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Evaluating environmental perceptions and residential energy-
related behaviours in remote work practices

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Patras, Greece, May 2026

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Evaluating environmental perceptions and residential energy-related behaviours in remote work practices

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“To my family for their support through this journey.”

Abstract

This dissertation examines how the intensity of remote work relates to employees' environmental perceptions and to the energy-related behaviours they report at home during work-from-home periods. Remote work is often presented as good for the environment because it cuts commuting. The full picture is less straightforward. Part of the environmental burden can simply move from the office to the home, through heating, cooling and the use of household appliances and electronic devices. The study focuses on three constructs: Remote Work Intensity (RWI), Perceived Environmental Sustainability of Remote work (PESR), and Residential Energy-related Behaviour (REB). The study used a quantitative, cross-sectional design based on an online questionnaire completed by employees in Greece with remote or hybrid work experience, producing a final sample of 180 valid responses. The data were analysed using descriptive statistics, reliability testing, bivariate correlations, multiple regression and bootstrapped mediation analysis. The findings show that remote-work intensity was not significantly associated with residential energy-related behaviour or with perceived environmental sustainability. Environmental perceptions, however, were positively and significantly associated with more pro-environmental behaviour at home during remote work. The mediation hypothesis was not supported: remote-work intensity did not significantly predict environmental perceptions, so there was no indirect path to test. At item level, respondents were most energy-conscious in limiting heating and cooling to necessary hours and in switching off devices, and least consistent in avoiding the simultaneous use of multiple electronic devices. Overall, the study suggests that the environmental impact of remote work cannot be judged by how often people work from home. Employee perceptions and the household context appear to matter more in shaping energy-related practices at home. The dissertation adds employee-level evidence from Greece and supports a more balanced view: remote work is an environmental opportunity, not an automatic environmental solution.

Keywords

Remote work, environmental sustainability, residential energy-related behaviour, environmental perceptions, hybrid work, Greece.

Αξιολόγηση των περιβαλλοντικών αντιλήψεων και των οικιακών ενεργειακών συμπεριφορών στο πλαίσιο της εξ αποστάσεως εργασίας

Ουρανία Κορδάτου

Περίληψη

Η παρούσα διπλωματική εργασία εξετάζει πώς η ένταση της εξ αποστάσεως εργασίας σχετίζεται με τις περιβαλλοντικές αντιλήψεις των εργαζομένων και με τις ενεργειακές συμπεριφορές που οι ίδιοι αναφέρουν στην κατοικία τους κατά τις περιόδους εργασίας από το σπίτι. Η εξ αποστάσεως εργασία συχνά παρουσιάζεται ως ωφέλιμη για το περιβάλλον, επειδή μειώνει τις μετακινήσεις. Η πλήρης εικόνα, όμως, είναι λιγότερο απλή. Μέρος του περιβαλλοντικού φορτίου μπορεί απλώς να μετατοπιστεί από τον χώρο εργασίας στην κατοικία, μέσω της θέρμανσης, της ψύξης και της χρήσης οικιακών συσκευών και ηλεκτρονικού εξοπλισμού. Η μελέτη εστιάζει σε τρεις βασικές έννοιες: την Ένταση εξ Αποστάσεως Εργασίας (RWI), την Αντιλαμβανόμενη Περιβαλλοντική Βιωσιμότητα της εξ Αποστάσεως Εργασίας (PESR) και την Οικιακή Ενεργειακή Συμπεριφορά (REB). Η μελέτη χρησιμοποίησε ποσοτικό, συγχρονικό σχεδιασμό, βασισμένο σε ηλεκτρονικό ερωτηματολόγιο που συμπληρώθηκε από εργαζομένους στην Ελλάδα με εμπειρία εξ αποστάσεως ή υβριδικής εργασίας, με τελικό δείγμα 180 έγκυρων απαντήσεων. Η ανάλυση των δεδομένων έγινε με περιγραφική στατιστική, ελέγχους αξιοπιστίας, διμεταβλητές συσχετίσεις, πολλαπλή παλινδρόμηση και διαμεσολαβητική ανάλυση με bootstrapping. Τα αποτελέσματα έδειξαν ότι η ένταση της εξ αποστάσεως εργασίας δεν συνδέθηκε στατιστικά σημαντικά με την οικιακή ενεργειακή συμπεριφορά ούτε με την αντιλαμβανόμενη περιβαλλοντική βιωσιμότητα. Αντίθετα, οι περιβαλλοντικές αντιλήψεις συσχετίστηκαν θετικά και στατιστικά σημαντικά με πιο φιλοπεριβαλλοντική συμπεριφορά στην κατοικία κατά την εξ αποστάσεως εργασία. Η υπόθεση διαμεσολάβησης δεν επιβεβαιώθηκε: η ένταση της εξ αποστάσεως εργασίας δεν προέβλεψε σημαντικά τις περιβαλλοντικές

