An Exploration of Telecommuters' Perceptions and Narratives on Energy Usage in the Netherlands

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Abstract

This study was conducted to investigate the energy consumption patterns of energy sector telecommuters after the COVID-19 pandemic with focus on integrating telecommuting with energy-efficient behaviors and digital technologies. Energy sector telecommuters were selected mainly because of their specialized knowledge and direct experience in their energy consumption pattern. Through semi-structured interviews, this research showed that telecommuting has a dual effect on energy consumption, and while the reduction in commuting has led to a reduction in fuel and energy consumption, the increase in energy consumption at home was also highlighted. To optimize energy consumption at home, telecommuters have increasingly turned to using smart and optimal technologies. However, challenges such as building restrictions and high costs of energy-efficient technologies have created an obstacle in the way of this adaptation. The findings of this research emphasize the need for strong support policies and organizational incentives to increase energy efficiency among telecommuters and point to the importance of aligning digitization efforts with sustainability goals.

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1.Introduction

Since the beginning of the COVID-19 pandemic, telecommuting[1] has spread more than before in the world and has created many changes in work practices and arrangements. It has created different opportunities and challenges for different employees, companies, and societies. Telecommuting includes different practices, including full-time or part-time remote work, each of which has different effects on commuting patterns, work productivity, and personal well-being (Asgari & Jin, 2018). Telecommuting involves performing job duties outside of the traditional office environment, often from home, and using technology to increase productivity and maintain communication. Due to the variety of definitions and methods of telecommuting implementation, various strategies are used by organizations and individuals to adapt to this work style. With the increasing promotion of telecommuting after the COVID-19 pandemic, a suitable opportunity has been created to investigate its effects on energy consumption. understanding these effects is important to increase energy efficiency and develop effective energy-saving strategies. also, it can help the efforts to maintain Energy stability and sustainability.

Studies have shown the results and potential of telecommuting to lessen carbon emissions remarkably. For instance, two research projects (KASTOM and LIFE ASTI) were carried out quantitatively in Greece during and after the COVID-19 pandemic to investigate the impact of telecommuting on the environment. Based on two specific research projects, during and after the COVID-19 pandemic, a significant reduction in carbon emissions between 49% and 55% was observed. This reduction has been attributed to the decrease in commuting and less use of cars for commuting. Assuming that 50% of employees are working remotely during the pandemic, this research emphasizes the reduction of commuting and changes in electricity consumption to meet the telecommuting requirements due to setting up computers and using the Internet. The Kastom project shows a 55% reduction in electricity-related emissions and a 40% reduction in transportation during the pandemic. Life Asti also indicates a 49% reduction in electricity emissions and a 47% reduction in transportation emissions and generally emphasizes the impact of telecommuting in reducing environmental impacts(Papadogiannaki et al., 2023).

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[1] In the Netherlands, the term 'home office workers' is generally preferred, as these workers often have hybrid working conditions(*Statista,* 2020). Please check definition section.

Also, a research carried out after COVID-19 in the Netherlands showed that telecommuting has a major effect on traffic congestion and commuting and reduces the traffic load. this study utilizing a unique dataset combining large-scale GPS tracking and detailed survey responses from Dutch employees demonstrated significant changes in teleworking habits and commuting behaviors. According to this research, employees use their cars less due to their desire to continue working at home, which helps to save energy and create new patterns for the prediction of commuting(Olde Kalter et al., 2021).

After COVID-19, telecommuting has become one of the main elements of sustainable urban development programs throughout the Netherlands. Combining advanced building technologies and sustainable design principles helps reduce energy usage among telecommuters. Telecommuters in the Netherlands mainly work from home and benefit from various designs such as advanced insulation, energy-efficient windows, and smart home technologies that these actions minimize energy consumption. They also optimize energy consumption by using renewable energy sources such as solar panels and heat pumps, among other measures. Government measures, such as the ''Zet ook de Knop ''campaign, also encourage people to use energy-saving practices(Vasseur et al., 2024). Also, the Netherlands is trying to strengthen its IT infrastructure to support telecommuting. By investing in high-speed Internet capabilities, it is possible to create a more flexible and efficient work model. Strengthening these structures contributes to sustainable development and a work-from-home culture aligned with modern digital workflows("The Netherlands Thrives in a World of Digital Connections," 2020).

This research is presented to investigate the narratives of telework in Netherlands, focusing on the perceptions of energy consumption among telcommuters

1.1. Research Problem

The evidence shows that working from home could lessen energy spent traveling to and from the office and, therefore, lower carbon emissions. Many studies have proven that telecommuting reduces energy used in traveling and, as a result, reduces carbon footprints. Accordingly, several studies have shown that telecommuting practices have reduced daily commuting and the associated energy consumption because of the COVID-19 pandemic. This has benefitted urban air quality and road congestion (Chen et al., 2022).
In addition to this and beyond environmental issues, telecommuting has a significant impact on the mental health of telecommuters. Saving time by reducing commuting reduces stress and increases the balance between people's work and life. According to the Eurofund report, one of

the important stress factors is commuting, caused by traffic congestion and exposure to environmental pollutants. According to studies conducted in countries such as the Netherlands, Germany, and France, reducing commuting due to working from home office, reduces stress and fatigue. Also, telecommuting increases flexibility in work planning and creates a balance between work and life, and for this reason, employees can better manage personal and family issues. In studies conducted in Belgium, about 56% of employees emphasized the positive effects of home office work on their work-life balance and stated that this work procedure increased the quality of their lives and made it easier to manage household chores. Overall, it has increased the balance between work and personal life(European Foundation for the Improvement of Living and Working Conditions. & International Labour Office., 2017).

However, telecommuting's environmental benefits are not immediately apparent and may be offset by rebound effects. When the rebound effect occurs, energy saved is negated if used for other purposes. Higher residential energy consumption, for instance, could result because one spends more time at home if they are not commuting to work. This could offset many of the benefits of not commuting(Shi et al., 2023). Due to the complex effects of telecommuting on the environment, it is necessary to consider its direct and indirect effects. In the meantime, less attention has been paid to the personal experiences and perceptions of persons who work from home office, while examining these perceptions can provide useful insight into the motivation and obstacles of telecommuters, which can provide a basis for identifying energy-saving methods among telecommuters.

Through this study, valuable insights can be gained about the consequences of telecommuting and suitable solutions can be provided to increase the positive effects of telecommuting. Examining these personal narratives and perceptions makes it possible to understand how telecommuters understand their role in achieving sustainability goals and determine the motivations or barriers to their participation in energy-efficient methods.

1.2. Research Objective

The main goal of this research is to investigate the narratives about telecommuting, with a special focus on understanding the perceptions of telecommuters in the Netherlands in terms of their energy usage. By evaluating the qualitative dimensions of telecommuting practices, this study goals to concentrate on how telecommuters conceptualize their impact on energy consumption and identify the strategies they employ or suggest for boosting energy efficiency within the context of telecommuting. Furthermore, the purpose of this study is to investigate the different insights of telecommuters about their role in supporting energy consumption, so

that the review of these insights, will help to develop effective telecommuting practices, and in this way, it will support well-being and productivity and helps to energy conservation and sustainability.

1.3. Research questions

Main Research Question:
How do energy sector telecommuters in the Netherlands, particularly in urban areas like Amsterdam, perceive and narrate their energy consumption patterns, focusing on the compatibility of telecommuting with energy-efficient behaviors and digital technologies?

Sub-Questions:
1- How do telecommuters describe changes in their energy usage due to telecommuting?

2- How do telecommuters perceive their individual impact on energy consumption as a result of telecommuting, considering both reduced commuting and increased home energy use?

3- What energy-saving measures do telecommuters in urban areas find most effective, and how do they integrate these practices into their daily work routines given their digital skills and access to smart technologies?

1.4. Literature review

Because of the increasing acceptance of telecommuting in different countries, the world is witnessing a different perspective on employment, and considering the speed of changes in this field due to international changes, there is a need to examine the various dimensions of telecommuting further(O'Keefe et al., 2016). This literature review applies a body of general literature on telecommuting to the Dutch context. It highlights the significant increase in telecommuting after the COVID-19 pandemic and its impact on different perceptions of the workplace.

The increase in telecommuting in the Netherlands has made it necessary to investigate its effects on energy consumption and environmental sustainability. It is also important to examine the opinions and experiences of Dutch telecommuters in this field because it helps to understand broader concepts about sustainable work practices and understanding of the

impact of telecommuting on energy consumption and sustainability(O'Brien & Yazdani Aliabadi, 2020).

1.4.1. Definition

Telecommuting in the Netherlands is widely defined in various scientific and professional fields. According to Allen (2015), a clear definition of telecommuting according to the existing interpretations of it seems necessary. These definitions cover a wide range, including replacing commuting with telecommunication technologies or any work done outside of a traditional office environment using digital tools. Knowing the variety of forms and methods of remote work is necessary for a deeper understanding of their effects on energy consumption and environmental sustainability (Allen et al., 2015).

Term Used	Definition	Publication
Distributed work	Employees work over geographical boundaries and to some extent work with computer-mediated communication in order to achieve a common goal	Bosch-Sijtsema, P. M., & Sivunen, A. (2013)
Flexible work arrangements	Alternative work options that allow work to be accomplished outside of the traditional temporal and/or spatial boundaries of a standard workday	Shockley, K. M., & Allen, T. D. (2007)
Remote work	A work arrangement in which the employee resides and works at a location beyond the local commuting area of the employing organization's worksite; generally includes full-time telework and may result in a change in duty location to the alternative worksite	U.S. Office of Personnel Management. (2013)
Telecommuting	The use of telecommunications technology to partially or	Mokhtarian, P. L. (1991a)

	completely replace the commute to and from work	
Telecommuting	Working some portion of time away from the conventional workplace, often from home, and communicating by way of computer-based technology	Golden, T. D. (2006b)
Telecommuting	Work conducted from home that is often supported by telecommunications technology	Kossek, E. E., Lautsch, B. A., & Eaton, S. C. (2006)
Telecommuting	Work arrangement in which employees perform their regular work at a site other than the ordinary workplace, supported by technological connections	Pinsonneault, A., & Boisvert, M. (2001)
Telecommuting	The use of information and communication technologies to replace or substitute for work environments that require individuals to commute to a traditional office	Bélanger, F., Watson-Manheim, M. B., & Swan, B. R. (2013)
Telecommuting	Systems that enable employees to perform regular, officially assigned duties at home or at alternative work sites geographically convenient to their residences	Pearce, J. (2009)
Telework	Work performed by (a) those whose remote work is from the home or a satellite office, (b) those whose telework is primarily in the field, and (c) those whose work is 'networked' in such a way	Morganson, V. J., Major, D. A., Oborn, K. L., Verive, J. M., & Heelan, M. P. (2010)

	that they regularly work in a combination of home, work, and field contexts	
Telework	A form of work organization in which the work is partially or completely done outside the conventional company workplace with the aid of information and telecommunication services	Konradt, U., Schmook, R., & Malecke, M. (2000)
Telework	Work that relies on technology-mediated communication and sophisticated information-processing capabilities instead of colocation for the production and delivery of work outputs	Garrett, R. K., & Danziger, J. N. (2007)
Telework	A work arrangement in which employees perform their regular work at a site other than the ordinary workplace, supported by technological connections	Fonner, K. L., & Roloff, M. E. (2010)
Virtual teams	Spatially or geographically dispersed work arrangements that are generally characterized by a relatively short life span, technology-enhanced communications, and a dearth of face-to-face interaction	Tworoger, L. C., Ruppel, C. P., Gong, B., & Pohlman, R. A. (2013)

