



Data Science  
and AI Solutions

# Energy Systems

Catapult can quickly guide businesses to solutions that extract new value from data.

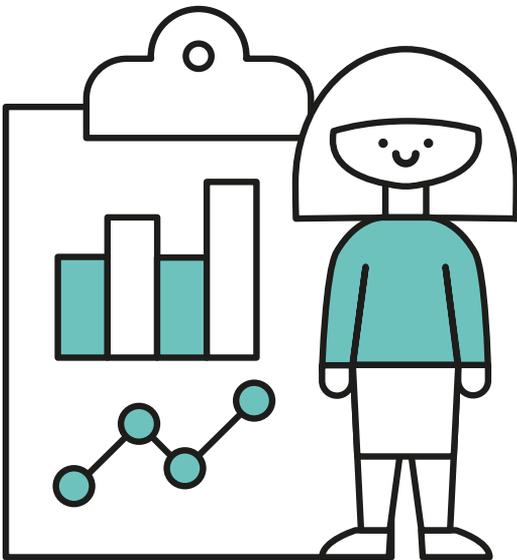


Data has the potential to be as valuable to this century's low carbon energy transition as oil, gas and coal were in the 20th century. Data from a huge array of sources – including energy exploration, generation, transportation, distribution, consumption and smart connected homes – offer transformational opportunities to enable the market to operate more effectively and efficiently as we move towards a smart, sustainable and secure energy system.

However, data must be refined to allow us to unearth valuable information. The emergence of big data – produced by the ever-growing proliferation of sensors that capture all kinds of data at multiple levels, combined with real-time data coming from markets, weather stations and even transport networks – means that the industry is faced with the challenge of how to handle and utilise data in three ways: volume, velocity and variety. Whilst big data, open/shared data, analytics/insight, and machine learning/AI offer huge opportunities, there are concurrent risks around cyber security, data privacy and data protection that need to be addressed.

Businesses are increasingly struggling with how to securely organise, store and extract value from big data, which is where we come in. We can help not only extract valuable insights from big data that are crucial to cutting operational costs, optimising investments and reducing risks in the energy industry, but also help you develop smart energy systems that capture new value from the UK's transition to a low carbon economy.

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## Why us?

Energy Systems Catapult can quickly support innovators to identify, develop and test solutions that extract new value from their data. We are home to some of the UK's leading, independent data experts with a breadth of experience across industry, research and consulting. Our experts draw on this experience to select the best techniques that extract the most value from your data, saving you time and accelerating the growth of your business.

We don't favour particular techniques over others. This impartiality enables our work to be completely customised for your specific needs, ensuring the most appropriate and efficient solutions are defined. Combining the latest scientific thinking with our own experience at the forefront of AI, we are uniquely positioned to solve your data queries and unlock new value from the low carbon economy.

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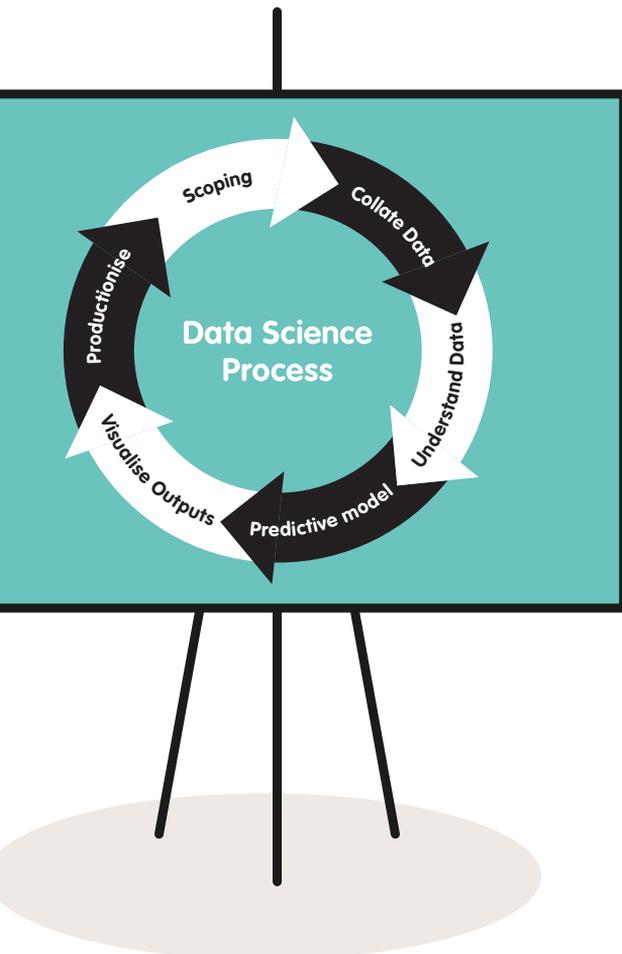
## Our services

- **AI development:** harnessing our machine learning capability, we can maximise the value of your data by helping to find solutions to your business' most difficult problems. Our AI team tackles challenges at the cutting edge of data science, combining our practical, industrial and research experience to deliver the best solution to meet your business' needs.
- **Insight and analytics services:** our experts will work closely with your business to understand the data you have, identify new insights and outline the practical steps required to utilise these in your business. When your teams are focused on delivering business as usual, our experts can provide practical independent support to show you where the biggest opportunities for growth and efficiency lie.
- **Advisory services:** we advise on best practice and support for understanding your data, the use of particular techniques and how to apply them. This is ideal for projects where there's uncertainty over the sources and volumes of data available, or for smaller companies who are preparing to collect large amounts of data.
- **Research services:** we will work closely with your experts to solve the big questions relevant to your business or wider industry. Often working in collaboration with other organisations to answer cross-disciplinary problems, we bring whole system thinking and knowledge of energy data – from generation to behind-the-meter – to accelerate opportunities for UK businesses.

