resilience.



1 Support regulation to enhance data sharing and interoperability at scale

Government and regulators should enhance data sharing and interoperability through enabling a common data sharing infrastructure, providing clarity for market actors. The energy trilemma of balancing security, cost and sustainability should be at the heart of this. In the process of making these reforms, regulators, utilities and grid operators must prepare backup plans for new security challenges of a connected grid with diverse actors, complex systems and black boxing.

2 Establish trust frameworks and transparent data sharing agreements

For interoperability across an AI-enabled energy system to be successful at scale, all actors across a more distributed urban energy value chain should have full visibility in data sharing agreements, frameworks, and standards. This should involve creating shared key concepts (ontologies & taxonomies etc.) as well as common exchange mechanisms and data sharing infrastructures to enable AI to more seamlessly integrate across the network and reduce data hoarding from stakeholders.

3 Invest in training, upskilling and raising public awareness

AI will introduce new data, actors and sectors into the energy grid that have historically been regarded as unrelated – including everything from meteorology to demography to high-street footfall. This will require greater public awareness of the implications of AI as well as a greater need to invest in the skills to take advantage of AI. Organisations will need to invest in upskilling of practitioners, who will increasingly need a deep systems-level understanding of energy networks, the remit of AI applications and the governance and ethical challenges associated with AI assisted decision making.

4 Leverage distributed energy and greater insight for local need

City and municipal leaders should explore opportunities to proactively engage with the evolving AI-enabled energy system, which is becoming more open-source, distributed, and automated. As urban energy data becomes richer and more interoperable, new possibilities will arise to understand local needs and develop innovative projects, tools, and initiatives that address acute community energy challenges.

5 Move beyond the asset

AI is already providing valuable insights in how we manage resource use and operation at an asset and building level, but a shift is needed to achieve the promised benefits of AI on a broader scale. That shift is to move from building-scale planning to larger-scale planning, that looks at a neighbourhood, district, or city scale through initiatives such as Local Area Energy Planning (LAEPs) and Regional Energy Strategic Plans (RESPs).

6 Build in resilience across a more distributed network

As we utilise AI to support the transition away from a centralised energy infrastructure to one that's more distributed, regulatory bodies, utilities and municipalities should take steps to build new forms of redundancy and resilience, and strengthen network connections. This could include policies which mandate redundant infrastructure, development of right-time monitoring systems, self-healing grids and enhanced energy storage systems that provide backup during disruptions.

7 Design for consumer and prosumer accessibility

From charging vehicles, to using heat pumps and solar panels in urban homes, an AI-enabled urban energy system will require a change in behaviours and involve transitional disruption for users. The roll-out of AI, therefore, should be easy to learn and user-centric, with systems designed to maximise user benefits transparently and with minimal input. Stakeholders across the energy system, should use AI to support breaking down barriers to adoption while also giving users greater agency around how they consume, generate, and sell their energy.

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Get in touch with our experts to discuss further.

Arup University is our corporate university function that prepares our clients, collaborators, and global membership for the future. We are committed to raising technical standards across the natural and built environment sectors.

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