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# The practice of AI and ethics in energy transition futures

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# Contents

# Executive summary

Discussions regarding the ethical implications of Artificial Intelligence (AI) have been a significant feature of technological advancement discourse, debated long before the techniques and approaches in use today were developed. As the practical applications of AI have evolved, these discussions concerning ethics have become more focused, significant and urgent.

One sector where this focus on ethical considerations of AI is particularly relevant is the UK Energy Sector, which is undergoing a significant shift towards digitalisation. With AI and related systems such as the Internet of Things (IoT) and Machine Learning (ML) becoming instrumental in improving the design, operation, and delivery of energy systems, ethical thinking needs to be more widely addressed. Fully digitalised energy systems will require more actors and automated agents to engage in the collecting, storing, and utilising of significant amounts of energy data, which raises concerns around increased security and privacy risks. This, in turn, could act as a barrier to innovation in the use of data to generate highly connected energy systems.

Existing data sharing practices emphasise legislation around data protection. Yet, while there is a strong culture of regulatory compliance, there is a significantly less established understanding of ethical practices and frameworks in the sector. Ethical concerns are often assumed to be 'covered' by regulations and legislation, both surrounding the use of energy data in general and relating to the specific complications that come from the use of AI.

Policy makers, businesses, and other stakeholders have increasing concerns around how to implement digitalised energy systems ethically. There is a need for greater clarity around how ethics and ethical practices are understood and applied by stakeholders that can operationalise a duty of care, aid the penetration of renewable energy, and encourage responsible innovation. By addressing ethical concerns from the outset, taking a proactive rather than reactive view, risks can be mitigated, and potential issues addressed early on, leading to more opportunities for digital and technological advancement. Our recommendations offer key steps in this direction.

# Summary of recommendations

1. **Ofgem should expand its focus to include stronger consideration of ethical practice, including sector-specific guidance. This could include establishing an ethical regulatory body that provides space and opportunities to develop a culture of critical ethical thinking.**

While recognising that regulation is not the same as ethics, there is still a key role for industry regulators to play in creating sector-specific guidance that can aid with devolving and maintaining ethical practices. At present, there is a lack of space within the industry and within organisations specifically to discuss potential ethical issues and ethical barriers to innovative projects. An ethical regulatory body can enable a wide range of voices to be heard to ensure ethics are embedded into energy design and data practices.

2. **Companies should invest in programmes, including training that raises awareness of ethical considerations, to create a community of practice and an ethics-conscious culture that promotes innovation.**

Investment in training and opportunities to develop and share practices is crucial to developing a culture of ethics that supports responsible innovation. Greater open access to data without compromising privacy and cyber security will facilitate new business models and services that can more readily be integrated into the wider national infrastructure and services.

3. **UK government(s) and Ofgem should review the effectiveness and appropriateness of data privacy restrictions, given the increasing capabilities and availability of AI tools.**

Data privacy remains critical but maintaining privacy alone is not ethics; restricting access to data may be unethical as representative and current data is required for good practice. Existing restrictions that limit good practice around data sharing may prevent innovation, which could contribute to the common good. Additionally, developments in AI may make current privacy measures obsolete. Even when data is anonymised, customers should be well-informed as to what data can be accessed and how this might be used.

4. **National government and research funders should invest in detailed sector-specific research around the use of energy data and AI to aid an industry-wide move to adopting dynamic and responsive ethical principles.**

Given the increasing use of AI in the energy sector, including the availability of AI tools that require little expertise to operate, outputs similar to the Energy Systems Catapult's Taskforces or the UK's National AI Strategy would aid sectoral understanding of these issues and legitimise sector-specific ethical frameworks.

# Scope and methodology

The overarching aim of this research was to explore experiences and understanding of the role of AI and ethics in working towards the digitalisation of the UK energy landscape from a stakeholder perspective.

The methodological design for this project brought together researchers from arts and humanities, social science, computer science, and engineering. Approaching the research through diverse disciplines allowed for cross-discipline contemplation around the possible meanings or interpretation of ethics and ethical practices in relation to energy digitalisation. Phenomenological framing was employed to focus on perceptions held by people working within the energy sector towards ethics and AI. Using a phenomenological lens uncovers the way a person constructs, experiences and interprets a phenomenon, such as an issue, event, or, in this case, ethical practices, to make sense of their world.