αντιλήψεις, επομένως δεν υπήρχε έμμεση διαδρομή προς έλεγχο. Σε επίπεδο επιμέρους ερωτήσεων, οι συμμετέχοντες ήταν περισσότερο ενεργειακά συνειδητοποιημένοι στον περιορισμό της θέρμανσης και της ψύξης στις απαραίτητες ώρες και στην απενεργοποίηση των συσκευών, ενώ ήταν λιγότερο συνεπείς στην αποφυγή της ταυτόχρονης χρήσης πολλαπλών ηλεκτρονικών συσκευών. Συνολικά, η μελέτη υποδηλώνει ότι η περιβαλλοντική επίδραση της εξ αποστάσεως εργασίας δεν μπορεί να κριθεί με βάση το πόσο συχνά εργάζεται κανείς από το σπίτι. Οι αντιλήψεις των εργαζομένων και το οικιακό πλαίσιο φαίνεται να έχουν μεγαλύτερη σημασία στη διαμόρφωση των ενεργειακών πρακτικών στην κατοικία. Η διπλωματική εργασία προσθέτει εμπειρικά δεδομένα σε επίπεδο εργαζομένων από την Ελλάδα και υποστηρίζει μια πιο ισορροπημένη θεώρηση: η εξ αποστάσεως εργασία αποτελεί περιβαλλοντική ευκαιρία, όχι αυτόματη περιβαλλοντική λύση.

Λέξεις - Κλειδιά

Εξ αποστάσεως εργασία, περιβαλλοντική βιωσιμότητα, οικιακή ενεργειακή συμπεριφορά, περιβαλλοντικές αντιλήψεις, υβριδική εργασία, Ελλάδα.

Table of Contents

Abstract	v
Περίληψη.....	vi
Table of Contents	viii
List of Figures	x
List of Tables.....	xi
List of Abbreviations & Acronyms	xii
1 Introduction	1
1.1 Background	1
1.2 Problem statement and research gap	1
1.3 Objectives of the study	2
1.4 Significance of the study	3
1.5 Structure of the dissertation	4
2 Literature review	4
2.1 Defining remote work and related concepts.....	6
2.1.1 Concept and definition	6
2.1.2 The COVID-19 inflection point	7
2.2 Remote work in Europe and the case of Greece	8
2.2.1 The European landscape	8
2.2.2 The case of Greece	9
2.3 Environmental benefits of remote work.....	10
2.3.1 Commuting impact: the primary lever	10
2.3.2 Office energy and urban systems benefits	12
2.4 Environmental costs of remote work: rebound effects and complications	13
2.4.1 Residential energy consumption	13
2.4.2 Mobility rebound effects	15
2.4.3 The hybrid work paradox	15
2.5 Behavioural perspective: insights from the Theory of Planned Behaviour and the attitude-behaviour gap.....	16
2.5.1 Core concept.....	16
2.5.2 Evidence from Research	17
2.5.3 The attitude-behaviour gap	18
2.6 Employee environmental awareness in remote work settings	18
2.7 Research gap	20
3 Research Methodology.....	21
3.1 Research design.....	22
3.2 Conceptual framework, research questions and hypothesis.....	22
3.3 Population and sampling	24
3.4 Survey instrument and variable operationalization	25
3.5 Data collection procedure	28
3.6 Data analysis methods.....	29
3.6.1 Data preparation and screening.....	29
3.6.2 Descriptive statistics.....	30
3.6.3 Reliability assessment	30
3.6.4 Bivariate analysis	31
3.6.5 Hypothesis testing	31
3.7 Ethical considerations	33

