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Unlocking energy efficiency potential through digitalization

Addressing Behavioural Barriers to Energy Digitalization

Note by the secretariat

Summary

Many technologies have been developed recently to reduce greenhouse gas emissions through digitalization. Although many of these technologies are readily available, the pace of energy system transformation is slow. One of the crucial factors, and the missing link in understanding the lagging implementation of these technologies, is human psychology. Individual psychological and behavioural barriers to adopting digitalization must be overcome to realize the full potential of technologies.

Recognizing this, the Group of Experts on Energy Efficiency, in the course of implementing its Work Plan for 2022-2023, assigned the Task Force on Digitalization in Energy to explore and provide insight into the matter of psychological and behavioural barriers and prepare a report.

In response, The Task Force on Digitalization in Energy developed the present document that takes into account psychological aspects and focuses on energy behaviour (actions that affect the way energy is utilized to achieve desired services) and its interlinkages with digitalization, energy efficiency, and broader energy system transformation. It identifies and assesses seven barriers and suggests ways to overcome them.

I. Introduction

1. Digitalization enables fine-grained measurement and real-time monitoring of energy usage. This information in turn increases prediction accuracy and results in better energy user decision-making. The outcome ultimately contributes to improved energy behaviour, which for the purpose of this document is defined as all human actions that affect the way energy is utilized to achieve desired services.[1] This includes the application of energy-related technologies and materials, the ways in which these technologies are used, and the psychological and behavioural processes that inform human interaction with energy and new technologies.[2] The advantages include improved efficiency, reduced costs, increased participation at an individual and a community level, and enhanced flexibility of the energy system.

2. Though many of the digitalization technologies delivering these advantages are currently, or soon to be available, many people and companies are still apprehensive to adopt digitalization. Greater knowledge sharing, increased incentives, and tailored policies are required for more significant acceptance, which is a first step toward subsequent adoption.

3. Before these steps can be successful, it is imperative to gather data on prime causes, motivators, and enablers, which can help bring about the required mindset. For example, individuals may be open to adopt digitalization to improve energy behaviour but may have limited capacity, caused by routine or any other individual factor, to change behaviours.

4. By leveraging digital insights to use energy more effectively, the resulting energy use reduction can lead to monetary savings for consumers. These potential savings can be used as a motivational driver to use more digitalization technologies. Beyond savings for individual consumers, businesses and offices can also gain major savings. In this way, the integration of digitalization can be viewed as a cost saver rather than a cost driver.

5. This document describes seven barriers that commonly deter individuals and companies from significantly improving energy behaviour and reaching the full potential of energy benefits achievable through digitalization, specifically:

(a) The experienced cost of change;

(b) Fear of failure;

(c) Addressing the right need;

(d) Missing intrinsic motivation;

(e) Disempowering beliefs;

(f) Maintaining consistency over time;

(g) Negatively formulated goals.

II. Overcoming Barriers to Achieving the Energy Benefits Enabled by Digitalization

A. Lowering the Cost of Change

6. The first barrier involves the costs of changing a habit. Habits are important for humans and making adjustment or changing engrained behaviour requires effort. Humans tend to only change their habits when the cost of keeping a habit is larger than the cost (or

[1] This document is an adaptation of an unpublished study by E. van Genuchten, A. Udall, B. O'Regan, D. Pandya, and R. Savickas (members of the Task Force on Digitalization in Energy of the Group of Experts on Energy Efficiency), to the United Nations Economic Commission for Europe region.

[2] D. Crow et al. Do we need to change our behavior to reach net zero by 2050? International Energy Agency. Available at: https://policycommons.net/artifacts/1860682/do-we-need-to-change-our-behaviour-to-reach-net-zero-by-2050/2608854/

effort) of changing their behaviour. This implies that to make change more likely, the options are either:

(a) To reduce the cost of change (i.e., make it easier to become more energy-efficient), or;

(b) To increase the cost of keeping the habit (i.e., making it more difficult to stay energy-inefficient).