The research was conducted in two stages. First, a rapid review of the literature around AI and ethics in the UK energy data landscape was conducted to interrogate the current discourse around ethical approaches towards AI and energy data. The rapid literature review as a method is a simplified systematic review process conducted over a short period of time (Trico et al, 2015). This method limits the inclusion, criteria, and publication date, with only one researcher screening the literature search results, and does not conduct a quality appraisal or meta-analysis. Through mapping, we could show how AI, ethics and energy literature coalesce with metaethics, normative ethics and applied ethics concepts.

The second stage of the research was primary data collection through focus groups and interviews using semi-structured questions. Interviews and focus groups as a qualitative method can explore unaccounted for themes and concerns, as well as confirm existing literature as it allows participants more space to discuss their experiences (Rubin & Rubin, 2012). Moreover, other projects on energy data have used interviews and focus groups as a method, so it was important we could similarly collect knowledge to enable comparison (Sovacool et al, 2018).

The sample for the focus groups and interviews was non-probability, which is commonly used in exploratory studies. Twenty-two participants took part from 15 different institutions or companies and their job roles varied from engineers to energy consultants and academic professors to doctoral candidates. Recruiting purposefully helped ensure there was a balance of academics, energy suppliers, and policy makers in each group, which meets one of the research objectives to identify best practice in AI and ethics from multiple perspectives and positionalities. However, to address gender inequality within the energy sector, there was an over-representation of females in the sample. Just under half of the participants were women in comparison to less than a quarter of females working in the energy sector.[1]

1 "Despite making up 48% of the global labour force, women only account for 22% of the labour force in the oil and gas sector and 32% in renewables" (IEA 2020).

The data was thematically analysed and coded to capture and categorise experiences and meanings around AI, ethics and energy data, with further input through reflexive and dialogic discussions between the researchers.


**Figure 1**: Interview transcripts word frequency diagram

# AI penetration in the UK energy sector

In its ambition to achieve Net Zero emissions by 2050, the UK government believes the energy sector should be a global leader in the development of tools for digitalisation (BEIS, 2021b; BEIS, 2020). To achieve this aim, digitalisation and digital innovation is one of ten technological priorities identified by the Department for Digital, Culture, Media & Sport (DCMS) (DCMS, 2021). Similarly, when the government published its first energy sector digitalisation strategy and action plan in July 2021, the digitalised exchange of data was seen as critical to how energy systems can operate flexibly to optimise assets and enable rapid decarbonisation while maximising the use of renewable energy (BEIS, 2021a).

Digitalisation of the energy sector refers to how digital technologies, such as AI, are integrated into energy systems. AI can be understood as the way 'machines perform tasks that traditionally required human intelligence' (BEIS, 2021a, p.2), as well as identifying patterns and trends in large datasets to support decision making. With initiatives such as the 'smart grid' becoming a critical component of modernising the generation, supply, and use of energy to meet national and international carbon emission reduction goals, the future of AI techniques has been of significant interest both academically and industrially. It is expected, therefore, that the use of AI in the energy sector will increase significantly over the next decade, with an assumption that AI and ML techniques will be vital in achieving 'Net Zero' targets through:

- Optimising performance by modelling virtual representations of energy infrastructures
- Improving the maintenance of energy system assets and cyber/ physical security
- Aiding consumers in decision making around their energy usage
- Generating market innovation by automating energy trading between consumers who also produce energy (Wentworth et al, 2021)

However, despite these ambitions, one major area of confusion for participants was around the definition of AI and ML. Some participants questioned if ML was a subset of AI, or something entirely separate, with discussions around other analytic techniques as to whether they would be considered AI or not. For example, one participant, a senior academic, explained:

> "I mean after all this time, it still confuses me as part of energy, whatever the difference is between like AI, cyber-physical, and all of those kinds of elements. I guess AI, if I really think about it, is collecting lots of data and then interpreting that data to be able to forecast what's going to happen in the future."