Table 1. Sample of telecommuting definitions used in literature

In the Netherlands, telecommuting includes different arrangements including full-time, part-time, and occasional, each offering various levels of flexibility and independence. The term ''Home Office Workers'' is preferred as the meaning of telecommuting in the Netherlands and telecommuting itself is usually not used(*CBS*, 2024.). This class of employees divides their work

time between home and traditional office spaces in a hybrid way, which has caused more flexibility and a noticeable reduction in energy consumption(Athanasiadou & Theriou, 2021). This thesis uses a combination of definitions from Mokhtarian (1991a), Golden (2006b), and Bélanger et al. (2013) articles based on the hybrid work model and the increase of this model in the Netherlands. The combination of these definitions can be the most appropriate definition of telecommuting in this research in the context of the Netherlands because, in addition to the definition of hybrid work, it emphasizes the use of digital tools and technologies in working from home, which contributes significantly to an analysis of how energy consumption is impacted by telecommuting. Considering the plans of the Netherlands to reduce energy consumption and achieve environmental goals, the integration of this variety of work routines can greatly contribute to energy efficiency and sustainability. For this reason, knowing and understanding the heterogeneous nature of home office work seems necessary to achieve these goals (Guerin, 2021).

1.4.2.Telecommuting and Energy Consumption

Across Europe, awareness is rising of how energy and carbon emissions are saved through telecommuting. In this regard, the significant environmental impact of telecommuting is particularly well known in terms of fuel savings and reduces both commuting times and global CO_2 emissions. As one example, a cross-sectional study conducted in France found that, on average, 2.9 days of home office work per week would reduce commuting environmental burdens by about 30%, which would, on average, reduce greenhouse gas emissions by 0.5%(de Palma et al., 2022).

Telecommuting changes travel behaviors and reduces the need for physical space. This reduction in the need for physical spaces reduces energy consumption in commercial spaces. In urban areas where commercial spaces have a significant share of energy consumption, this reduction in energy consumption is evident and can lead to a potential decline in urban energy consumption in the long term(Hook et al., 2020). In a case study in the Netherlands, it has been shown that during the two phases of quarantine from 2019 to 2020, the amount of electricity consumption decreased by about 12%, the main reason for which was the reduction in the use of spaces such as offices, commercial places and restaurants, which shows the effect of Reducing physical presence in spaces such as companies and offices has an impact on energy consumption and supports telecommuting as a tool for long-term energy savings in urban areas(Luo et al., 2022).
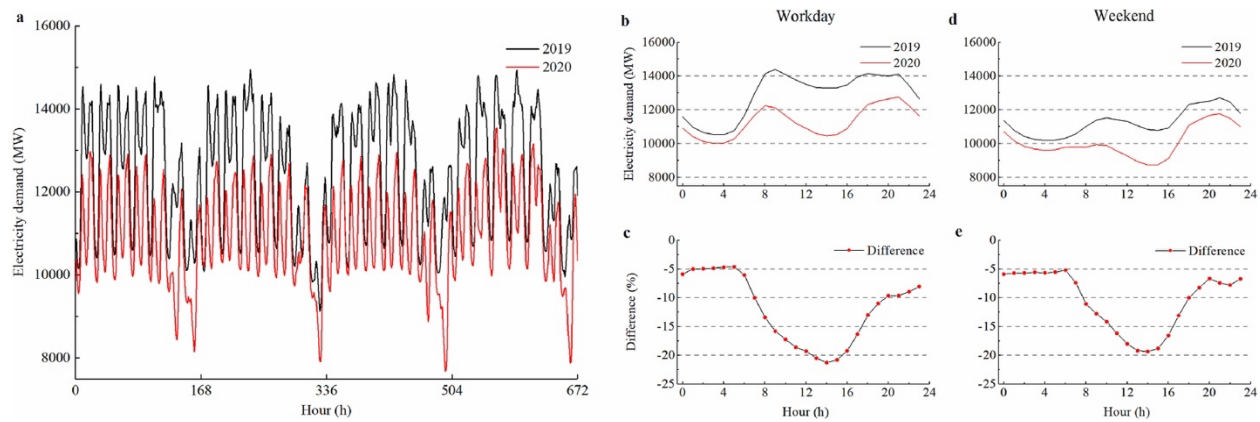
Fig.1. Electricity demand curve under lockdown(Luo et al., 2022)

With more people who work from home, residential energy consumption increases due to the use of heating and cooling and electronic devices. Net reductions from less commuting may be offset by increased energy use at home(Vasseur et al., 2024). In addition, telecommuting may increase non-work-related travel if the time saved from not traveling to work is instead devoted to other activities that residents choose to carry out in different locations. For this reason, it is necessary to have more efficient tools and appliances and optimal methods of energy consumption at home in order to increase the effectiveness of remote work in reducing energy consumption(Olde Kalter et al., 2021). Studies show that some behaviors of telecommuters can negate the benefits of reducing energy consumption that comes from reducing commuting (Chen et al., 2022). Therefore, the benefits of telecommuting in this field can be different according to individual choices and lifestyles of employees and telecommuting arrangements.

In terms of digitalization and energy consumption, digitization in the Netherlands has accelerated significantly since COVID-19. The digitalization strategy of the Netherlands shows that after the increase of telecommuting, the dependence on digital tools has increased and this has led to an increase in energy consumption at home (Klimaat, 2021).
This strategy emphasizes the importance of suitable and efficient digital infrastructures such as smart meters in residential areas. This tool helps in optimal energy consumption and creates a balance between energy supply and demand. Also, the digitalization strategy in the Netherlands seeks to deal with social challenges, including sustainability. For example, the integration of digital tools in energy management helps in sustainable energy transition. By following this strategy, the Netherlands pursues environmental goals in line with the European Green Deal, which sees digitalization and sustainability as an interconnected transition. Also, as

telecommuting is becoming more widespread, digital initiatives play an important role in shaping the understanding and management of telecommuting energy consumption and ensuring that telecommuting contributes to sustainability goals in the Netherlands. For example, initiatives such as data sharing allow consumers to use data to identify opportunities for savings and optimal consumption, which is an example of using digital tools to foster a culture of sustainability (Klimaat, 2021).

1.4.3.Telecommuters' Perceptions and Narratives

Qualitative dimensions of telecommuting, particularly the perception of working at home, motivation, and narratives, provide insight into subjective experiences at work and any perceived environmental effects. Research into these qualitative aspects reveals a complex interplay between telecommuting individual experiences and broader environmental concerns. For example, research has pointed out that although telecommuters often list increased flexibility and work-life balance as vital personal motivations for working away from the office, their sharpness and concern about the environmental impact of the work arrangement vary greatly (Allen et al., 2015). In this sense, a difference in attitude toward the same fact emphasizes the misalignment between telecommuters' personal motives and the sustainability objectives that must be reached.

As seen in different parts of previous sections, most of existing empirical evidence on telecommuting's environmental impacts often reveals the positive ones: reduced carbon footprints and minimized energy consumption. Telecommuters' narrations sometimes appear disassociated from such impacts. some of them have a strong sense of environmental stewardship and believe that their telecommuting practices contribute directly to minimizing carbon footprints and fostering sustainability. On the other hand, others may not identify their telework behaviors with the obtained environmental outcomes and benefits. Instead, they perceive and experience the immediate advantages gained from both personal and career dimensions (Weber et al., 2022).

Telecommuters who work from home tend to modify their behavior to minimize their energy consumption. Whether they are maximizing their home workplaces with green technology or modifying their ways of working to reduce energy use, telecommuters demonstrate a range of commitments to sustainability practices. It is suggested that telecommuters have a vital role to play in the energy transition, both as individuals and in relation to the larger sustainability targets (Metselaar et al., 2023). However, the extent to which these individual tactics are

adopted and their effectiveness in reducing overall energy use is influenced by different factors, such as telecommuters' concern for the environment, access to resources, and employers' organizational support for sustainable strategies. This is an area where more supportive frameworks and policies can be developed to help increase the ability of telecommuters' capacity to contribute to sustainability goals, where organizational and policy interventions are placed in the position of linking the gap between personal motivations for telecommuting and the achievement of broader environmental targets.

1.4.4.Policy and Telecommuting

Policies at different levels—from organizational directives to national policies—have a strong bearing on facilitating or hindering adoption and may have significant potential to influence the associated environmental consequences. Telecommuting policies in the Netherlands have evolved to encourage not only boosting home office work but also to foster energy efficiency and reduce the environmental impact. The measures include incentives for employers to accept telecommuting, investments in information and communication technologies to support efficient work from home, and tips to make better use of lights, heat, and other devices in home offices(van Klaveren, 2023). Furthermore, telecommuting policies are also seen for their capability to aid local development and broader sustainability goals. Policies have been articulated that extend beyond the individual benefits of telecommuting and its direct impact on reducing commute-associated energy consumption, aiming to use telecommuting as a tool for local development and spatial justice. That is, in this regard, telecommuting can take different forms than each of the other items mentioned above. It seems that the combination of these variables explains telecommuting differences. Telecommuting as an example of a solution could be highly recommended for urban congestion and pollution reduction. In addition, it could balance economic activities in these areas. This will help to ensure a more balanced local development and contribute to sustainable development(van Klaveren, n.d.).

In the Netherlands, under European standards, telecommuting increased because of the need for flexible working and technological changes that made the country's technical infrastructure suitable, particularly with easy access to the Internet and high computer and digital skills. According to CBS Netherlands website, 5 million people in the Netherlands work from home either some or most of the time, which is about 52% of all employees. This ratio is higher than in other EU countries. The majority of people who work from home spend more than half of

their working hours at home, and from 2021 to 2023, this number has increased by almost 700,000 people. shows the number of home workers between 2021 and 2023(CBS, 2024a).