3.8	Methodology limitations	33
4	Data analysis and findings	34
4.1	Sample profile	35
4.2	Descriptive statistics.....	39
4.3	Reliability assessment	42
4.4	Bivariate analysis	42
4.5	Hypothesis testing	43
4.5.1	Remote work intensity and residential behaviour	43
4.5.2	Remote work intensity and environmental perceptions	44
4.5.3	Perceived environmental sustainability and residential energy related behaviour.....	44
4.5.4	Mediation analysis	46
4.5.5	Summary of hypothesis results	47
4.6	Additional descriptive insights on residential behaviours	48
5	Conclusion.....	49
5.1	Discussion of findings.....	49
5.2	Implications and recommendations.....	52
5.3	Limitations and suggestions	53
	References	56
	Appendix A: “Questionnaire”	62

List of Figures

Figure 3.1: Conceptual model	23
Figure 4.1: Remote work intensity distribution	35
Figure 4.2: Remote work duration	36
Figure 4.3: Residence type	36
Figure 4.4: Residence size.....	37
Figure 4.5: Heating system	37
Figure 4.6: Home presence	38
Figure 4.7: Industry/sector	38
Figure 4.8: Distributions of the PESR and REB composite scores (N = 180).....	40
Figure 4.9: Mean scores for the four PESR items.....	41
Figure 4.10: Mean scores for the nine REB items (pro-environmental direction).....	41
Figure 4.11: Perception-behaviour relationship (scatter of PESR and REB with OLS fit)	46

List of Tables

Table 3.1: Variable operationalisation	27
Table 4.1: Sample data summary	38
Table 4.2: Descriptive statistics for the main study variables	39
Table 4.3: Item-level descriptive statistics for PESR and REB	40
Table 4.4: Reliability statistics	42
Table 4.5: Spearman correlations	42
Table 4.6: Main regression results summary (unstandardized coefficients) for H1, H2, H3. Controls: residence type, heating system, residence size, household occupancy.	46
Table 4.7: PROCESS macro for SPSS (Model 4) analysis (RWI -> PESR -> REB), controlling for residence type, heating system, residence size and household occupancy. 5,000 bootstrap resamples.	47
Table 4.8: Hypothesis summary	47
Table 4.9: Descriptive interpretation of residential behaviour domains	48

List of Abbreviations & Acronyms

CI	Confidence Interval
EL.STAT	Hellenic Statistical Authority
EU	European Union
HVAC	Heating, Ventilation and Air Conditioning
ICT	Information and Communication Technologies
IEA	International Energy Agency
IS	Information Systems
IT	Information Technology
OLS	Ordinary Least Squares
PESR	Perceived Environmental Sustainability of Remote Work
PRQ	Primary Research Question
REB	Residential Energy-related Behaviour
RWI	Remote Work Intensity
SD	Standard Deviation
SE	Standard Error
SDGs	Sustainable Development Goals
SRQ	Secondary Research Question
TPB	Theory of Planned Behaviour
UK	United Kingdom
US	United States
VIF	Variance Inflation Factor
WFH	Working From Home

1 Introduction

1.1 Background

Remote work has become one of the most important changes in present working life. Although the idea of working away from the employer's premises is not new, the COVID-19 pandemic accelerated its adoption at a scale that had not been observed before. Across Europe, many organisations moved from office-based work to remote or hybrid work arrangements within a short period and hybrid work has remained an important feature of post-pandemic employment (Eurofound, 2022). This change has affected not only how people work, communicate and organise their professional lives, but also how daily energy use and mobility patterns are distributed between offices, homes and transport systems.

This change took place alongside rising environmental pressure. Climate targets have become more demanding, organisations face growing expectations to account for their environmental footprint and employees are increasingly attentive to the ecological implications of how and where they work (Moglia et al., 2021). As a result, remote work and environmental sustainability have become closely linked something only a few would have anticipated before the pandemic.

At first glance, the reasoning looks simple. If commuting falls, emissions should fall too. The evidence is however more complicated. Reductions in commuting-related emissions can be partly offset by higher residential energy use, additional non-work travel, or hybrid patterns that keep offices running while household consumption rises (Hook et al., 2020; Hostettler Macias et al., 2022). The environmental value of remote work is therefore better understood as a system-level outcome shaped by several interacting factors, rather than a direct result of fewer commutes.

1.2 Problem statement and research gap

The main problem addressed in this dissertation is that remote work is often presented as an environmental solution, while the behavioural and residential side of remote work is less clearly understood. Much of the existing literature estimates the environmental impact of remote work through modelling, simulation or system-level analysis. These studies are valuable because they show how commuting, office energy, household energy and mobility

rebound effects interact (Hook et al., 2020; Tao et al., 2023; Wu et al., 2024). However, they often treat employee behaviour as an assumption rather than as a measured part of the analysis.