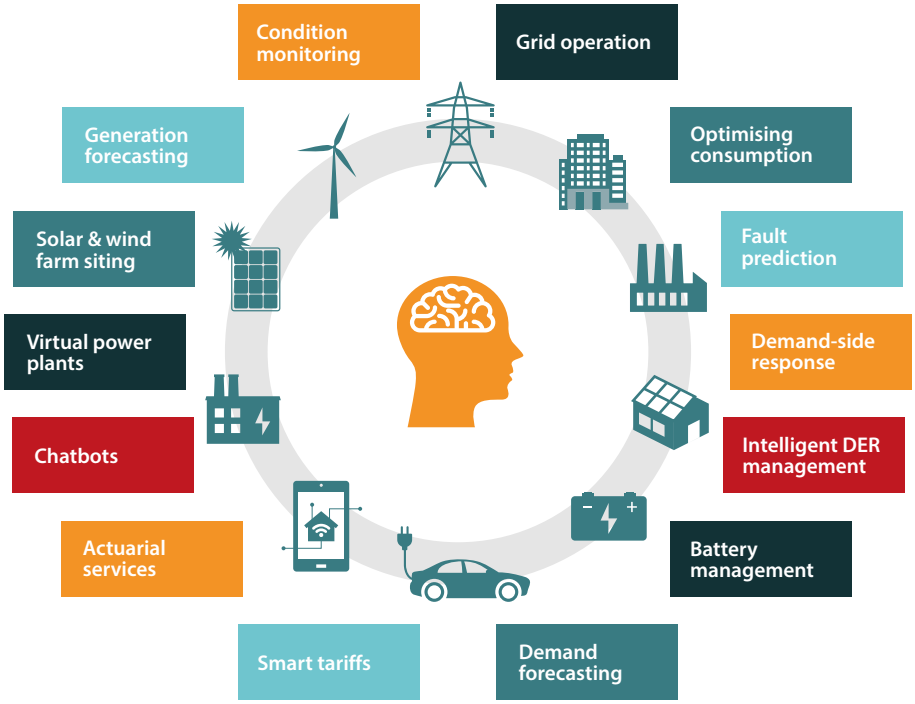


**Figure 2**: Uses for AI/ML in the energy sector

A lack of clarity around AI in the energy sector, whether in the way it is defined or its role in digitalisation, could explain why its use has been limited, with it 'primarily deployed in pilot projects for predictive asset maintenance' (Wentworth et al, 2021). As digitalisation accelerates and there is more widespread adoption of digital technologies, the extent to which AI penetration is permitted and achieved will be instrumental in how systems can respond to the political, economic, and environmental challenges currently facing the energy sector.

# Ethics and AI

The landscape of AI ethics has been rapidly growing in recent years, as disciplines such as robotics (Müller, 2020), computer science (Borenstein & Howard, 2021), and the automotive industry (McMenemy, 2021) have been developing frameworks concerning AI and its ethical implications. In contrast to regulations and legislation, which focus on the application of statutory duty and enforcement of the law, ethics is a system of principles or protocols influencing how people make decisions of their own free-will, acknowledging the need to improve the well-being of others and considering what harms or diminishes the well-being of others.[2]

An understanding of ethics, AI and technology is often located within a philosophically informed framework of ethical thinking (Hoffman & Hahn, 2020; Ocone, 2020; Stahl et al, 2021; Rochel & Evéquoz, 2020), considering how moral understanding is created, influenced, and applied as a philosophical outlook. The three prevalent schools of ethical thought that are dominant in AI ethics discussions are Consequentialism, Virtue Ethics and Duty Ethics, as detailed below:


**Figure 3**: Three key ethical branches from normative ethics

Other conceptualisations found in the literature focus more on the ethical principles that are most relevant (or perceived to be) for handling AI application. However, these principles and their prioritisation vary greatly across the literature. For example, while some frameworks focus on single principles such as trust (Ryan, 2019; Godoy et al, 2021), justice (Know et al, 2022) or privacy (Carmody, 2021), other models consider the relationship between principles, juxtaposing or arranging them according to meaning and application. This suggests that rather than philosophically informed, ethical principles are values-based , and are commonly linked to codes of conduct or ethical guidelines.

2 Events such as the Reith lectures in 2021, delivered by Professor Stuart Russell and broadly titled 'Living With Artificial Intelligence', are bringing discussions regarding AI ethics to a broader audience.

# Digital and data ethics: more than regulations

**Recommendation 1**: Ofgem should expand its focus to include stronger consideration of ethical practice, including sector-specific guidance. This could include establishing an ethical regulatory body that provides space and opportunities to develop a culture of critical ethical thinking.