Working from home, working population (aged 15-74)

x mln
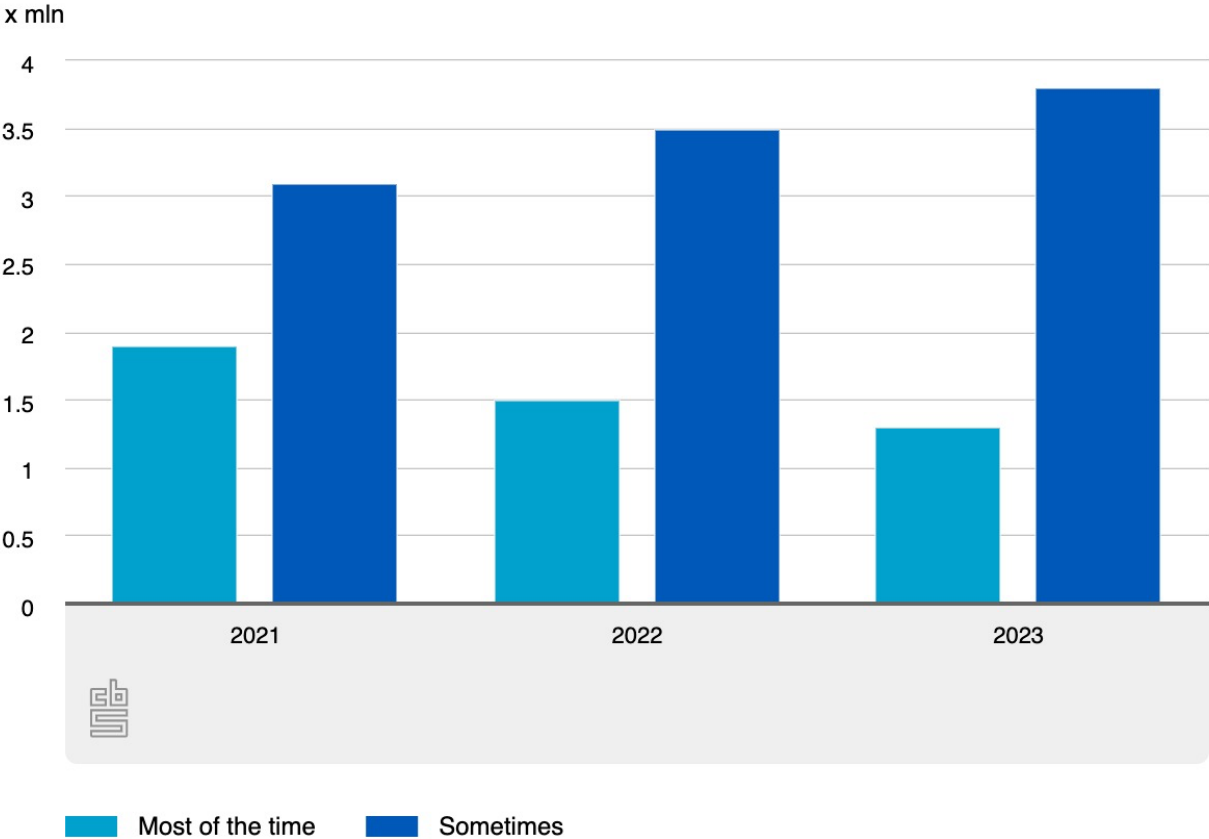
Fig.2. Number of dutch people working from home (CBS, 2024a)

According to figure 3, in 2023, 9 out of 10 of them did so most of the time or sometimes. a relatively high number of those in managerial positions also worked from home, but usually only some of the time. those working in service-oriented jobs and transport, or logistics jobs worked from home the least(CBS, 2024b).

Working from home, by occupational class, 2023
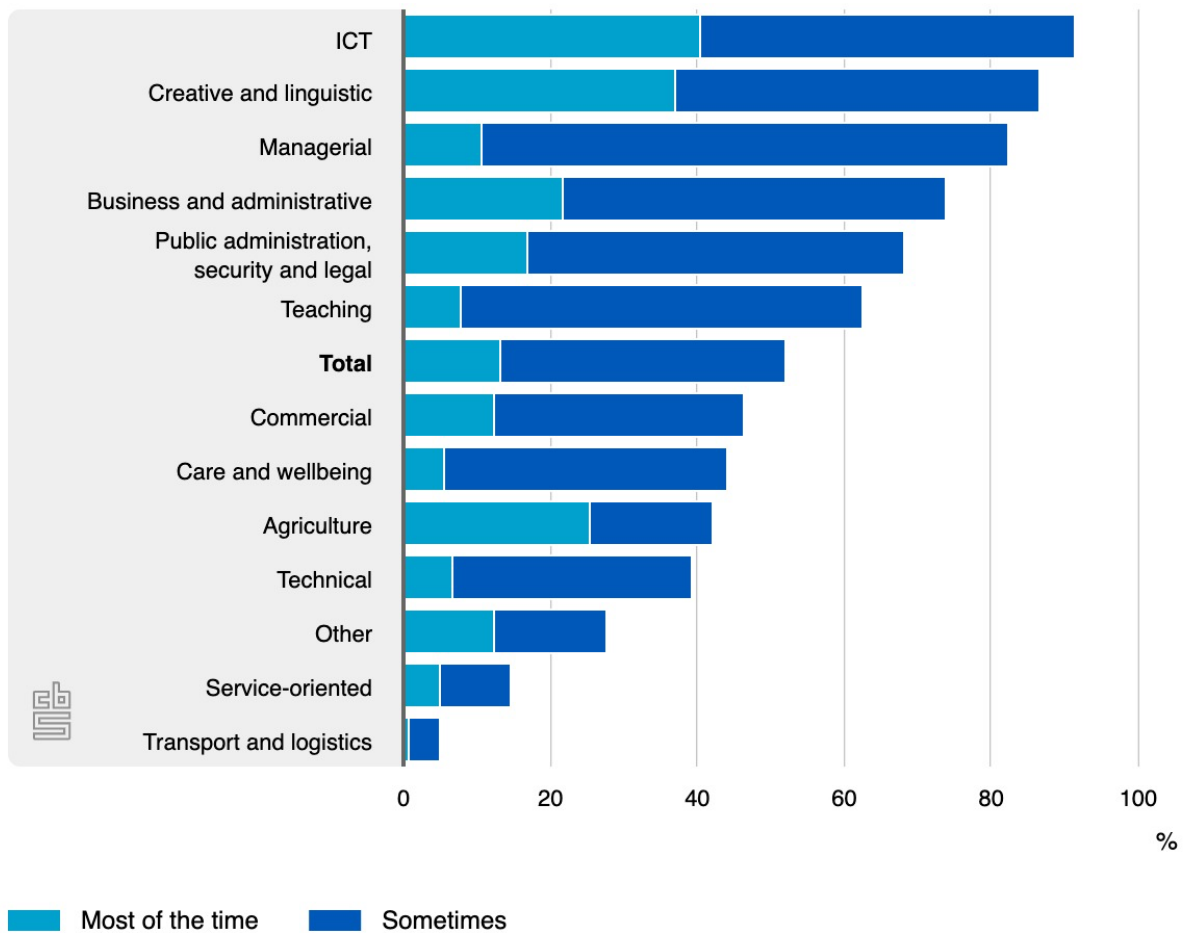
Fig.3. Percentage of people working from home by occupational class(CBS, 2024a)

The Netherlands leads the pack among the EU member states regarding total telecommuters. In 2022, the most recent year for which international figures are available, most workers in the Netherlands worked from home sometimes or most of the time. In particular, the percentage of workers who sometimes work from home is relatively high in the Netherlands. by contrast, in other countries with a high number of homeworkers, such as Sweden, Finland, Luxembourg, and Ireland, the percentage who work from home most of the time is higher(Netherlands, 2024b).

Working from home the EU, 2022
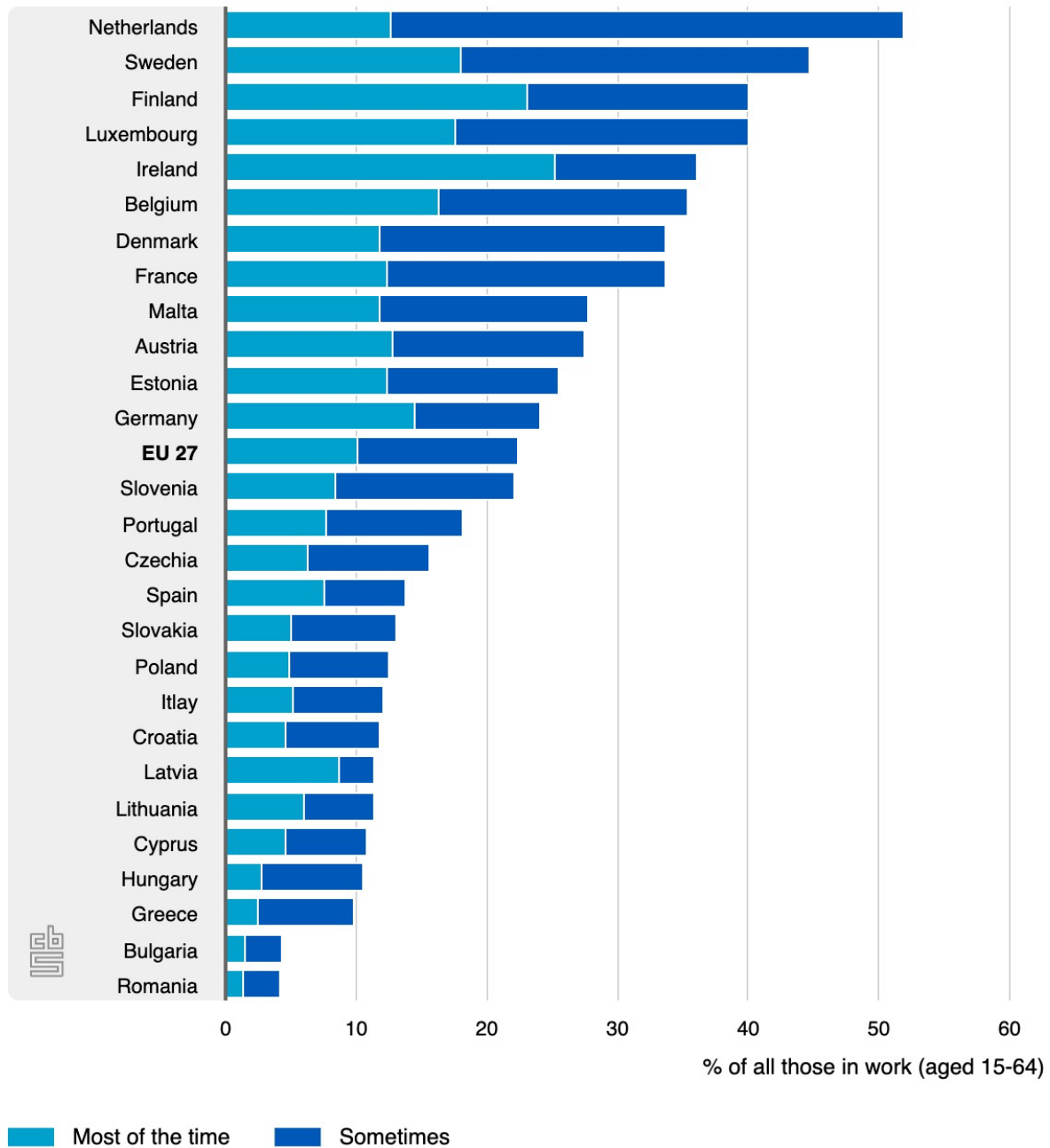
Fig.4. Percentage of people working from home in the EU(CBS, 2024b)

In terms of digital skills (fig 5), In 2021 the Netherlands had the largest share of inhabitants aged between 16 and 75 with at least basic digital skills, at 79 percent. In 2023, this had

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increased to 83 percent. This means the Netherlands has already achieved the European target of at least 80 percent basic digital proficiency by 2030(CBS, 2023).

