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Perspective

Data donation: Using the gift relationship framework to address privacy and environmental issues of energy consumption data collection

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ABSTRACT

Data, particularly consumption data, is an essential and often overlooked aspect of energy transitions. Fine-grained data on the diverse sources of energy in the energy mix, how it is distributed, and patterns of use by individuals and households help smoothen the transition to renewable energy. However, obtaining, utilizing, and storing energy data generates concerns about privacy and climate change. We propose that both the need for high quality data and concerns related to privacy and environmental sustainability can be addressed by rethinking and re-designing how data is produced. More specifically, we argue that the concept of data donation and the idea of gift relationship can be fruitfully exploited to revolutionize how we view and relate to energy data. We specify how gift relationships established through data donation address core challenges related to privacy (i.e., it enables individuals to understand the inherent value of data and empowers them to demand transparency and accountability) and emissions (i.e., it makes higher quality data available, reducing the likelihood that surplus data will be stored). Furthermore, the gift relationship lowers the likelihood of abuse by emphasizing an ethics of care, responsibility, and respect for individuals and their data. We highlight challenges that may arise, cautioning about potential abuses while also suggesting feasible ways to address these pitfalls. This perspective aims to stimulate research and debates not only on energy data, but also on how we reap benefits from it and mitigate social and environmental harms.

1. Introduction

One of the overlooked aspects of the energy transition is data. In particular, nuanced and fine-grained data on the diverse sources of energy in the energy mix, how it is distributed, and patterns of use by individuals and households help smoothen the transition to renewable energy (RE). Some energy systems such as smart grids and transactive energy require granular energy consumption data to operate effectively, and as communities and governments push to further decentralize energy, the data needs of the energy transition are expected to grow. Smart grids are electricity network systems that use digital technologies to match supply and demand of energy consumption in real time [1]; therefore they need accurate and reliable data from energy producers and consumers. Similarly, transactive energy systems respond to supply and demand of energy consumption in real time but can also include distributed energy resources and economic modeling of energy consumption/billing [2].

Emerging technologies (e.g., smart meters, which are interfaces that can frequently record energy consumption data remotely using wired or wireless communication technologies and reduce the need for manual monitoring or recording) present a tremendous opportunity to meet this demand for high quality energy consumption data, but collecting and storing these data is not without challenges. Individuals and environment are dually put at risk by the collection of massive sets of data. As the collection of data regarding the consumption of RE intensifies, tensions around data management and data collection tradeoffs, sustainability, and privacy become more apparent and raise ethical and moral concerns around data justice and environmental responsibility.

A pathway for sparking such a mindset shift can be built, we argue, by marrying the concept of data donation with the idea of gift relationship. By integrating and transposing these ideas borne in health sciences to energy sciences, we explore the nuanced and deepening relationship that we currently share with energy data and outline pathways and proposals to revolutionize it. In what follows, we outline

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the challenges related to the collection, use, and storage of energy consumption data, we put forward a line of argumentation that illustrates how these concerns may be alleviated through data donation, and how the consideration of data as a gift rather than an object to be collected refines how we see and thus treat data.

2. The importance of energy consumption data and challenges

Extensive household level energy consumption data collection is a lynchpin for promoting sustainable energy consumption and the use of RE [3–5]. For example, transactive energy requires energy consumption data as often as every 5 minutes, so that consumers can have more control over their energy bills, engage in sustainable energy consumption practices, and participate in further RE developments [2,6]. Transactive energy also allows two-way communication between producers and consumers, which enables consumers who are interested in sustainable energy practices to more easily convey their demands around renewable and sustainable energy [2].

Large energy data also facilitates grid management. With the adoption of smart grids, demand-side management, RE management, and fault and infrastructure management have gradually intensified. These practices ensure more sustainable and reliable energy systems and accurate energy consumption predictions, and they also require vast amount of energy consumption data that is captured at various temporal and spatial settings [3,7].

Furthermore, energy consumption data is important in developing batteries that address the issue of intermittency of RE [8,9]. Fluctuations in the supply of RE sources such as solar and wind render them unreliable, and several studies have tried to address this problem through technological advances [10] and economic theories [11]. To date, the most effective solution is energy storage systems that can be used during the periods of low sunlight or wind [9,12,13]. In order to measure the parameters of the required energy storage system, energy consumption data is needed.