A key theme that emerged from the interviews was the use of regulation and legislation as monitoring practices and guidance regarding ethics. Evidentially, while ethical frameworks around the use of AI in energy spaces need to be flexible and respond to change, there is still a desire and need from the sector for clear guidance and monitoring procedures that can also act as boundary lines.


**Figure 4**: Current approaches to monitoring

There appears to be some understanding that regulations equal ethics or are so informed by ethics that they encompass ethical considerations.

> "Ethics is what ends up informing legislation right, because somebody goes, this isn't right and then how do we get some control over this... more regulation that comes in potentially it could slow down innovation."
> Senior Energy Professional

The need for regulation, legislation and guidance to shift and change in response to changing requirements, such as the evolving and increasing use of AI and energy data, was recognised by participants. Not only should this happen in response to societal developments, but also, as this participant highlights, as technology evolves:

> "Sometimes regulation, it depends whether regulation has kept up, kept pace, with the changes in technology...But then, I'm sure as they like [to] push the technology boundaries, there will be some things where they have to think about ethics 'cos sometimes regulations enforce the ethics, don't they?"
> Data Handler

What appears to be contested territory between energy stakeholders is how the energy sector should prioritise ethics. Similarly, there is little guidance on navigating the tensions when there are conflicting approaches to ethical practices. As the participant below indicates, some actors in the sector appear to prioritise financial viability and success, which places them in tension with those who strive for greater equity and justice in the delivery of services.

> "I find the general ethics of people in the software industry to be incompatible with my personal general ethics. There is a lot of greed and [one-]upmanship. I have met too many unethical people in the broad software industry, multiple sectors. They're just in it for the money."
> Energy Consultant

If discussions around ethics and ethical guidelines are required to navigate these areas of tension and different prioritisation, this emphasises the critical need for accountability and responsibility in the decision-making process. Yet, many participants couldn't identify who in their organisation is responsible for, or is making decisions about, ethics. Participants seemed wary of who would have the 'final say' on ethical boundaries and decisions. There was also a concern that there would be little consensus because ethics can be understood through multiple different lenses.

> "...something I see non-ethical you could see as ethical, and we could debate, and we probably wouldn't get to a common ground, so who is that person, who's that utility that gets the final say into that common ground, and how do we report, is there a hierarchy of even raising ethic issues that we couldn't debate."
> Senior Industry Professional

Therefore, the question of who is involved with constructing ethical frameworks, making ethical decisions and/or implementing ethical assessment needs to be carefully thought through, especially considering the concerns around the diversity of voices that has been raised by participants.

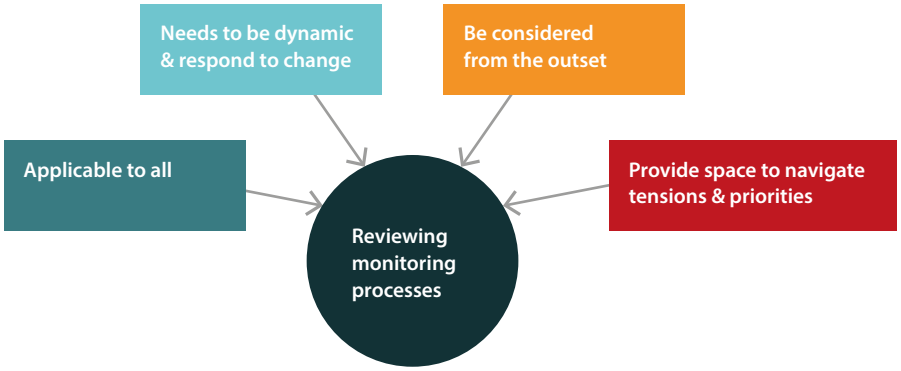


**Figure 5**: New considerations for monitoring processes

# Ethics: an aid to responsible innovation?

**Recommendation 2**: Companies should invest in programmes, including training that raises awareness of ethical considerations, to create a community of practice and an ethics-conscious culture that promotes innovation.

An emerging finding from the interviews was around how the energy sector understands innovation in relation to ethics. In positioning ethics as symbiotic with regulations, some interviewees perceived ethics as limiting agility and stifling innovation. They saw this in part because of the way that ethics can expose innovation failure. There was a concern that ethics reveal how innovation doesn't meet expectations, but this was also recognised as a benefit. Some participants saw ethics as a way of mitigating the risk of 'dazzlement' of AI obscuring what can be achieved in capacity.