Overall digital skills in the EU-27, 2021
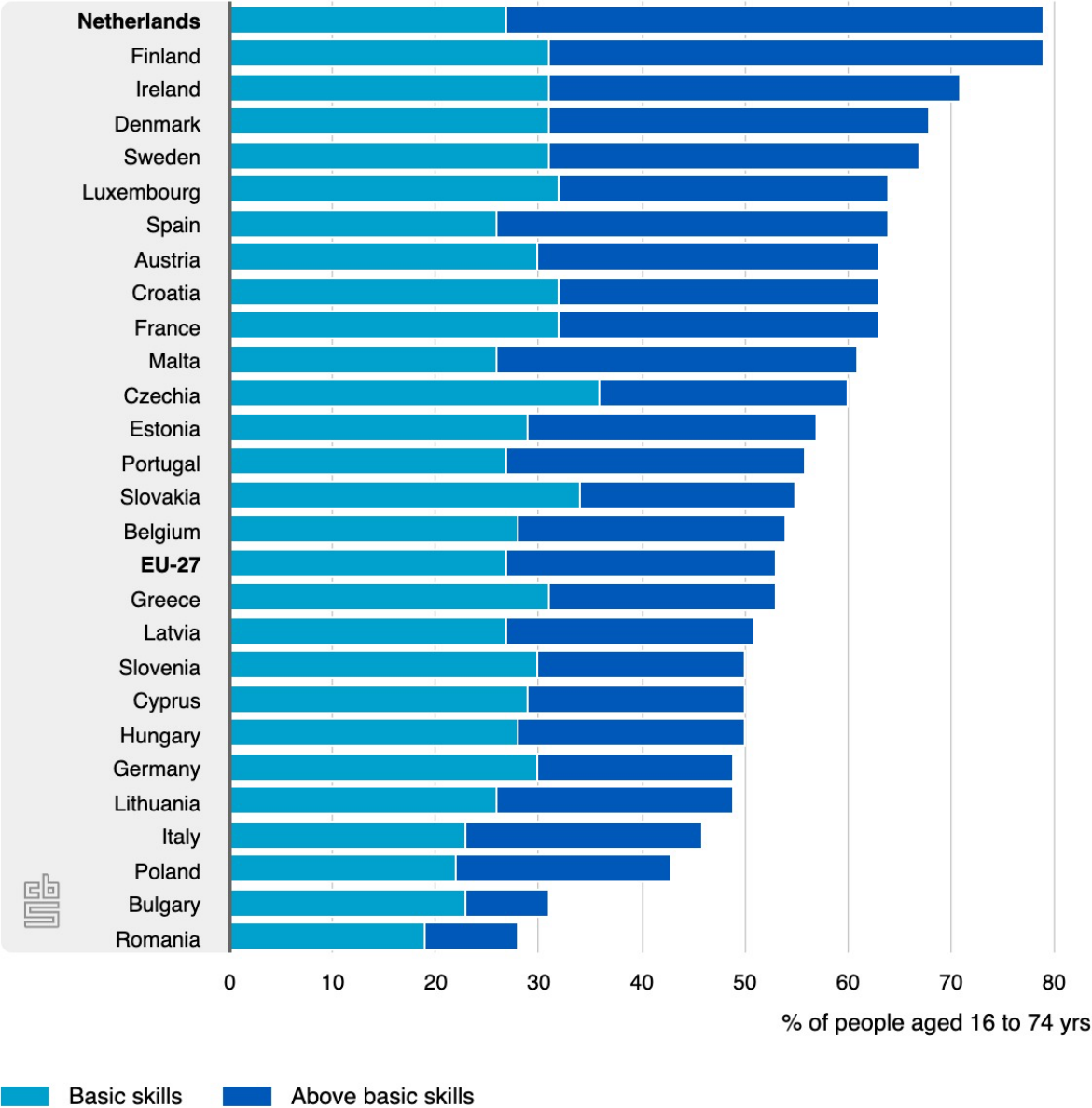
Fig.5. Percentage of people's digital skills in the EU(CBS, 2023)

Some companies in the Netherlands are already promoting and supporting telecommuting practices. However, most organizations are not yet ready to practice telecommuting in its formal arrangement. This is because of several reasons like insurance issues, the possibility of

long work hours, and the fact that work stress might even be higher. This shows a gap between the potentials created by enabling technologies and those realized by telecommuting practices (Akhavan et al., 2023). For instance, energy sector companies, has always tried to provide suitable conditions for its telecommuters. These efforts include providing tools and equipment needed in the field of telecommuting as well as trying to improve the balance between life and work of our employees(Nico, 2024). However, there are various challenges in the optimal implementation of telecommuting, and this makes it necessary to create improved policies in this field. This improvement requires proper interaction with telecommuters and using their opinions and perceptions in the field of telecommuting(*Vattenfall's Annual and Sustainability Report*, 2023).

Although the infrastructure exists and the country has high digital skills, the adoption of formal home office working policies in the Netherlands is not uniform. Hesitation at the organizational level, coupled with not enough pressure through trade unions and workers' councils, has slowed down this implementation process. Addressing these barriers and aligning policies with the growing demand for flexible work arrangements might bring Dutch organizations to a level where they could realize the advantages of telecommuting.

1.4.5.Gaps in the Literature and Justification for the Study

While research has quantified the environmental benefits and challenges of telecommuting, less interest has been paid to perception how telecommuters themselves perceive those effects and what measures they consider are powerful in improving energy efficiency within their remote work arrangements (Vayre et al., 2022). Moreover, the nuanced discourse around telecommuting and sustainability, as experienced and described via telecommuters, is often ignored. There is a need for more studies that investigate the motivations, behaviors, and lived experiences of telecommuters, mainly about their environmental interest and practices to reduce energy consumption (Ton et al., 2022). Such an exploration is crucial for getting the complex interplay between individual actions, policy directives, and broader sustainability desires, especially in a country like the Netherlands, famed for its revolutionary environmental regulations and high telecommuting rates.

This study pursues to fill those gaps using supplying an investigation of telecommuters' narratives in the Netherlands, specializing in their perceptions and practices regarding energy usage. By exploring the subjective dimensions of telecommuting, this research seeks to discover the underlying motivations, demanding situations, and possibilities related to telecommuting from an energy usage perspective. This approach not only contributes to the existing body of

know-how through way of adding depth and complexity to our knowledge of telecommuting's environmental impacts but also gives realistic insights that could inform policy and organizational practices. However, some limitations should be mentioned. First of all, the sample size of the interviewees is small , which cannot represent the wide population of telecommuters in the Netherlands. In addition, some interviewees may show themselves in a favorable situation or may not accurately remember their behavior in the field of energy consumption, and this may expose the obtained data to bias. It should also be noted that this study is based on personal behaviors and perceptions, and it is possible that it may not be consistent with actual energy consumption data.

2.Theoretical/Conceptual Framework: Social Practice Theory

The theoretical basement of this research is based on Social Practice Theory (STP), which provides a proper framework for investigating the differences in perceptions on the impact of telecommuting on energy consumption. This theory is based on three main elements - materials, competencies, and meanings(Penuel et al., 2017).

 Social Practice Theory applications in scientific research have been mentioned in various articles. For instance, the SPT is applied to understand the gap between design and actual operational performance in sustainable office buildings. As they claim, traditional psychological approaches have focused primarily on individual behavior, which is not adequate in dealing with the complex dynamics of building use. Instead, SPT shifts the focus from individuals to practices. This allows for a more comprehensive analysis of how various elements interact to influence the energy consumption of material features of buildings, social norms, and daily routines. This recognizes that sustainable building features are part of a more comprehensive social system and not merely physical structures designed to dictate behavior(King et al., 2014). In another article, the impact of COVID-19 on social practices related to consumption in four areas, food, materials, housing, and mobility, has been investigated. using the theory of social practice and examining the participation of materials, Competencies, and meanings in accepting and maintaining sustainable practices, has concluded that after the epidemic, temporary sustainable measures have been taken in areas such as the consumption of substances and food, but their long-term sustainability requires specific social changes and supportive policies (Klitkou et al., 2022). Also, another article emphasizes the continuity of social practices in the five areas of work, residence, mobility, eating, and recreation, and shows that changes in one area affect other areas in an intertwined manner. This article emphasizes

that achieving sustainability requires interventions beyond individual behavior or technological solutions and emphasizes the interconnected nature of social practices (Zollet et al., 2022).

In its holistic nature, STP provides a useful framework for analyzing the integration of new technologies and practices into everyday routines, especially in the context of reducing energy consumption and carbon emissions. Through this framework, it is possible to identify procedures related to remote work and suitable interventions to promote more effective sustainability. For example, energy-efficient technologies in the homes of telecommuters can be considered not only as a matter of individual choice, but also as a broad approach that is shaped by social norms and infrastructural support. Also, the impact of cultural and social factors on telecommuting plays an important role in understanding energy consumption. For example, countries like Netherlands with a strong emphasis on environmental responsibility, telecommuters in such societies may be more inclined to adopt sustainable practices, and this alignment of personal values with broader social goals can increase the effectiveness of telecommuting and reduce energy consumption(Akerboom et al., 2020).