Despite the importance of energy consumption data for sustainable and efficient energy management, energy consumption data collection poses two significant challenges. First, the most commonly discussed problem associated with energy consumption data collection is the issue around privacy [3,14–18]. Energy consumption data have been used to identify or infer household appliance use [19], socio-economic status [20], and security issues such as what people are doing in their home and if they are away from home [21]. Schirmer et al. [22] also showed that energy consumption data could be used to identify the multimedia content played by a TV or a monitor device. Consequently, governments have introduced regulations and practices to protect personally identifiable information (PII) and other personal information through intermittent sampling, data aggregation, and opt out policies [3]. Even so, the importance of real time sampling of energy consumption data is increasing as smart meters and smart grids become more diffuse technologies, which most likely will raise severe privacy issues.

Second, storing a vast amount of energy consumption data requires data centers that use significant amount of energy, water, and land and can also lead to waste, biodiversity issues [23–25]. Energy consumption data analysis requires longitudinal and granular big data, which is collected repeatedly over a long period of time. Storing such data can lead to environmental problems - data centers have been identified as one of the growing culprits of climate change [24,26], and with an increasing demand for more frequent sampling and a wider geographical coverage of smart meters, the size of energy consumption data is only expected to increase, which will add to the need for data storage.

In this sense, energy consumption data collection is a paradoxical issue. On the one hand, it addresses certain aspects of social and environmental challenges: a greater control over the energy bill, which can be beneficial to lower income households, environmental benefits that come with more efficient and systematic grid management and energy technology management, and an easier transition towards RE. On the other hand, energy consumption data collection leads to significant problems such as privacy risks and contributes to climate change by storing masses amount of data. This paper argues that a possible solution is data donation by energy users.

3. Data donation

The idea of data donation is not new. Data donation is a form of public participation in which "people voluntarily contribute their own personal data that was generated… to a collective dataset" [27]. The concept has been discussed in the health and medicine literature to encourage and publicize the importance of quality data for academic and medical research [27–30]. Some studies even present data donation as a form of ethical behavior that supports the greater good [29]. Other papers discuss posthumous medical data donation as a way to promote scientific research and to increase accessibility to patient and medical data [31,32].

With the prevalence of digital data, the notion of data donation has been adapted to digital PII. Social justice and welfare are among the key foundations for digital data donation. A few studies claim that data donation is a type of privacy preservation framework that can ensure high quality social science research [33], as it provides direct access to relevant data. In the digital data donation literature, digital trace data and computational social science become particularly relevant for studying human behavior [33,34], and some studies claim the importance of donating real time data by using specific software or plugin that monitor user behavior [35]. However, data donation in digital environments remains a severely under researched area. Consequently, it is difficult to provide overall trends or consensus of existing studies. A greater clarity on contemporary data donation can be gained through further elucidation of the concept. One field that is ripe for such experimentation is energy research.

4. Gift relationship: data donation for energy data

Our central argument is that energy data donation, which this paper embeds in the framework of gift relationship, can be a solution to dual problems of privacy and environmental issues that energy consumption data collection and storage face.

The idea of gift relationship goes even further than data donation because it highlights the absence of profit, capitalistic exchanges, and market. Initially introduced by Titmuss [36] – and highly cited in philosophical and genetics research [37–40] – to accentuate the importance of blood and organ donation that is free from market intervention and the logic of capitalism, the concept of gift relationship stresses the importance of altruism and the public good. In other words, Titmuss claimed that blood and organ donation should be a gift that does not expect a financial return as one would in a contract relationship or in an exchange of commodity. Titmuss's main concern was with equity of accessibility of blood and organs and the financially motivated third parties creating and intervening with the blood and organs market [38]. These ideas carry forward to other domains.

The idea of gift relationship is particularly useful in imagining a new paradigm in the field of energy studies, which currently is highly motivated by financial incentives through various systems and policies such as prosumerism, net metering, financial savings of customers, and monetary incentives [2,3,41]. This idea also addresses the issues of data justice by addressing notions of community creation, voluntary movements, and civic participation, which are central to building gift relationships [42]. By engaging donors in the gift relationship, data donation touches on the recognitional, procedural, and distributional dimensions of justice by acknowledging donors' roles in data production and consumption, intensifying their participation in this process, and respecting their self-determination around issues of own-data. We link the concept of gift relationship with energy consumption data donation with two goals in mind: (1) to provide potential solutions to privacy and

environmental concerns that are associated with the collection and storage of energy consumption data, (2) to explore possible policy instruments that can advance the discussion of data donation of energy consumption data.