More significantly, participants referenced how ethics encourages and discourages data sharing within the sector, which seems to be somewhat influenced by a shared lack of clarity about what can or cannot be shared or how. This was referred to by one participant as the following:

> "[It] feels as though the business mindset has gone from our people are our greatest strength to our data are our dragons' hoard of treasure. And even if we are not going to do anything with it, we don't want to let anyone else do it. The reason that we struggle with it is down to ethics because we say, if you shared it, more could be found out that could help accelerate the entire industry…"
> Multidisciplinary Academic

This reference to data as the "dragons' hoard of treasure", suggesting that data is very difficult to share, is further informed by several participants' reservations about the extent to which more focus on privacy when collecting data could be preventing innovations that could contribute to positive outcomes. As one participant noted:

> "Under your smart meter you have all this regulation… I say it stymies innovation. I am going to say that. It should be more open."
> Postdoctoral Researcher

Conceptualising the way that regulations and ethical considerations around privacy result in 'data hoarding' is linked to how several participants saw competition or risk-taking as integral to innovation in the energy sector. Therefore, anything that stops that risk, especially around data sharing, is seen as problematic.


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By joining up the narratives from the participants (see Figure 6) it was clear that transparency was a key issue in a number of areas, for example, the curating and sharing of data. The aim is to take a user-centred approach without compromising data privacy or facilitating the misuse of data.

> "I think things are getting a lot more transparent in terms of what is needed to be done, which is really great. But again, it's not until the things that go wrong happen that we know that there's flaws in the landscape. And unless people come forward and talk about the flaws that they've experienced, it's quite tricky to ensure that everybody's then fixing those flaws. And it tends to be a bit of a cycle, if someone does it here and doesn't talk about it, and then someone does it here and don't talk about it, and someone does it over here and doesn't talk about it."
> User Engagement Industry Consultant

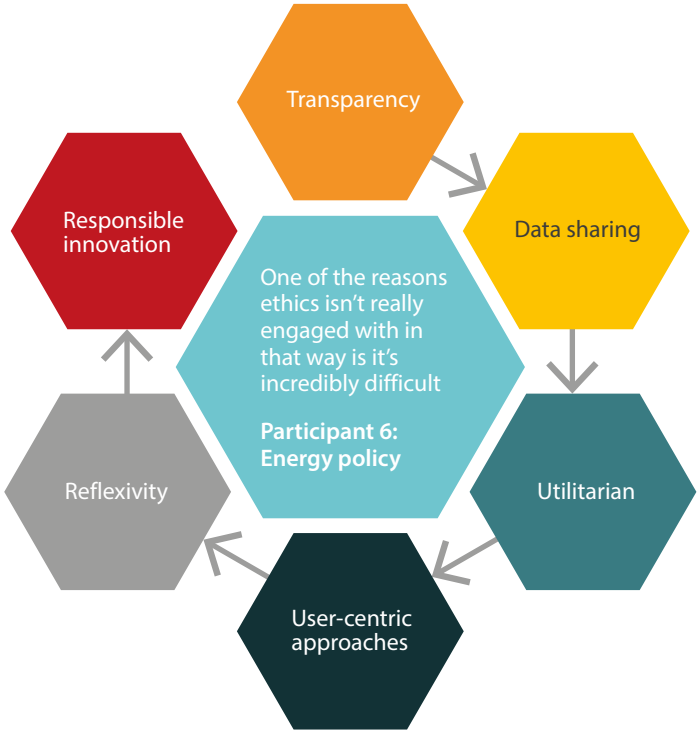


**Figure 6**: Process for achieving responsible innovation

Rather than simply reacting to problems, a future vision is needed; a systemic, robust, and visionary understanding of how ethics can be applied in the sector. This approach can bring together what can seem like competing territories, so people working in this field will feel supported and empowered when designing and deploying systems and lead to responsible innovation that positions end-users with respect and dignity ..

# Data privacy and user awareness

**Recommendation 3**: UK government(s) and Ofgem should review the effectiveness and appropriateness of data privacy restrictions given the increasing capabilities and availability of AI tools.

While the adoption of ethical practices and frameworks presents obvious challenges to the industry, there are opportunities to improve the use of data more broadly, in a way that aids transition toward fairer and just energy systems.