In telecommuting, materials refer to physical and technological infrastructures that facilitate telecommuting. The use of energy-efficient technologies by telecommuters plays an important role in evaluating the impact of materials on energy consumption. This research uses semi-structured interviews to collect the required data about the different types of technology used by telecommuters and examine different perspectives about devices impact on energy consumption and their optimization. Competencies for telecommuting include digital literacy, self-management skills, and knowledge of energy-saving practices. The design of the interviews is conducted to investigate the awareness of remote workers regarding the use of energy efficiency criteria and showing how the competence of telecommuters affects their ability to help save energy and recognize the barriers to effective energy management. Meanings deals with the importance of understanding important issues such as flexibility, independence and environmental responsibility. Through interviews, the meanings that telecommuters associate with their work arrangements and its effects on the environment will be investigated to determine the perception of telecommuters about their role in achieving sustainability goals.

3. Research Design and Methodology

In this research, semi-structured interviews were used to collect and examine different perceptions of telecommuters about their energy consumption, the impact of energy-saving measures, and the combination of these methods in their daily work process. By examining this information, a more accurate understanding of ways to increase energy efficiency among

telecommuters can be found. The format of such interviews encouraged the participants to present their personal views and helps to identify common issues and different opinions. It can also facilitate the examination of practical challenges and benefits associated with different energy-saving methods. In the detailed design of effective interventions and policies to improve energy sustainability among telecommuters, a deep understanding of their perceptions and experiences is essential and this can only be done through interviews(Horton et al., 2004). Combining the data obtained from this method with the existing literature provides a complete perspective on the factors affecting energy consumption among telecommuters based on real-world experiences.

3.1. Methodology

Through semi-structured interviews, participants could discuss their perceptions in-depth and will have more flexibility in their answers. Also, the STP provided a theoretical framework for examining the interaction of materials (technologies and tools used), competencies (required skills and knowledge) and, meanings (perceptions and importance related to energy consumption) in the field of telecommuting. this theory helped to design research questions and creates an organized approach to data analysis.

In my interviews, telecommuters working in the energy sector were selected. the reason for this choice was firstly their specialized knowledge and direct experience in their energy consumption patterns. they were also often involved with energy efficiency in both their professional and personal capacities. for this reason, they presented a dual perspective on the impact of telecommuting on energy consumption. also, these employees were typically familiar with a wide range of technologies and conservation practices, and their feedback provided valuable data on the effectiveness of technology in optimizing energy consumption. also, their feedback regarding the telecommuting policies of their organizations and their impact on energy consumption provided a better perspective to help improve these policies in optimizing energy consumption. Also, most of interviewees live in Amsterdam and cities near Amsterdam.

In general, 7 interviews were conducted between May 29 and June 18. These interviews were designed in a semi-structured way and each of them lasted between 30 and 35 minutes. Most of the interviews were conducted by telephone and face-to-face, and only one interview was conducted through Teams software. All interviews were audio recorded with the interviewee's consent. The interviewee's consent form, which was sent to them via email before the interview, can be seen at the end of the thesis. Interviews were conducted with various

available employees such as Project Manager, Sustainability Advisor and Senior business Development from energy sector Company. Table 2 shows the date of interviews.

Interviewee	Affiliation	Date of Interview
Interviewee 1	Project Manager	May 29, 2024
Interviewee 2	Sustainability Advisor	May 30, 2024
Interviewee 3	Senior Business Developer	June 3, 2024
Interviewee 4	Senior Business Developer	June 6, 2024
Interviewee 5	Project Manager	June 7, 2024
Interviewee 6	Sustainability Advisor	June 14, 2024
Interviewee 7	Senior Business Developer	June 17, 2024

Table 2. List of interviews

3.2. Data analysis

In this research, the thematic method was used for data analysis. this method of analysis allows examining the data methodically and thoroughly to identify themes and patterns. this method can be used to generate themes from texts such as interviews or group transcripts, and for this reason, a large amount of information can be interpreted to answer research questions. this method is flexible and it is suitable for checking the experiences or knowledge of people. For analysis, the 6-step method of thematic analysis was used. At first, I checked the data by carefully reading the transcripts. In the next step, I coded the data in a structured way and the key features were identified through coding. Then I grouped aligned codes to create themes to identify related patterns in the data. Then I re-examined the themes to ensure that they reflected the themes and concepts of the data well. After naming and refining the themes, I compiled and reported the findings and tried to present the themes in a way that was supported by evidence from the data (Braun & Clarke, 2006). Coding was done using the program Atlas.ti. Codes were extracted from the text of the interviews in order to identify the concepts mentioned by the interviewees. After identifying the codes, they were categorized to make different themes when the patterns were identified. In the next chapter, you will see those different categories present different topics and follow the expressions of the interviews as much as possible. Then, the themes and codes were analyzed through a theoretical lens.

3.3. Research Ethics

Since the participants are involved directly and through interviews to generate data, ethical principles should be considered in this field to eliminate possible risks and pressures on the participants. at first, an ethical evaluation of the research was presented and approved by the ethics committee. In general, the interviewees were informed about the objectives of the research so that they could participate in the research discussions with full knowledge. all participants were given an information sheet and an informed consent form to sign before the interviews. also, participants had the right to withdraw from the study at any time without consequences and were assured of the privacy and use of their information.

4.Findings

This section describes the results of the research based on 7 interviews of energy sector telecommuters. In table 1, you can see the codes obtained from the text of the interviews and the number of repetitions in each interview.

Code	Interviews Mentioned (Hypothetical IDs)	Count of Interviews
Energy-Efficient Devices	1, 2,3, 4,5,6,7	7
Smart Technology Use	1,2, 3,4, 5, 6,7	7
Renewable Solutions Interest	1, 4,5,6,7	5
Barriers to Implementation	2, 3, 5,6,7,1,4	7
Ergonomic Setup	1, 3, 4,6,7	5
Lighting Adjustments	1, 2, 4, 5	4
Heating/Cooling Management	2, 3, 5,6	4
Conscious Energy Habits	1, 2, 3, 5	4
Peak Time Energy Use	2, 4,5	3
Manual Adjustments	1, 3, 4, 5	4
Company Policy Awareness	2, 3, 4,5,6,7	6
Role of Corporate Culture	1, 3, 5,7	4
Environmental Responsibility	1, 2, 3, 4	4

Cost Savings Motivation	2, 3, 5,6,7	5
Technological Limitations	1, 4, 5,6,7	5
Financial Constraints	1, 2, 3,4,5	5
Rental Restrictions	1,2, 4, 5,6,7	6
Work-Life Balance Changes	1, 3, 4, 5,6,7	6
Shifts in Daily Routines	1, 2, 5,3,4	5

Table 3. List of codes obtained from interviews

In the next table, the themes were obtained based on the categories of codes and available information and were then analyzed

Theme	Related Codes	Theme Description
Energy Efficiency Technologies	Energy-Efficient Devices, Smart Technology Use	Focuses on specific technologies used by telecommuters to reduce energy consumption, such as smart thermostats, LED lighting, and energy-efficient computer equipment.
Renewable Energy Adoption	Renewable Solutions Interest, Barriers to Implementation	Explores interest in and actual use of renewable energy sources like solar panels, including challenges faced in adopting these technologies.
Adaptive Workspace Design	Ergonomic Setup, Lighting Adjustments, Heating/Cooling Management	Discusses modifications made to home offices to optimize comfort and energy efficiency, including ergonomic furniture arrangements and climate control strategies.
Behavioral Energy Conservation	Conscious Energy Habits, Peak Time Energy Use, Manual Adjustments	Considers the everyday behaviors that contribute to energy saving, such as manually adjusting thermostats or turning off unused devices.

Corporate Influence on Sustainability	Company Policy Awareness, Role of Corporate Culture	Looks at how company policies and culture influence individual behaviors and attitudes toward energy conservation and sustainability.
Personal Values and Sustainability	Environmental Responsibility, Cost Savings Motivation	Addresses how personal values such as environmental concern and economic benefits drive telecommuters' energy-related decisions.
Challenges and Barriers	Technological Limitations, Financial Constraints, Rental Restrictions	Identifies obstacles telecommuters face in implementing energy-efficient practices, focusing on technological, financial, and housing-related issues.
Impact of Remote Work on Lifestyle	Work-Life Balance Changes, Shifts in Daily Routines	Examines how telecommuting has reshaped daily routines and work-life balance, impacting overall energy usage patterns.

Table 4. List of themes

4.1. Main points of interviews

The first participant worked from home 4 days a week. To use energy optimally, this employee had made changes in his workplace at home so that he could use natural light in a good way. Also, the interviewee had tried to use energy-efficient electronic devices to both save costs and show his interest and commitment to efficient energy consumption. However, the interviewee mentioned the high costs of energy-efficient technologies and the limitations of rental properties as the challenges of this path. According to this participant, organizational and government policies and incentives are necessary to solve these challenges. For example, this interviewee mentioned the allowances that the company paid for the purchase of equipment and made it possible to purchase more suitable equipment in terms of energy consumption. Also, due to the reduction of the interviewee's commute to the company, he preferred to move his house outside the city next year. According to him, houses with better energy consumption

design can be found in those areas, and they do not have the limitations of houses and urban spaces for the implementation of renewable energy projects.

The second interviewee had not used renewable energy solutions to optimize his energy consumption due to limitations. However, he had tried to improve energy efficiency in his home workspace by using energy-efficient lighting and appliances. Also, this interviewee emphasized the importance of more organizational support and incentives in order to adopt energy efficient methods. Also, this interviewee mentioned the company's training and online programs in order to increase the awareness of remote workers and praised these programs for increasing the awareness of remote workers and encouraging them to adopt energy saving approaches.

The third participant was working at home 3 days a week. He had considered almost expensive changes such as installing a smart thermostat and buying energy-efficient appliances as his way to reduce energy consumption at home. Due to his interest in his work, he was trying to align his values with the company's sustainability goals. He emphasized that the company should also try to increase its contributions to advance the goals of optimal energy consumption at home. For example, he considered the company's purchase of energy-efficient equipment and continuous support for the implementation of efficient practices better than paying financial aid.

The fourth interviewee worked from home 4 days a week and also used electric cars provided by the company to commute. Although he was a homeowner, he had given up on renewable energy solutions due to high installation and maintenance costs. According to this interviewee, corporate incentives and government support are still not enough. He was trying to increase his personal skills by learning different ways to save energy. However, he was not very sure that the increase in personal skills would have a significant increase in the optimization of energy consumption at home and generally emphasized more organizational support along with the development of personal skills.

The fifth interviewee worked full-time from home and only went to the company for administrative meetings. For this reason, he decided to buy a house outside the urban environment of Amsterdam and in the peripheral areas. In order to save energy and reduce costs, he had taken different measures, such as installing a smart thermostat, improving insulation in his workspace, and using energy consumption control software. He had also installed solar panels, but in general, due to the high costs of installation and maintenance, he emphasized the need for more support from both the government and the company. He also emphasized the existence of seminars and training classes to increase the awareness of employees in the field of energy consumption during remote work. He tried to encourage his colleagues in online meetings to think together and find suitable solutions to save energy, for example, to look for the purchase of energy-efficient technologies together.