This creates an important gap. If remote work shifts part of the environmental burden from the office to the home, then employee behaviour inside the home becomes relevant. Heating and cooling decisions, artificial lighting, electronic-device use, appliance use and switching-off practices can all influence the residential side of remote work. These behaviours may not be fully explained by how often someone works from home. They also depend on whether employees recognise the environmental trade-offs of remote work and whether they feel able to act differently within their household conditions.

The perception side is also important. Employees may view remote work as environmentally beneficial mainly because they notice the avoided commute. This is the most visible and immediate environmental benefit of remote work (Hook et al., 2020). However, less visible effects, such as increased household electricity use, heating or cooling, and non-work travel, may be underestimated (Hostettler Macias et al., 2022; O'Brien & Yazdani Aliabadi, 2020). This creates the possibility of the perception-behaviour gap. Employees may believe that remote work is sustainable, but this belief may not automatically lead to more energy-conscious household practices.

The Greek evidence on this issue remains limited. Maipas and Chatzoglou (2025) provide an important study on remote work and firms' environmental profile in Greece, but the individual-level relationship between remote-work intensity, environmental perceptions and residential energy-related behaviour remains underexplored. This dissertation addresses this gap by focusing on employees in Greece and by examining how often they work remotely, how they perceive the environmental sustainability of remote work and how they report managing energy-related behaviours at home.

1.3 Objectives of the study

The aim of this dissertation is to examine whether remote-work intensity is associated with employees' self-reported residential energy-related behaviour during remote work and whether this relationship is linked to employees' perceived environmental sustainability of remote work. The reasoning behind this aim is that perception may act as a bridge: working

remotely more often does not change household energy use on its own, but it may shape how employees see the environmental aspects of remote work and that view may in turn shape what they do at home.

More specifically, the study has the following objectives:

1. To examine the relationship between remote-work intensity and residential energy-related behaviour during remote work.
2. To examine how employees perceive the environmental sustainability of remote work.
3. To test whether perceived environmental sustainability of remote work is associated with residential energy-related behaviour.
4. To examine whether perceived environmental sustainability mediates the relationship between remote-work intensity and residential energy-related behaviour.
5. To describe which residential practices, such as heating, cooling, lighting and electronic-device use, appear more or less energy-conscious among remote workers.

These objectives are designed to keep the study focused on employee-level perceptions and self-reported behaviour. The dissertation does not attempt to measure actual household energy consumption, office energy savings or carbon emissions directly. Instead, it examines behavioural and perceptual evidence related to the environmental implications of remote work.

1.4 Significance of the study

The study is significant for three main reasons. First, it contributes to the academic discussion on remote work and environmental sustainability by focusing on the employee level. Existing research has already shown that the net environmental impact of remote work is conditional and may be affected by rebound effects (Hook et al., 2020; Hostettler Macias et al., 2022). Much less is known however about whether employees themselves perceive these trade-offs and whether such perceptions are related to their reported behaviour at home. Establishing that link (or its absence) tells us whether employee awareness is a realistic lever for improving the environmental outcomes of remote work.

Second, the study contributes to the Greek context. Greece has received limited attention in the literature on the environmental dimension of remote work. This is important because national conditions, including housing characteristics, heating systems, commuting patterns and digital-work adoption, may influence the environmental outcomes of remote work (International Energy Agency, 2023; Fameli et al., 2021). By collecting primary data from employees in Greece, the dissertation provides context-specific evidence.

Third, the study has practical relevance for organisations and policymakers. If remote work is to be included in sustainability strategies, it should not be treated only as a commuting-reduction measure. Organisations may also need to consider employee awareness, home-working guidance, hybrid-work design and the household conditions that shape residential energy use. The findings can therefore help support a more balanced understanding of remote work as an environmental opportunity, but not an automatic environmental solution.

1.5 Structure of the dissertation

The dissertation is organised into five chapters. This first chapter introduces the topic, explains the research problem and gap and presents the aim and contribution of the study. Chapter 2 reviews the literature on remote work and its environmental implications, covering definitions, the European and Greek contexts, the environmental benefits and costs of remote work, and the behavioural perspective that frames the analysis. Chapter 3 explains the research methodology, including the research design, conceptual framework, hypotheses, sampling, questionnaire, operationalisation of variables and analytical methods. Chapter 4 presents the empirical analysis and findings, including the sample profile, descriptive statistics, reliability assessment and the testing of the hypotheses. Chapter 5 draws conclusions, discusses the implications of the findings and offers recommendations.