We define data donation not only as an act of giving one's data. Instead, by calling it the gift relationship we contemporaneously address the underlying intention of altruism and the desire to serve the public – the essences of gift relationship. Essentially, we argue that in order for data donation to be disseminated and promulgated among the public, the concept must embed the ideas of compassion, selflessness, and social and public kindness.

4.1. Privacy

The data collection practices of smart meters pose socially and politically salient privacy problems. In addition to potential concerns around PII, the forcefulness of data collection by many national and regional governments is questionable. Many places (e.g., France, Norway) do not offer an opt out option to smart meter installation, which effectively makes the installation mandatory [43,44]; consequently, energy consumption data is being collected without individual or household level consent. This enforcement neglects privacy concerns from the general public. In some of the places that offer an opt out option, there are financial penalties (e.g., California) because the utilities must then send out employees to check on the electricity use for billing purposes [3,45]. This discriminates against lower income households that cannot afford to opt out and are thus more likely to install smart meters. This ultimately leads to inequitable data collection processes and outcomes in which financially marginalized communities are more likely to have their PII extracted and exploited.

Data donation can be an alternative approach that resolves privacy issues, which are so closely entangled with energy data collection. The process of gathering and negotiating customer consent provides an opportunity to increase transparency in which organizations and institutions notify customers as to how their personal data will be used and stored. Because data donation relies on the good will of the public and affords them control over data collection as the donor, organizations that handle energy consumption data are more likely to limit the amount of collected data to what is truly essential (i.e., the principle of data minimization), and to use data only for the specified purposes (i.e., purpose minimization and use limitation). In a similar fashion, increased accessibility improves processes of data rectification and erasure. Thus, data donation could better align energy data collection with the privacy principles proposed by the Fairness in Information Practices Principles (FIPPs) and the EU General Data Protection Regulations (GDPR). In this sense, data donation honors privacy regulations and guidelines proposed in both sets of principles. Such an effort must be accompanied by the development, establishment, and implementation of appropriate governance mechanism which emphasize transparency and prevent the misuse or mishandling of data. Mechanisms emphasizing responsibility (of utilities), accountability, and transparency have the added benefit of raising donor trust and engagement in the process. Donors' active involvement in the deliberations and design of these mechanisms – for instance through co-creation [46] – will ensure that they are democratically achieved.

Furthermore, obtaining energy consumption data via data donation could yield long-term benefits. The processes and ideas of data donation will ultimately change societal perception of data as something that can be owned and controlled by individuals. This returns the agency of data collection processes back to the public and places the energy organizations as secondary and passive recipients of data. We hope that this changing notion of energy data collection stimulates the design and development of new safeguards that allows for alternative thresholds for individual and public ownership of data.

4.2. Environmental concerns

Data collection is contributing to climate change due to the data storage capacity that it requires. Because of the lack of global environmental policies and regulations around data centers and because companies tend to treat the location and capacity of data centers as confidential information, it is difficult to determine the exact impact of the energy consumption data on the climate crisis. Nevertheless, with the development of new and emerging technologies and with new modes of harvesting finer grain data, the scale of data collection will be exponential. Energy consumption data is collected almost in real time (i.e., some countries collect data every 30 minutes, others every 15 minutes depending on the type of data) [3] and the data are collected for every household, industrial buildings, and commercial buildings. The data, not all of which are useful, are then saved for many years to predict the most accurate energy consumption for a household, neighborhood, or region. These practices of data collection and storage are likely to have a significant impact on the data centers capacity; and consequently, climate change.

Data donation has the potential to mitigate the aforementioned climate related challenges posed by energy consumption data. Energy consumption data collected using data donation is likely to generate more complete data that is higher in quality (i.e., lower rates of missingness, less noise). Thus, the amount of data needed to make accurate predictions may be reduced even as the accuracy of predictions increases. This also reduces the size of data that must be stored. In other words, data donation yields higher quality data with greater accuracy and detail. Consequently, energy models can achieve comparable if not higher levels of accuracy with less data. This in turn will lower demand for data storage and management.

For example, in the U.S., California established the "15/15 Rule" to promote privacy for energy consumption data. The 15/15 Rule states that a utility could only share data if it is aggregated for 15 or more customers and only if the collected customers comprise less than 15 % of the aggregated group's consumption [47]. A similar rule was adopted in places such as Colorado and Illinois. Furthermore, New York decided that the 15/15 Rule was too restrictive and opted for the 4/50 rule (4 households accounting for no more than 50 % of aggregated energy use) [48]. These types of restrictions, although useful for privacy protection, lead to less accurate energy consumption predictions because household data are merged and aggregated. Any variations or changes in households such as people moving in and out, new family members, and occupational or lifestyle change can lead to different energy consumption patterns, which cannot be detected using aggregated data. We posit that if data is donated, energy providers are more likely access PII related to energy consumption habits, which can yield a more accurate energy consumption predictions.