The sixth interviewee worked from home three days a week. He was also trying to reduce his household energy consumption by using technology, but because the property is rented and

there is no possibility of making permanent modifications, he had to use portable devices such as portable heating and cooling devices. However, because the energy costs were paid by the owner, this interviewee did not focus much on the way energy consumption and rather sought to create an environment to increase the quality of his work while working from home. However, according to his personal motivations, he was trying to improve the energy consumption in his home office as much as possible.

The seventh interviewee also worked from home 4 days a week. He also tried to use smart and affordable technologies in his home workspace. He was trying to increase his awareness of optimal energy consumption in the home workplace by obtaining information about low-consumption technologies. He considered telecommuting as a factor in paying more attention to things that may have received less attention before, one of which is energy consumption at home. According to him, only organizational assistance and support are not effective in reducing energy consumption, and individuals must show their desire and be committed to optimal energy consumption at home.

4.2. Definitions of themes

4.2.1. Energy Efficiency Technologies

Several important subjects regarding the acceptance of the impact of energy-efficient technologies were identified during interviews with telecommuters in the energy sector. Interviewees highlighted the use of energy-efficient LED lighting and smart technologies, such as smart thermostats and energy control and monitoring applications, as tools to reduce energy consumption and improve the telecommuting experience through improved performance and comfort. Among the interviews, the economic factor is mentioned as the main motivation for using these technologies. One of the interviewees shared:

"**I got this new smart thermostat to have more control over my heating schedule, and I think my energy bills have gone down**" (Interview 6).

This shows that telecommuters are looking for cost-effective solutions to manage energy consumption. Considering the high ranking of the Netherlands in digital skills and literacy, it seems that the adoption and effective use of smart technologies has been facilitated in the densely populated urban areas of the Netherlands, such as Amsterdam. These technologies have led to the integration of energy management systems in homes. For example, two interviewees mentioned using energy monitoring applications such as Huisbaasje and Umeter to control and optimize their energy consumption (Interviews 5,7). It also seems that the

increase in telecommuting has caused energy sector telecommuters to make more efforts to align personal and professional values, and this has led to an increase in the acceptance of efficient technologies in the homework environment. For example, interviewee 3 emphasizes that because his work is about sustainability, he tries to make his home reflect his work values.

However, challenges were pointed out in the interviews, especially among tenants. In areas such as Amsterdam, restrictions imposed by landlords and the instability of rental situations limited the ability to implement permanent and energy efficient solutions. Also, some mentioned the high initial costs, as one of the interviewees mentioned:

"**I really thought about buying such equipment, but the price is high, and I don't know how long I will stay in this place**".

4.2.2. Renewable Energy Adoption

In the interviews, there were different opinions on renewable energy acceptance. The factors influencing these opinions were usually personal and varied from personal commitment to sustainability to economic considerations. For example, an interviewee pointed out:

 "**I install solar panels to save some money and reduce my carbon footprint but with these additional charges, it feels like they are punishing us for doing the right thin**g'' (Interview 4).

Also, the role of the company in promoting renewable energy was discussed. Some of the interviewees pointed out that the incentives and information provided by the company to the employees will encourage them to think more about sustainability (Interviews 3,5,6). However, some other interviewees did not consider these incentives sufficient and considered the need for more incentives necessary (Interviews 1,4). As the interviewee 4 mentioned:

 "**The company offers a 30% discount for solar panels, but I only pay 80 to 90 euros per month for electricity. Therefore, I don't think paying around 5,000 euros to install these panels is worth it**".

It was also pointed out that in a city like Amsterdam, the buildings are often dense and have limited roof space, which can cause restrictions on the installation of solar panels. In general, the increase in telecommuting has caused telecommuters to seek the use of renewable

resources to reduce energy consumption at home and reduce costs, and by increasing their awareness, they try to overcome the challenges.

4.2.3. Adaptive Workspace Design

In the interviews conducted with telecommuters, the proper arrangement of home office spaces was highlighted as an important factor for effective telecommuting. for instance, Interviewee 7 mentioned:

"I had to rearrange my home office to get more natural light. It just makes the space feel better, and I got myself an ergonomic chair because sitting all day was killing my back ."

The reduction of physical strain and energy consumption are among the important motivations for these changes in the workspace at home. Interviewees also discussed the balance between comfort and energy efficiency in their workspace design. Interview 5 noted:

"Turning off my devices when they are not in use has become second nature to me. It is one of those easy things you can do to save energy."

This shows a conscious effort to reduce energy consumption without compromising on the functionality of their home office. Also, telecommuters point out that with the help of the company's financial incentives and the energy-efficient digital equipment provided to telecommuters, they can save energy more effectively and the productivity of telecommuting increases (Interviews 2,3).
However, the existence of challenges such as space limitations and restrictions in the rental contracts, are mentioned as challenges. The compact nature of living space in cities like Amsterdam often necessitates creative solutions for workspace design:

"Because I have rented my home, I can not make big changes to the place. So, I got a portable heater and cooler. They are easy to move around and don't require any major modifications to the apartment." (Interview 1)

4.2.4. Behavioral Energy Conservation

Different behavioral adjustments in energy saving can be seen among the interviewees. conscious use of energy-efficient devices, management of heating and cooling systems, and conscious electricity consumption are common strategies among telecommuters (Interviews 3,6,7,4). for example, interviewee 4 pointed out :

"The simple way that I got used to and which has saved electricity consumption is that I turn off the electrical appliances that are not used. it may seem simple to you but it's effective in saving energy."

Interview 6 mentioned:

"When I see my bills getting lower, it is a big motivation to keep up with these practices, and it is super important because I cover my energy costs."

As seen in this quote, economic factors such as reducing energy bills are important in improving these behaviors. This is especially true if telecommuters pay for energy consumption directly. Also, the interviewees emphasized that the company's policies and support during telecommuting have an important effect on encouraging them to adopt sustainable energy practices. For example, providing advanced digital tools and resources along with periodic training has increased the quality of telecommuting for employees and encouraged them to change their behavior to reduce energy consumption.

However, one of the most important challenges to improving energy consumption behavior is still living in a rented property, which gives telecommuters less control over different parts of the house, limiting energy-saving measures. However, some interviewees still have ideas such as using low-consumption lighting and smart devices in the rented house. According to another interviewee :

"It is tough trying to save energy when you rent because you can not install things like solar panels. But I make do with what I can, like using LED bulbs and smart plugs to cut down on electricity use." (Interview 3).

4.2.5. Corporate Influence on Sustainability

In most of the interviews, the role of the company's sustainability policies in influencing the formation of telecommuters' behaviors has been emphasized. according to most of the interviewees, these policies include instructions for the optimal use of energy, payment of incentives for the use of renewable energy sources, and also the provision of electric cars for employees. Interviewee 6 mentioned:

"The company organizes various workshops and webinars to increase our awareness about energy consumption during working from home, which increases our motivation about using energy-efficient devices."

, and also mentioned :

"Electric cars are available in the parking lot for everyone to use these cars whenever they want for work plans, which I think is an attractive idea."

During the interviews, the interviewees emphasized that part of their efforts to adopt sustainable practices in energy saving is the continuation of the company's path in this field. In this case, interviewee 7 pointed out:

"The company organizes workshops and webinars about managing energy use. I can not join them as often as I would like, but the ones I have attended were really helpful and gave me good tips on using energy-efficient devices."

Interviewee 4 also emphasized that due to the social and regulatory support that exists in the Netherlands in terms of promoting sustainability, it is easier to implement the company's policies in the field of energy efficiency :

"Honestly, the social and regulatory backing we have makes it so much simpler to stick to the company's sustainability goals. It is like everyone around is pushing for the same thing, so it feels more natural."

While there were limitations in the field of changes in this case as well, the interviews showed that one of the goals of the employees in carrying out sustainability projects in their place of residence is to reflect the company goals and policies. For example, one of the interviewees encouraged his team to buy energy-efficient lamps as a group and showed them that individual initiatives can complement company policies (Interview 2).

4.2.6. Personal Values and Sustainability

Interviews show that personal values significantly impact energy consumption decisions and behaviors. the employees in all interviews said they were committed to turning off unnecessary devices or using energy-efficient devices. It was also mentioned that the company encourages employees to adopt sustainable practices while working remotely to help maintain these values and company policies and resources support this encouragement. Another subject that was highlighted in the interviews is the impact of job positions in the company in strengthening the individual's role in energy consumption during telecommuting. interviewee explained how his sustainability responsibility as a project manager contributes to his commitment to reducing energy consumption at home. he pointed out :

"My role at work encourages me to think about energy use all the time. It is like when you are constantly thinking about sustainability at work, it naturally spills over into how you live at home"(Interview 5)

, and this shows that the alignment of personal and corporate values makes the understanding of telecommuting in the field of energy consumption stronger.However, participants in the interviews emphasized that only their values are not effective in the optimal use of energy and there is a need for more material and spiritual support from both the company and the government to achieve this goal (Interviews 3,6,7).

4.2.7. Challenges and Barriers

A recurring theme among the interviewees was the restriction on modifying rented properties.The interviewees are usually not allowed to make changes, or they do not have the financial conditions to cover the costs of energy-efficient appliances, which has weakened the motivation of the interviewees to reduce energy consumption by making changes. Interviewee 4 mentioned:

"Sometimes I think about getting a portable energy-efficient device, like a heater or cooler, but even then, the cost is high, and I am not sure it is worth it without knowing how long I will be staying here."

Another important challenge among the interviewees is the integration of sustainable management practices in the home environment, especially when the boundaries of work and life overlap. Turning people's awareness of sustainability and energy saving into continuous action is still a challenge. According to the interviews, some interviewees still resisted changing their past habits and were not motivated to change. Interviewee 2 mentioned:

"It is a challenge to keep up with energy-saving practices consistently. Sometimes, I just do not feel like making the effort, especially when there is no immediate reward because I am not always convinced it will make a big difference."

According to the interviewees, the need for stronger support from the employer in terms of providing incentives and appropriate resources to increase motivation in this field is vital.

 4.2.8. Impact of Remote Work on Lifestyle

Telecommuting provides significant flexibility, allowing employees to use time saved from commuting for personal activities or spending time with family. This flexibility has positively affected their quality of life. The need to match the home environment with work needs is one of the other recurring topics that are raised in this theme. This issue has positive and negative effects on lifestyle. For instance, need to invest in ergonomic equipment to maintain health was discussed, indicating that telecommuters tend to imitate their company's traditional office space. At the same time, making these changes is expensive and requires more financial support from the company, as Interviewee 1 pointed out:

"I realized I needed better equipment to avoid back pain and other issues. It is been good for my health, but the cost was a bit of a shock. I think more financial support from the company would really help."