Privacy was the most common ethical concern raised during the engagement exercises. One participant said succinctly:

> "Privacy is the most important thing in the energy sector."
> Data Handler

Another ethical issue identified by participants was the use of legacy data. Several participants found this to be problematic, due to questions over whether consent was sufficiently informed for the use of such data in perpetuity. There was also hesitancy about how data could potentially be used for applications that may not have been considered, or even been technically possible, at the time that the data was gathered. Other concerns centred around the fact that legacy data may no longer be representative enough to be used in wider applications.

> "There can be legacy data that you're working with and that can cause issues where you might be… When you think about using that data for an ethical purpose, it might only be data collected within the five years that you essentially, have consent to use the data for that purpose. It could be that older data sets get brought in and then, that creates more risk."
> Energy and Law Professional

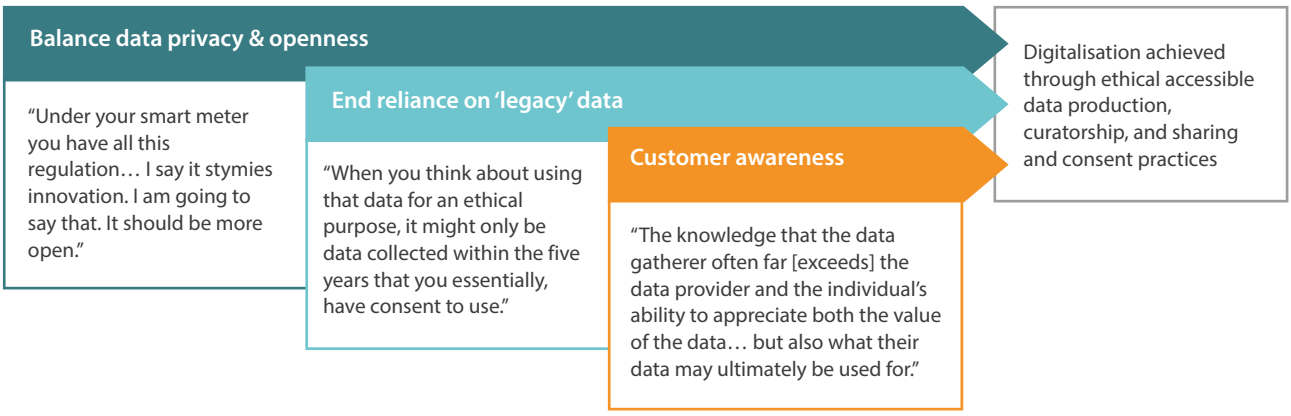


**Figure 7**: The ethics journey to better data usage

There was also an awareness of the power imbalance inherent in the knowledge gap between those collecting the data and those from whom data may be collected.

> "I think… one of the biggest challenges is this asymmetry, the fact that just because we've told somebody or we've asked somebody to kind of tick a box and say yes it's okay to use their data, doesn't mean they really understand the implications for it. So, I think that asymmetry in knowledge, the knowledge that the data gatherer often has far exceed[ed] over the data provider and the individual's ability to appreciate both the value of the data i.e. are they getting a fair deal for data that they may willingly offer up but also what their data may ultimately be used for, what could ultimately be deduced from the data that they've given up."
> Senior Industry Consultant

In contrast, other participants felt that consumers were becoming more aware of data exploitation as an emerging issue.

> "What I did notice was customers getting a lot more savvy to the questions that we were getting asked by people, how is this data being used and stuff like that."
> Senior Energy Professional

Digitalisation of the energy sector is ongoing, and this will increase the use of energy data and applications such as AI and ML. But there are clear risks and challenges if this digitalisation is not achieved through accessible, ethical data production, curation, and sharing practices.

> "There's far too much trust in technology as a kind of neutral calculator, without thinking of the human input at the beginning and the human interpretation at the other end… It is enchanting, I just want to be sure that we're building in the humanness."
> Multidisciplinary Academic

# Reframing ethics as dynamic and responsive principles

**Recommendation 4**: National government and research funders should invest in detailed sector-specific research around the use of energy data and AI to aid an industry-wide move to dynamic and responsive ethical principles.

The emerging discussions around current AI and ethics practice in decision-making reveal a lack of prioritisation around ethical issues, with these discussions often influenced by more relevant pressures or even misunderstandings about the effect ethics can have on innovation and competitiveness. This is not specific to AI implementation but occurs in other aspects of current technological and data-collection practice in the UK energy sector.