## Our approach

Our data science team can give you the information you need to reduce the risk of decision making, even within the uncertain and complex future facing the energy system.

Our capabilities include the full breadth of machine learning, predictive modelling and optimisation methods. We have experience using supervised, unsupervised and reinforcement learning techniques with energy data. Models our AI team build include clustering, time series analysis and neural networks. Using real-time prediction and control algorithms, our data science expertise can enable you to reduce costs by creating value through optimisation.



Following consultation, we will create a tailored package of solutions to fit the needs of your organisation. Our projects typically follow a six-step process.

- 1. Defining and scoping the challenge:** Our team will meet with you to discuss your problem, then conduct a detailed analysis of what will be required to tackle it, as well as highlighting any ethical considerations that can be foreseen.
- 2. Data collation:** Once the nature of the problem has been understood, we can then carry out an exploratory data analysis. We will carry out any necessary data preparation to ensure it is compatible with our processes, decide on which features are needed, and whether the creation of entirely new features are required.
- 3. Understanding the data:** This stage could include visualisation exercises to create a decipherable 'snapshot' of your data, the building of preliminary models, trend analysis and/or assessing the importance of any features.
- 4. Predictive Modelling:** Drawing on extensive expertise and experience, our data scientists can offer a range of services for developing and executing predictive modelling projects. Our capabilities include machine learning, deep learning, probabilistic forecasting and optimisation.
- 5. Results and reporting:** On completion of the modelling exercises, we will produce a detailed report complete with visual representations of the outputs and analyses of the model parameters.
- 6. Productionise:** Where the business requirements and scoping allow for it, we can offer guidance and help you understand the risks and opportunities of the processes involved in implementing these algorithms into a live environment.

## Analysing consumer heating preferences in a 'Living Lab'

Our experts have worked on programmes of intense depth and complexity, most notably the £30m Smart Systems and Heat programme – a new approach to decarbonising heat in the UK. Working with the Energy Technologies Institute (ETI) and Department for Business, Energy and Industrial Strategy (BEIS), the Catapult developed and trialled future-proofed, efficient, smart local heating systems for the UK.

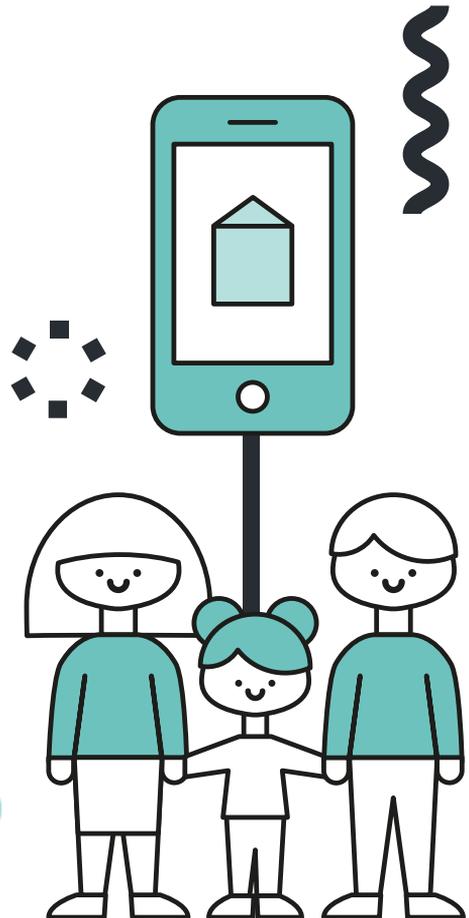
The Catapult used cutting-edge data science and machine learning algorithms as part of our Living Lab offering: over 100 real-world homes fitted with extensive in-home IoT sensors/actuators connected to our cloud-based digital platform, the Home Energy Services Gateway (HESG), with the Catapult data science team developing algorithms to process over four million data points per home per day.

The advanced data science capability powering the Living Lab allows real-time decision-making (e.g. dynamic heating system warm-up times based on house thermal dynamics, weather predictions and cost predictions) and complex data analytics to understand how people used heat in different rooms at different times of the day to create personalised 'comfort profiles'.

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We used advanced AI techniques to understand how energy, particularly heat, is used by consumers and to solve key industry challenges. This involved working with substantial volumes of real-time data from customers deploying techniques to process these in a timely way and deliver valuable insight.

These rich insights uncovered information to define and test products, services, and business models that can be specifically tailored to deliver great customer experience and optimise efficiency and cost.



“The Energy Systems Catapult’s analysis of large datasets and algorithm expertise has been crucial to the ETI’s vital research into how the UK could decarbonise domestic heat. Collecting the right data and presenting it in a relevant and engaging format has allowed us to move forward quickly.

Revealing key insights from the data, such as which rooms different people treat as a ‘priority’, how they ‘micro-manage’ heating in different rooms and how people use heating controls differently, has significantly advanced our understanding of how people experience heat in the home. Data showing people’s interaction with heating, costs and weather has also exposed how energy suppliers could price energy services.

Great work by the Catapult’s data scientists.”

**Jon Willis**  
Chief Executive Officer of the Energy  
Technologies Institute

## Unleashing innovation

and opening new markets  
to capture the clean growth  
opportunity.

For further information  
and to arrange an initial  
consultation, please contact  
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Energy Systems Catapult was set up by government to accelerate the transformation of the UK's energy system and ensure UK businesses and consumers capture the opportunities of clean growth. The Catapult is an independent, not-for-profit centre of excellence that bridges the gap between industry, government, academia and research. We take a 'whole system' view of the energy sector, helping us to identify and address innovation priorities and market barriers, in order to decarbonise the energy system at the lowest cost.