In some interviews, it was talked about the feeling of isolation due to not having face-to-face interactions. These changes have caused telecommuters to use alternative solutions to maintain social contact. For example, interviewee 3 pointed out:

"Working remotely can feel isolating at times. To combat this, we have set up regular virtual meetings. It is a nice way to stay connected, but it does not completely replace face-to-face contact."

Also, as mentioned earlier, the interviewees mentioned the changes in energy consumption at home and these changes have made them more aware of this issue and try to use more energy-saving methods. so, this can be considered as a change in lifestyle.

4.3. Answers to sub-questions

For answering first sub-question ''How do telecommuters describe changes in their energy usage due to working remotely'' Telecommuters in the urban areas of the Netherlands, such as Amsterdam, try to adapt to using devices with optimal energy consumption and use them while working from home. For example, smart thermostats help them manage energy consumption better without compromising their comfort. Also, telecommuters are making changes in their behavior to improve energy-saving methods, for example, turning off electrical appliances when not in use and adjusting the layout of the room to maximize the use of natural light. It shows the increasing awareness of telecommuters in adopting these methods. The high adoption of digital skills and smart technology in the Netherlands are key factors that enable these energy-saving practices. In the European Commission's Digital Economy and Society Index (DESI), the Netherlands continually performs well when it comes to digital skills and internet usage(Klimaat, 2021). This skill allows telecommuters to seamlessly work more cutting-edge energy management tools into their daily routine. For instance, more telecommuters are now downloading energy monitoring applications such as Huisbaasje or Umeter, allowing them to monitor and optimize their home's energy consumption in real time.

The recent improvement in energy efficiency is mainly due to easy access to technology, which they have been using smartly as a part and parcel of their everyday life, acknowledging the need for creating a digitally literate society. Also, the challenges arising due to population density and limited living space in urban areas such as Amsterdam have created different energy solutions and at the same time appropriate to the urban living space. For example, several of the interviewees, especially those who had rented houses and were limited in making permanent changes for optimal energy consumption, mentioned the use of portable and low-energy devices. In addition, corporate and government support has increased the impact of energy-saving efforts. According to the interviews, energy companies are trying to coordinate with the national sustainability goals and help to improve energy consumption during remote work by providing financial incentives for the purchase of low-energy devices, and according to the interviewees, these supports has had a very positive effect on energy-efficient usage during remote work.

For my second sub-question "How do telecommuters perceive their individual impact on energy consumption as a result of telecommuting, considering both reduced commuting and increased home energy use?" According to telecommuters, telecommuting has reduced their need to use cars, which is a personal contribution to reducing fuel and energy consumption and It is supported by a developed public transportation system and a strong cycling culture in the Netherlands, leading to a reduction in fuel and energy consumption.

However, telecommuting has increased energy at home, and telecommuters are trying to manage their energy consumption using smart technologies and energy-efficient devices. Due to the escalation of digital skills in the Netherlands, telecommuters are trying to manage their energy consumption using advanced energy management tools and software, which were mentioned in the interviews.

Also, according to the interviews, the company has an important role in the perceptions of telecommuters in terms of their impact on energy consumption. In the interviews, it was pointed out that companies by providing various incentives and resources, such as energy-efficient equipment, holding workshops and seminars related to optimal energy consumption while working from home, and providing financial incentives to use Renewable energy sources, try to align the personal values of telecommuters with the sustainability policies of the company. These supports, especially in urban and expensive areas of the Netherlands such as Amsterdam, play an important role in encouraging telecommuters to reduce energy usage and cause a strong alignment between the company's goals and personal commitments to reduce energy consumption during telecommuting.

In addition, many telecommuters considered their efforts part of a larger collective action for the expansion of positive effects of telecommuting in sustainability and optimization of energy consumption. The alignment of corporate and personal values has created a supportive environment that encourages telecommuters to adopt appropriate energy-saving practices while working from home. This environment, which is a combination of personal commitment, corporate support, and digital skills has highlighted the unique aspects of telecommuting in the Netherlands, especially in dense urban areas, and offers practical solutions to increase the efficiency of telecommuting in terms of energy consumption.

According to my third sub- question " What energy-saving measures do telecommuters in urban areas find most effective, and how do they integrate these practices into their daily work routines given their digital skills and access to smart technologies? Due to high digital skills and access to smart technology in most regions of the Netherlands, telecommuters adopt different methods for optimal energy consumption. Using devices with optimal consumption is one of

the important factors in reducing energy consumption during telecommuting. The interviews mentioned programmable thermostats, smart lighting, and accurate energy consumption control software. These tools and technologies have received more attention, especially during telecommuting when employees spend long periods at home. In addition, making changes in home office environments is another way to increase energy efficiency among telecommuters. They try to arrange their rooms to maximize the use of natural light and minimize the use of artificial light. Among other energy-saving measures that have spread among employees after the increase in telecommuting is the habit of turning off electrical devices when not in use and better management of heating and cooling systems, which are usually supported by digital technologies that provide real-time feedback on consumption and strengthen positive habits. For example, two programs that are widely used in the Netherlands have played an effective role in optimal energy consumption.

Also, corporate support and government policies play a significant role in choosing more effective solutions. Compared to other European countries, energy companies in the Netherlands provide more financial incentives and training resources to telecommuters. For example, telecommuters pointed out that the company has prepared electric cars that telecommuters can use for free when there is a need for the physical presence of telecommuters in the company. The existence of this supervisory and supportive environment in the Netherlands has made remote workers better able to know and implement effective solutions for optimal energy consumption.

5. Discussions

Telecommuting is one of the important factors in changing the dynamics of the work environment and has caused fundamental changes in the place and manner of energy consumption. due to the impact of individual behaviors, technological advances, and organizational strategies on these changes, many challenges and opportunities for sustainability have been created. the results obtained from the interviews show different perceptions of how to manage energy consumption during working from home.

5.1. Telecommuting's Dual Impact on Energy Consumption

Telecommuting in the Netherlands, especially in urban areas such as Amsterdam, where digital skills and technology adoption are high, is recognized as one of the important factors in

changing energy consumption patterns. Telecommuters' perception of reduced car use and reduced energy consumption due to reduced daily commute is consistent with existing literature(Olde Kalter et al., 2021). However, due to spending more time at home, energy consumption at home has increased because of spending more time at home.

telecommuters are trying to reduce energy consumption at home by using energy-efficient hardware and software technologies as mentioned in the previous sections. However, based on the conducted interviews and also studied litrature, the effectiveness of these technologies depends on factors such as people's physical environment, the level of digital skills, and the specific characteristics of the urban environment, which usually includes smaller living spaces and relies more on smart solutions(Chen et al., 2022).

Due to the existence of advanced digital infrastructure in the Netherlands and its high ranking in the European Digital Economy and Society Index (DESI), the integration and acceptance of smart solutions during telecommuting is more than in other European countries and has a significant impact on reducing energy consumption and improving the quality of working from home(Klimaat, 2021).

5.2. Role of Personal Values and Corporate Support

Given the strong digital skills in the Netherlands and the widespread adoption of digital technologies, personal values and company support for reducing energy consumption during telecommuting are more evident. For example, in the city of Amsterdam, telecommuters show a strong sense of responsibility in reducing energy consumption, and this is reinforced by the Dutch strategy in addressing social challenges, including energy efficiency.

Most of energy companies in the Netherlands are trying to increase the efficiency of telecommuting by facilitating the access of home office workers to efficient energy tools. At the same time, they try to align the corporate culture in the field of sustainability with employees' personal values to strengthen the adoption of sustainable practices in reducing energy consumption during telecommuting(Errichiello & Pianese, 2021).

The Netherlands' high ranking in the European Digital Economy and Society Index (Desi) has made telecommuters acquire the skills needed to use smart technologies(Zancajo et al., 2022). This will increase people's commitment and understanding of these goals, and as a result of this coordination between personal values and corporate support and digital infrastructure, a strong infrastructure will be created to increase energy efficiency among remote workers.

5.3. Behavioral Changes and Energy Consumption

According to the review of telecommuters' experiences, the digitalization strategy of the Netherlands has played an important role in the behavioral changes of telecommuters in the field of changing their behavior about energy consumption. The availability of smart technologies has played an important role in supporting these changes and has made telecommuters reconsider their energy consumption behaviors and at the same time maintain their comfort and convenience.

In addition, various literature has emphasized that behavioral changes in energy consumption can play an important role in optimal energy usage, especially when there is a strong cultural commitment to optimal energy consumption and sustainability (Zhang et al., 2023). In the Netherlands, according to corporate and government policies and social values, individual and collective actions to save energy have been strengthened. This has not only increased the effectiveness of these measures but also set a standard for other countries to achieve sustainability and optimal energy consumption through the improvement of digital infrastructure during remote work(Zancajo et al., 2022).

5.4. Technological Adoption and Efficiency

The dual need for comfort and energy efficiency in homes that have become workspaces, has led to the increasing adoption of smart technologies among remote workers. It is important to use these technologies in dense urban areas with limited space such as Amsterdam. Companies also try to help the acceptance of technologies among telecommuters and align with national digitization by providing various incentives.

Also, various literatures show that corporate support has increased the adoption and use of energy saving technologies among employees (Asatiani & Norström, 2023). Also, by emphasizing flexibility and digital connection in the digitization process, the Netherlands is trying to ensure telecommuters have access to the tools needed for the optimal use of these technologies (Klimaat, 2021), and this approach is trying to support the improvement of remote working conditions in the field of optimal energy consumption.

5.5. Challenges and Structural Barriers

In this research, different limitations were pointed out in optimizing energy consumption during telecommuting, which include structural limitations in rental units, physical limitations of buildings, and the high costs of adopting and using new technologies. Also, these limitations

have been mentioned in various literature, especially the limitations in housing policies (McCabe et al., 2018). For example, people who live in rental properties usually face problems in installing solar panels or increasing insulation and need the consent of the owner and a significant investment. Also, technological limitations such as high costs of new technologies and incompatibility with home systems as well as insufficient technical support are also part of these specificities. These technologies must be accessible and affordable and ensure that they meet the needs of a wide range of users.

When comparing these challenges with other countries in the European Union, similar things can be pointed out. In Germany, for example, there are strict rules about making changes to rental properties, which could somehow mirror the situation in the Netherlands (Yuen, 2023). Overall, these restrictions in the Netherlands reflect different trends across the EU, where structural, political, and technological challenges limit the progress of energy efficiency. there is a need for coordinated action between governments, employers, and property owners to create a supportive environment.