> "I suspect that ethics has very rarely played a part in any technology development and if it has, if ethical questions have ever been raised they've always been suppressed by the argument that if we don't do it someone else will do it, and that ethics tend to be imposed as a reactive response, like various industries have regulations written in blood. So, the train industry and various others, the regulations there are because of an accident, and it's always responsive."
> Energy Data Consultant

The examination of definitions reveals confusion about, and multiple understandings of, the concept of ethics and ethical practice. This raises the question of whether one definition of ethics will be sufficient to encapsulate the many aspects it needs to cover. Additionally, it raises questions about who creates the definition and whether a single definition could cause more harm by excluding ethical concerns that should be considered. Conceptualising ethics and ethics in practice as a dynamic, iterative process that shifts and changes might be more useful when applying ethical thinking in the UK energy space.

The acknowledgment of how ethics permeates both social and work environments means an understanding of ethics is constructed from the public and private domains. This emphasises the need for a fluid and responsive ethics process, one that can reference ethical concerns or experiences from beyond the energy sector itself. If this symbiotic approach is not taken, some individuals can compartmentalise ethics as only belonging to the social space or only applicable when dealing with humans, as this participant indicates:

> "Usually, when ethics are coming into context, you're thinking either organisations or individuals, but from the technology aspect, usually you're not thinking of ethics in terms of the relationship between one turbine or the other because they are objects. So, the ethical or the need for ethical consideration is not at the forefront because you're not necessarily dealing with individuals. You're dealing with objects."
> Energy Industry Engineer


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What is also significant from the findings in this discussion is how individuals did not necessarily identify as having expertise in either AI or ethics or both. Nevertheless, as the participants continued discussing and giving examples, it was evident that they did have relevant knowledge and experience in this area. This suggests an awareness of the ethical implications of AI use, but this has not been an area of focus.

> "I'm not an expert in this, but obviously we are aware there are increasingly important ethical issues not just around data and using data, but rather when you apply different AI algorithms there are ethical issues." - Senior Academic

Greater emphasis on ethics and ethical discussions as dynamic, shifting spaces is important to bring people into the process and ensure that they feel equipped to respond to ethical issues as needed.

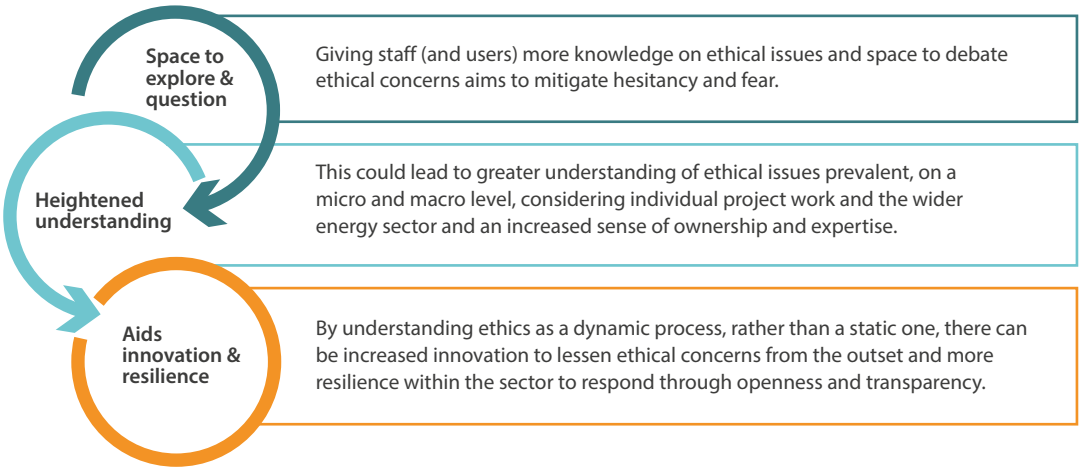


**Figure 8**: Benefits of a flexible and dynamic approach to ethics

# Conclusion

A clearer conceptualisation of ethics that reflects and responds to the digitalisation of the energy landscape will support a culture of openness and transparency for people working in the energy sector. Developing a common understanding of ethical practices through the establishment of a regulatory body for ethics in energy, would encourage the dissemination of practices that support greater ethical assessment and critical analysis of projects. While participants responded positively to having the space and opportunity to debate issues around ethics, this research brought into focus underlying concerns around the development and application of AI in the energy sector.