7. Digital technologies can be used to this end:

(a) Digital standards can be developed, so that energy users follow behavioural guidelines to increase energy benefits. In buildings, for instance, a combination of data analysis and energy modelling can be used to segment building owners (or residents) into groups with similar energy behaviour patterns and known actions that result in improving energy efficiency. One emerging trend is the use of "gamification", which turns friendly competition into a game (for example, a user gets to see if they can save more energy than their neighbours). This drives further engagement and incentivizes such energy saving actions;

(b) Machine learning techniques can also be used to reduce the cost of change by analysing data (preferably real-time data if available) and providing continuous insights on energy use and cost. This makes decision-making easier and encourages positive behaviour change. Machine learning also offers potential to learn human behaviour and make automated decisions, such as automatically switching between energy sources, including storage. Specifically, techniques such as reinforcement learning. Reinforcement learning is about obtaining the maximum reward by learning the optimal behaviour in an environment (can be deployed for more intelligent controls for built environment).

8. An example of increasing the cost of keeping a habit is when owners of building hardware, such as photovoltaic equipment, are prevented from receiving benefits when they decide against having their equipment being monitored, managed, and controlled by trusted third parties. Participation in the power grid can offer huge benefits to both the entity that is responsible for operation and maintenance of the grid (utilities, transmission, and distribution system operators, etc.) and the building hardware owners.

B. Overcoming Fear of Failure

9. The second barrier involves fear of failure and the related anxiety for potential embarrassment. The latter often leads to continuing business-as-usual, thus making individuals less likely to adopt a new behaviour.

10. Overcoming fear of failure may necessitate a change of perception, so that the process is recognized more as a learning curve concept which implies a cycle of (1) acting, (2) reflecting, (3) learning, and (4) planning.

11. Internet of Things (IoT), as one example, can be used to support users to reflect and learn from detailed measurements concerning energy usage. This can be achieved via smart meters, sensors and end use submetering, which can provide real-time data to a central software application. This data enables energy use analysis, which users can utilize to optimize their energy usage. The application may also feature information on scenarios-based economic benefits.

12. Also, Artificial Intelligence (AI)-based recommendation systems can be used to advise, based on available best practices, on end-users' actions to achieve personal objectives. This in turn reduces the fear of making a wrong decision. And though big data is too complicated to be directly used by a general user, it can be used when converted into a user-friendly, readable, understandable form. Thus, user-friendly software interfaces reduce requirements on special skills and knowledge, so that the fear of failure is likely to decrease.

C. Addressing the right need: Alleviating pain vs. Creating gain

13. This barrier involves not addressing the right needs and priorities of the users. It is important to know what is more important to them – reducing the pains (e.g. reducing cost of a product or service) or increasing the gains (e.g. increasing the benefits through complementary products or services). People focus their decision-making on either moving away from personal pain or moving towards personal gain. When adopting digital solutions to increase energy benefits, it should be considered how these contribute to helping an individual move away from pain and towards related gains. Addressing both when designing and implementing a technology and when communicating the importance of energy benefits provides multiple motivators for behavioural change.

D. Triggering intrinsic motivation

14. This aspect of self-orientation involves intrinsic motivation, which comes from within. For example, an individual is intrinsically motivated by decisions that align to their personal values. This is in contrast to extrinsic motivation, which comes from external factors such as grants, fees, and legislation. When people are intrinsically motivated to adopt digital solutions, their motivation is usually stronger and lasts longer. To achieve energy benefits, digitalization should therefore trigger intrinsic motivation by taking the benefits for users into account.

15. Besides using digital technologies to increase intrinsic motivation by appreciating users' efforts towards energy usage goals, these can be used by applying game mechanics into non-game environments ('gamification') aimed at reducing energy consumption, competition between similar buildings, immediate feedback, or capacity-building. It is important to note that gamification must form part of a wider strategy and not as a stand-alone solution.

E. Creating empowering beliefs

16. Humans tend to harbour certain beliefs about themselves and their identities, which can be (but are not necessarily) true. These beliefs in what an individual considers to be within versus beyond their capabilities can both help achieve goals by providing a motivating force, and hinder change. For example, as Henry Ford famously stated, "Whether you think you can, or you think you can't, you're right". The positive "I can" sentiment is an empowering belief; an "I cannot" sentiment is a limiting belief and can lead to self-sabotage or otherwise prevent success. By identifying limiting beliefs and intentionally flipping them to empowering, behavioural change can be self-motivated and supported by the individual.

17. Natural language processing techniques like sentiment analysis can be used to analyse the emotional tone of voice in a message and the implications of various empowering and limiting beliefs. Such data analysis can prove to be an essential tool in keeping people motivated, by providing informative updates on a person's motivation and progress towards goals. The data insights keep reminding users of empowering beliefs, yet it is important to note that negative insights may have a detrimental effect and may in fact have the opposite effect on their beliefs.