5. Discussion: limitations to data donation

Despite the potential advances data donation offers, there are some limitations that must be discussed. One that is most significant and somewhat obvious limitation is biased data collection. The people who decide to donate their energy consumption data are more likely to have an interest in energy and environmental issues and are more likely to be concerned about their PII and privacy. As a consequence of this selection bias, the collected data may not be generalizable to the wider population, and they may not portray an accurate picture of the energy dynamics. In order to improve the quality of the collected data and to minimize sampling biases, it is vital to educate the general public about the importance of data donation for climate change mitigation. Data donors would not receive any financial compensation or incentives for their donation, and the primary motivation for donation derives from political attitudes and beliefs that their voluntarism contributes to the public good (which is also Titmuss's explanation for why people donate blood and organs). As studies employing contingent valuation have long

demonstrated [49,50], altruism and social responsibility are both rewarding and valuable to individuals and motivate them in a similar way that monetary incentives do. Establishing this relationship (i.e., data donation and contributions to the public good) would be the most foundational component of data donation. Various outlets and strategies must be used in order to reach as many varying social and political groups as possible. For example, social media may be used to reach the younger population. For the older population that have built a community around their neighborhoods, community workshops may be useful. Engaging with varying types of educational outlets would increase public awareness and participation, give agency back to the customers, and protect privacy to the best of existing systems and institutions' abilities.

Another problem is that once individuals or households decide to donate their energy consumption data, control is then handed over to energy providers that may potentially abuse the system by collecting data too frequently, store the data for an extensive amount of time, fail to offer donors an option to rectify or delete their data, and collecting too much PII. These types of practices must be strictly regulated and monitored. The utilities must be reminded that they can collect energy consumption data because of people's good will, which must be respected and appreciated. Here, the question of design comes into play, ensuring the ethical use of data must be built into by design. Furthermore, the donors should also receive sufficient education and training on how to control their own data.

Data donation requires accompanying democratic governance mechanisms that guide the operation and performance of data donation, either through a centralized institution or through the adoption of an overarching set of principles and programs. For instance, educational programs designed to raise awareness and to encourage data donation could be rolled out. One might assume that data donation is singularly an anarchic and community-based proposal because it relies on individual responsibility and ownership. However, it requires good governance principles such as responsibility, accountability, and transparency to prevent data bias and data misuse. We further propose that donors should be involved actively in the co-creation of governance institutions and mechanisms for data donation to ensure that the resulting mechanisms adhere to democratic principles and reflect societal values.

6. Conclusion

With this paper, we seek to stimulate a conversation about energy data, promote new ideas on how to relate to it, and contribute to ensuring that a global energy transition is achieved in the most ethical and responsible way. We merge the concepts of energy consumption data donation and gift relationship. We argue that data donation can only work as a framework if it is perceived as a form of gift relationship. The donors should donate their data for the sake of environmental sustainability and the utilities should be grateful for the donated data, which should be used with thoughtfulness and deference. Essentially, data donation puts individuals and households in the driver's seat when it comes to the question of access to data. It dually recognizes their decision-making power while also asking them to be responsible for this data and how it is used. In this sense, this framework has the potential to revolutionize how people and society view data.

The transfer of data through data donation also denotes a transfer of responsibility when individuals entrust this information to others. Here is where the idea of the gift relationship comes into play as it puts the emphasis on what is being gifted: data. It reminds both the giver and receiver that data is something meaningful and precious. Just as a friend may be curious about how a gift was ultimately put into use, the gift relationship transforms how data holder and data user relate to one another through the accessing of data which may later be inquired upon and even retrieved.

We are moving into an era with more energy options, and our relationship with energy itself may begin to shift. A shift to data donation must be pursued with the necessary safeguards in place. Given the important concerns tied to the data that we use, considering how we design our data gathering and utilization process in light of this new opportunity is a new agenda point for energy scientists like ourselves.

CRediT authorship contribution statement

Dasom Lee: Writing – review & editing, Writing – original draft, Funding acquisition, Conceptualization. **Le Anh Nguyen Long:** Writing – review & editing, Conceptualization. **Sikke R. Jansma:** Writing – review & editing, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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