2 Literature review

The relationship between remote work and environmental sustainability has moved to the centre of recent discussion. The pandemic relocated millions of employees from offices into domestic settings and once initial disruption subsided, it was clear that much of this shift would last. Hybrid working is now an established feature of working life across the European Union and Greece is no exception (Eurofound, 2022). At the same time, climate

targets have become more demanding, organisations face growing pressure to account for their environmental footprint and employees are increasingly attentive to the ecological implications of how they work (Moglia et al., 2021).

At first glance, the environmental implications of remote work appear straightforward: if commuting decreases, emissions should also decline. However, the evidence suggests a more complex picture. Reductions in commuting-related emissions may be offset by higher residential energy use, additional non-work travel or hybrid arrangements that combine continued office energy demand with increased household consumption (Hook et al., 2020; Hostettler Macias et al., 2022). For this reason, the perceived environmental sustainability of remote work is better understood as a system-level outcome shaped by several interacting factors, rather than a direct consequence of fewer commutes.

This chapter establishes the academic foundation of the dissertation. It begins by defining remote work and situates it within the European and Greek contexts, where levels of adoption and policy frameworks differ in important ways. It then reviews the evidence on the environmental effects of remote work, considering both potential benefits, (especially reduced commuting and lower office energy use) and potential costs, including greater residential energy consumption, mobility rebound effects and the hybrid work paradox. Finally, it turns to the behavioural literature, particularly the Theory of Planned Behaviour, used as an interpretive lens and the attitude-behaviour gap perspective, in order to interpret how employees' environmental perceptions may relate to their self-reported household practices during remote work. The conceptual model adopted in this study therefore does not directly measure environmental impact, energy consumption, or emissions. Instead, it examines whether remote-work intensity is associated with perceived environmental sustainability and self-reported residential energy-related behaviour, with residence-related factors included as controls (Ajzen, 1991; Kollmuss & Agyeman, 2002).

The chapter closes by identifying the main gap in the literature, presenting the conceptual framework that guides the empirical analysis and outlining the contribution of the study. Throughout, the aim is to remain close to the available evidence, distinguish between established findings and disputed ones and highlight the limited attention that the Greek context has received in this field so far.

2.1 Defining remote work and related concepts

2.1.1 Concept and definition

Remote work is not a new phenomenon. The idea of using technology to bring work to the employee, rather than requiring the employee to travel to a fixed workplace, was already being discussed in the mid-1970s. Jack Nilles introduced the term “telecommuting” during the oil crisis, presenting it as a possible response to fuel shortages and traffic congestion (Nilles, 1976). What has changed substantially over the past three decades is the underlying technology. The spread of broadband internet, cloud-based services and digital collaboration platforms has transformed what was once a relatively limited arrangement into a form of work that many knowledge-based occupations can now practise (Orzeł & Wolniak, 2022).

For the purposes of this dissertation, remote work is defined as any arrangement in which an employee performs their duties from a location other than the employer's premises, most commonly the home, with the support of information and communication technologies (ICT). This definition is consistent with much of the recent literature and is sufficiently broad to cover fully remote employees, hybrid workers and individuals who work from home only occasionally (Hook et al., 2020; Tao et al., 2023).

Clarifying terminology is important because the literature uses several related but not identical terms. Telework usually refers to ICT-supported work carried out away from the employer's premises. Telecommuting places greater emphasis on the substitution of the daily commute. Working from home (WFH) highlights the location in which work is performed. Hybrid work refers to arrangements in which employees divide their working time between home and the office. Remote-first describes organisations that treat remote work as the default mode of operation rather than as an exception (Moglia et al., 2021; Ríos Villacorta et al., 2025). These distinctions are not only semantic. They matter for environmental analysis because the frequency, location and organisational form of remote work shape its impact on commuting, household energy use and office demand. Two studies with apparently similar subject matter may therefore examine different populations and produce different estimates of environmental impact (O'Brien & Yazdani Aliabadi, 2020).

2.1.2 The COVID-19 inflection point

The COVID-19 pandemic marked the most extensive expansion of remote work in modern history. Before March 2020, regular home-based work remained relatively limited across Europe. Within a short period however, remote work became widespread, with an estimated 39% of EU employees working from home during the pandemic, with figures exceeding 50% in certain sectors (Eurofound, 2020, 2022). What had previously been a flexible option and often a benefit available to certain groups of workers, quickly became the default for many organisations (Baert et al., 2022).