F. Maintaining consistency over time

18. Although single actions make a positive difference, consistency over time ensures that the impact grows. As discipline or a strong intrinsic motivation is required for humans to be consistent over a long period of time, certain tasks might be facilitated by digital solutions. By automating decisions to improve energy benefits, positive effects add up automatically.

19. Digital technologies can be used to automate tasks and decisions, for example by detecting occupancy of a room using sensors to turn off the lighting or reduce heating. Doing this repeatedly increases the amount of energy that is saved by turning them off.

20. As concerns resource efficiency, using AI can also improve recycling so that less materials and energy is required to produce materials, thus higher rate of materials' reuse and related environmental and economic benefits. To achieve this, AI is trained to identify waste objects and which materials they are made of, to enable an automated and correct separation of objects and materials.

G. Setting positively formulated goals

21. Humans tend to focus intensely on pathways that they do not want to take, and often the consequence is that they in fact end up manifesting that exact outcome. In turn, positive and visionary goal setting can direct efforts towards achievement of the desired targets. Hence, to achieve better results, decisions on how to use digitalization to increase energy benefits should also focus on 'where to go', as opposed to 'where not to go'.

22. Digital technologies can ensure that goals are set in a positive way, for example by using AI to recognize goal definitions and if necessary, reformulate them. Such technology can use software to create output (e.g., progress visuals, models) that is in line with positively formulated goals.

III. Recommendations

23. Understanding these behavioural barriers and overcoming them has many advantages for human energy behaviour. Leveraging behavioural changes contributes to speeding up the energy transition. To achieve this, the Task Force on Digitalization on Energy suggests the following key conclusions and policy recommendations:

(a) Realizing that psychology is key driver to change in energy use: Awareness of human psychology enables the formulation and implementation of effective behavioural change instruments that are more likely to succeed in changing energy use habits. This knowledge should be used as a facilitating factor in decision-making and communication, as well as when taking action;

(b) Using digitalization as a facilitator for psychological and behavioural change: Digitalization is not only useful in facilitating transformation of energy systems but can also be used as a tool to address psychological aspects as well. Well-designed digital technologies can address both the systemic and behavioural transformation of systems and make it easier for individuals to contribute;

(c) Making the use of digitalization technologies easy: When digitalization is implemented, it is important that these digital solutions are as simple as possible to use. This means that the final product for the consumer should be easily understandable by the general public (i.e., non-energy experts). Also, it is important that solutions are highly accessible and affordable, and that users are informed about the multiple benefits at the individual as well as the system level;

(d) Making change easy: Whenever individuals are required to change, the experienced hurdles of such a change should be made as low as possible. This is because humans prefer to keep their habits, and most people are only willing to change when the experienced cost is lower than the experienced hardship of continuing this habit;

(e) Addressing people's 'pains and gains': Apart from making sure that the cost of change is as low as possible, it is important to communicate and consider people's pains when they do not change, and their gains when they do decide to change. This is because moving away from pain or towards gain are the two main forces in decision-making. When digital solutions are employed, it should be clear to a user how these solutions contribute to relieving pain and creating gain in their life;

(f) Triggering intrinsic motivation: To make sure that users are willing and likely to keep their new behaviour, and continue using digital solutions, it is important that they are motivated from within. This ensures that people want to keep up their behaviour. When they

would instead feel that they are forced to make a change, the perceived cost of that change is increased, making it less likely to continue or even inspire others to do the same;

(g) Reducing people's mental load: Adding new tasks and decisions to the routine may not be possible as it may require too much capacity. That is why digitalization should be used to encourage automated task performance and decision-making as much as possible and ethically viable;

(h) Leveraging empowering beliefs: Everyone has beliefs, either consciously or unconsciously, that guide their behaviour. When such beliefs include a perceived limit to a person's ability to contribute to the transformation of energy systems (e.g., the belief that individual contribution is so small that it does not make a difference) they should be addressed and overcome. Instead, empowering beliefs should be cultivated;

(i) Supporting consistency over time: Apart from inspiring people to take action once, it is important to create consistency over time. This ensures that all small changes add up to make a difference. At scale, this can make a significant contribution to transforming the energy system. Digital solutions can be used to automate processes and create consistency;

(j) Formulating positive goals: To implement a sustainable energy development strategy, it is important to communicate positive goals and generally foster positive goal setting in legislation and regulations.