5.6. The Role of Policy and Education

Research has shown that political interventions such as tax incentives for efficient building design or creating updated standards for rental properties can strengthen energy conservation measures and increase telecommuters' ability to manage energy consumption while working remotely (Broers et al., 2022). Also, corporate policies that were mentioned during the research play an important role in supporting and encouraging remote workers in this field.

Also, raising awareness and creating educational opportunities about the effects of telecommuting(Agrawal et al., 2023) on reducing energy consumption can play an important role in the acceptance of saving technologies and approaches. As mentioned in the interviews, programs such as seminars or training courses can increase motivation and improve energy management. Research also supports the idea that knowledgeable people are more likely to adopt sustainable behaviors.

It is also possible to compare the approach of the Dutch government to integrate digitalization and energy efficiency in remote work policies with the approach of other European countries. For example, Germany has also implemented various policies, trying to increase motivation to improve energy efficiency in rental properties, although it has stricter regulatory frameworks and often hinders the development of rental properties. In contrast, Sweden has adopted more flexible policies and provides subsidies to homeowners and tenants for energy-efficient

renovations. Both the Netherlands and Sweden are leading the way in advancing digital skills and infrastructure, but Sweden has been more successful in directly integrating infrastructure with sustainability initiatives, especially in less connected and rural areas, while the Netherlands has focused more on dense and crowded places like urban areas(Zancajo et al., 2022).

5.7. Cultural Dimensions of Sustainability

The Netherlands is a country known for progressive environmental policies and a strong social commitment to sustainability is seen in this country(Jansma et al., 2023). The formation of environmental attitudes and the performance of telecommuters concerning energy consumption are closely influenced by cultural norms. in all the interviews, it became clear that the existence of the culture of energy efficiency in the Netherlands greatly contributes to the awareness and motivation of telecommuters to properly manage energy. In designing telecommuting policies for optimal energy use, understanding the cultural context is of great importance. for example, telecommuters in the Netherlands are receptive to strategies that emphasize personal responsibility for sustainability because these strategies align with their cultural orientation. This point has been mentioned in different literature (Wagner et al., 2023). For this reason, organizations can strengthen employees' participation and commitment in the implementation of these goals. This is done by encouraging and valuing telecommuters' cultural perspectives regarding energy consumption.

6. Conclusion:

In this study, through semi-structured interviews and thematic analysis, several significant and key issues were identified aligned with telecommuters' perceptions of energy consumption that provide insights into energy management approaches among telecommuters and how they perceive them. By examining the themes, the multifaceted nature of telecommuting impact on energy use is highlighted. In the interviews, the dual nature of telecommuting was mentioned, and telecommuters talked about reducing their commute to the workplace and thus reducing fuel consumption, at the same time, they also emphasized the increase in energy consumption at home due to telecommuting. Also, they were looking for ways to save energy and advanced technologies and low consumption as a suitable option, which is in line with the existing literature on the role of telecommuting in reducing energy consumption and pollution.

Also, in this research, telecommuting employees included various energy-saving measures in their daily routine while working from home. For example, adjusting the workspace to optimize the use of natural light and using energy-efficient devices were among the practical steps telecommuters took to comply with sustainable energy consumption practices. Also, behavioral changes such as getting used to turning off electrical appliances when not in use are part of their efforts in this direction. Additionally, the company used policies to encourage employees' behavior during telecommuting in order to maximize energy efficiency. Employees' emphasis on the role of the company's support and assistance in increasing the motivation to implement proper energy management while working from home because it not only facilitates the adoption of sustainable technologies but also enhances the culture of sustainability and frugality among telecommuters.

However, different challenges such as restrictions on rental properties and the high costs of advanced technologies hinder energy consumption optimization. These challenges add to energy efficiency complexity during telecommuting. Telecommuters in this field are realistic about these problems and desire optimal consumption if they are provided with sufficient support and resources. Telecommuters' lifestyles have changed significantly during the telecommuting and the balance between life and work has increased. However, there are also problems such as isolation and increased home energy consumption. Telecommuters have adapted to these changes by creating ergonomic spaces, optimal consumption approaches and virtual social interactions.

In response to the main question of the research, it should be said that according to the interviews, telecommuters have well understood the double impact of telecommuting on energy and are aware of the challenges of increasing energy consumption at home. Due to high digital skills in the Netherlands and the country's efforts to implement the digitalization strategy, awareness of telecommuters about new tools and technologies for optimizing energy consumption has increased significantly. They are also trying to save energy by using sustainable practices and advanced technologies, and they need support to improve this efficiency, both at the organizational level and at the policy level.

Finally, according to the results of this research, telecommuters understand the impact of telecommuting on their energy consumption and personal life and are trying to adopt sustainable methods and use new technologies with optimal consumption. at the same time, they need organizational support and policies aligned with optimal consumption goals. This study helps to better understand the environmental effects of telecommuting and can provide useful practical insights for policymakers and organizations that aim to optimize energy consumption while working from home.

6.1. Limitations

One of the primary limitations of this research is the narrow scope of interview participants. which cannot represent the wide population of telecommuters in the Netherlands. In addition, some interviewees may show themselves in a favorable situation or may not accurately remember their behavior in the field of energy consumption, and this may expose the obtained data to bias. It also seemed that despite sending the interview questions to the participants, they did not have detailed answers and I tried to conduct better interviews by asking secondary questions.

6.2. Recommendations and future research

In future studies, it is recommended to choose a wider and more diverse range of participants. increasing the participation of the employees of various industries and organizations will allow us to have a more comprehensive and complete view of this matter. Also, future studies can investigate the long-term effects of telecommuting on energy consumption. Changes in telecommuting practices and energy consumption can be followed through longitudinal research projects. In addition, in future research, different geographical regions and different cultural contexts can be investigated and also focus specifically on the impact of national and organizational policies on the sustainability approach in various places.

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Appendix1. Invitation Sheet and Consent Form

Invitation to Participate in Telecommuting and Energy Consumption Research

I hope this email finds you well. My name is Omid Razmjoo and I am conducting a research study as part of my Master's thesis in Environmental and Energy Management at the University of Twente. I am reaching out to invite you to participate in an interview for my research on telecommuting and energy consumption.

Summary of the Thesis:

My thesis explores the narratives and perceptions of telecommuters regarding their energy usage, particularly focusing on how telecommuting impacts energy consumption and sustainability practices. The research aims to identify the strategies telecommuters employ to manage their energy use and understand their attitudes towards energy efficiency. By analyzing these insights, the study seeks to contribute to the broader discourse on sustainable telecommuting practices.

Purpose of the Research:

The primary objective of this research is to investigate how telecommuting influences energy consumption patterns among employees. The study aims to understand the various methods telecommuters use to save energy, their awareness of energy-efficient technologies, and their overall attitudes towards sustainability. Your participation will provide valuable insights into the practical challenges and benefits associated with telecommuting from an energy consumption perspective.

Procedure:

If you agree to participate, you will be invited to interview lasting approximately 30-35 minutes. The interview will be conducted at a time and medium convenient for you (in-person, via telephone, or via videoconference). during the interview, you will be asked about your telecommuting practices, the energy-efficient technologies you use, and your views on energy conservation. the interview will be audio-recorded with your consent to ensure accuracy in data collection.

Potential Risks and Inconveniences:

Participating in this interview poses minimal risk to you. The primary inconvenience may be the time taken to complete the interview. There are no foreseeable risks beyond those encountered in everyday life.

Compensation:

There is no monetary compensation for participating in this study. However, your contribution will be invaluable in advancing our understanding of sustainable telecommuting practices.

Confidentiality of Data:

All information you provide during the interview will be kept strictly confidential. data will be anonymized, and any identifying information will be removed to protect your privacy. The audio recordings will be transcribed and stored securely, accessible only to the research team. The results will be used solely for academic purposes and may be published in academic journals or presented at conferences.

Voluntary Participation:

Your participation in this research is entirely voluntary. You are free to withdraw from the study at any time without any consequences. If you choose to withdraw, any data collected from you will be destroyed and not used in the analysis.

Thank you for considering participating in this important research. If you have any questions or need further information, please do not hesitate to contact me at o.razmjoo@student.utwente.nl

If you are willing to participate, please reply to this email with your availability for the interview.

Best regards,

Informed consent form template for research with human participants

Consent Form for(An Exploration of Telecommuters' Perceptions and Narratives on Energy Usage in the Netherlands)

Please tick the appropriate boxes	Yes	No
Taking part in the study		
I have read and understood the study information dated [30/06/2024], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
I understand that taking part in the study involves an audio-recorded interview using a recording device that will be transcribed into text for further analysis in the research. If interview is conducted online, Microsoft Team's video and audio recording and transcribing functions will be used. After the research, precisely after the final submission of the thesis report, all recording will be destroyed as the data no longer serves any purposes outside of the research.	☐	☐
Use of the information in the study		
I understand that information I provide will be used for for the researcher's master thesis report on the topic of **An Exploration of Telecommuters' Perceptions and Narratives on Energy Usage in the Netherlands**	☐	☐
I understand that personal information collected about me that can identify me, such as [e.g. my name or where I live], will not be shared.	☐	☐
I agree that my information can be quoted in research outputs	☐	☐

Consent to be Audio/video Recorded

I agree to be audio/video recorded. Yes/no   ☐   ☐

Signatures

_____   _____ _____

Name of participant [printed]

                   Signature   Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

_____   _____   _____

Researcher name [printed]   Signature   Date

Appendix2. Interview Questions

Interview Questions

Interview Questions
Entry Questions
A) Could you introduce yourself and your role in ……..
B) Can you start by telling me about your current telecommuting arrangement? How often do you work from home, and how long have you been telecommuting?
C) what have been the major changes or adjustments you've had to make since starting?

1- Can you describe the specific changes you've made to your workspace at home for telecommuting? How do you think these changes have affected your energy use?

2- Have you implemented any renewable energy solutions or sustainable technologies in your home office? If so, what influenced these choices?

3- What considerations do you consider when selecting technology or equipment for your home office, particularly concerning energy consumption?

4- What skills have you developed to manage your energy efficiency while working remotely, and how did you acquire these skills?

5- How has telecommuting affected your approach to learning about and implementing energy management at home?

6- Can you share an example of a specific situation where your energy management skills directly influenced your telecommuting practices?

7- What personal values influence your thoughts and behaviors regarding energy consumption while telecommuting?

8- How do you perceive the role of telecommuting in contributing to reducing energy usage and environmental sustainability?

9- how does this perception influence your personal and professional actions?

10 - What specific actions have you initiated or participated in that reflect this advocacy?