By more widely engaging with energy actors in AI and data, an understanding of how ethics is applied by those working in the energy data sector will be improved. In turn, implementing policies and practices that are underpinned by stakeholder voices will work towards better conceptualising ethical frameworks, contributing to fair and just transitions in the digitalisation of the UK energy landscape.

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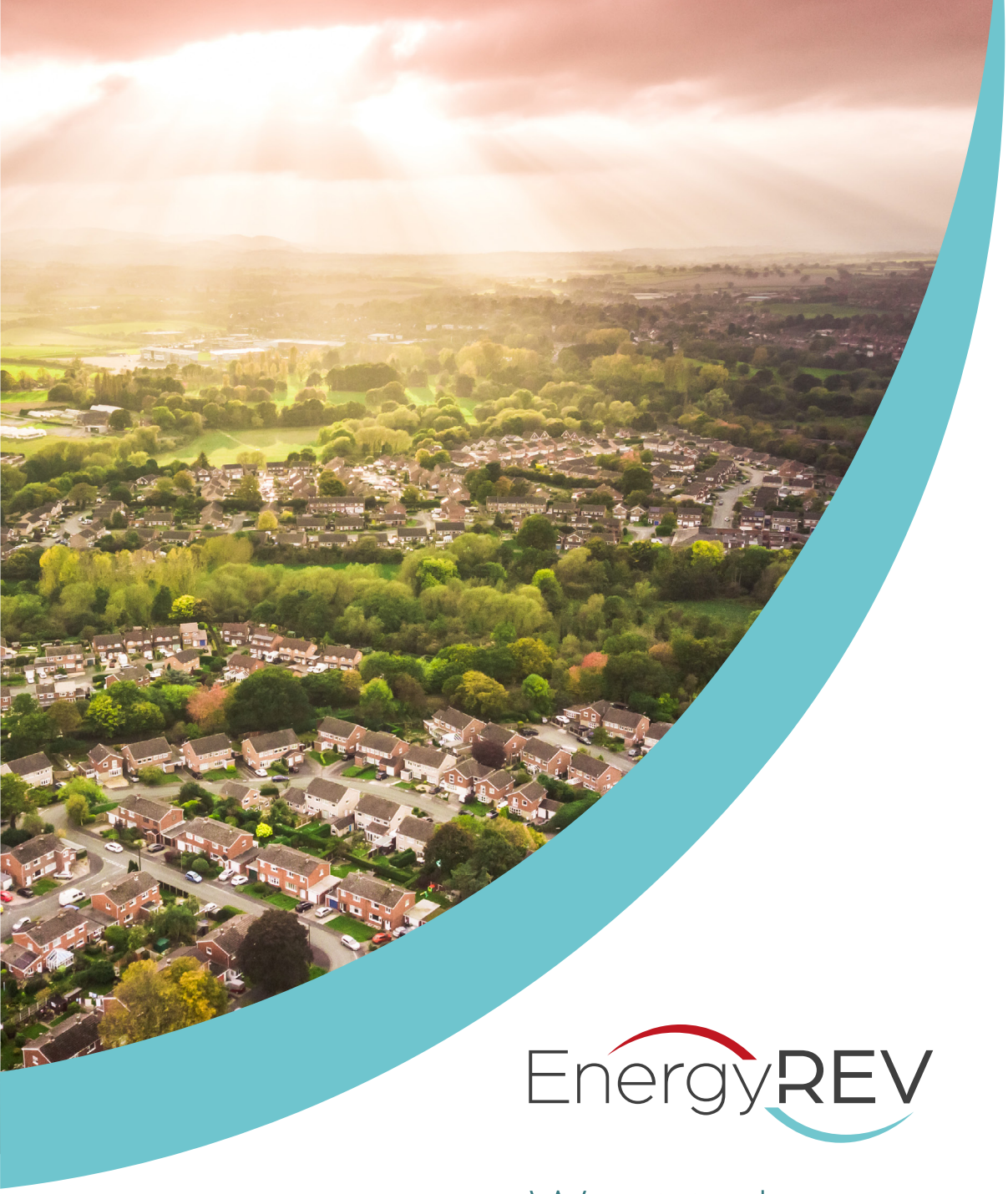

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