Eurofound's *Living, working and COVID-19* e-survey found that around 39% of employees in EU Member States were working from home in April 2020, rising to 48% in July 2020. These survey figures capture the peak of lockdown conditions. More representative EU-level estimates show that the proportion of employees working from home increased from 11% in 2019 to 19% in 2020 and 22% in 2021, confirming that the pandemic produced a substantial and lasting expansion rather than a brief spike. Crucially, these levels did not return to their pre-pandemic baseline once restrictions ended. Instead, hybrid work became an established post-pandemic arrangement in many sectors, with employees commonly working from home for part of the week and attending the office for the remainder (Eurofound, 2022; Stamos & Kotsopoulos, 2024).

This shift matters for environmental research for at two reasons. The post-pandemic baseline is increasingly hybrid rather than fully remote, which makes it more difficult to assess environmental effects through a simple comparison between office-based and home-based work (Tao et al., 2024). On top of that, the pandemic accelerated investment in remote-working infrastructure at both organisational and household levels, reinforcing behavioural and organisational changes that are likely to persist over time and continue shaping commuting patterns, energy consumption and travel behaviour (Ceccato et al., 2021). For this reason, recent work increasingly treats COVID-19 as a structural break in the study of remote work and its environmental effects, rather than a short-term disruption.

The pandemic also altered the academic conversation about remote work. Compared with earlier research, which often focused on flexibility, autonomy and productivity, post-2020 studies have given greater attention to collective experience, including team coordination, managerial control at a distance, employee well-being and the future role of physical office space (Ríos Villacorta et al., 2025). Within that shift, environmental questions also became

more visible, partly because the sudden reorganisation of work due to lockdowns generated natural experiments of how changes in working patterns could affect commuting flows, office occupancy and urban emissions.

2.2 Remote work in Europe and the case of Greece

2.2.1 The European landscape

Across the European Union, the pandemic expanded remote work sharply and durably pushing it closer to the centre of environmental research. In a broad review linking telework and hybrid work to the United Nations Sustainable Development Goals (SDGs), Moglia et al. (2021) argue that remote work intersects with several SDGs, with particularly strong links to climate action, sustainable cities and decent work. They conclude that remote work can support multiple sustainability goals at once, but only when rebound effects are recognised and managed appropriately.

Modelling studies have tried to quantify these potential gains. Kylili et al. (2020), report savings of at least 4 litres of transport fuel and 7.4 kg of CO₂ per hour of remote work per 100 employees for the case of Cyprus. Focusing on Italy, Noussan and Jarre (2021), similarly conclude that remote working, especially when combined with complementary mobility measures such as carpooling, can yield notable reductions in commuting energy use. These estimates should be interpreted carefully, since they depend heavily on assumptions about how often employees work remotely and which transport mode is being replaced. Even so, the overall direction of the evidence remains consistent: reduced commuting generally lowers transport-related environmental impacts (Noussan & Jarre, 2021; Kylili et al., 2020).

At the same time, remote work adoption has remained highly uneven across the EU. Northern and Western European countries, including the Netherlands, Sweden, Finland and Belgium, entered the pandemic with relatively higher levels of telework, supported by stronger digital infrastructure and more established flexibility norms (Eurofound, 2022). Many Southern and Eastern European countries, including Greece, started from a lower base and experienced a sharper adjustment during the pandemic (Stamos & Kotsopoulos, 2024). This variation matters from an environmental perspective because the same behavioural shift may produce different outcomes depending on national and local conditions, including

the energy mix, commuting patterns and characteristics of the housing and building stock (Eurofound, 2022; Stamos & Kotsopoulos, 2024).

Sectoral differences are equally important. Knowledge-intensive sectors such as finance, consulting, ICT and parts of public administration could move a much larger share of employees to remote work, compared to sectors with a stronger physical or customer-facing need, such as manufacturing, hospitality, retail and healthcare (Eurofound, 2022). This is important for environmental analysis, since the estimated benefits and costs of remote work are closely tied to the characteristics of the workers who can actually adopt it.

At policy level, the 2002 European Framework Agreement on Telework set a baseline that several member states have since extended, particularly after 2020, although environmental considerations remain largely absent from these frameworks (Moglia et al., 2021). The regulatory conversation has focused on labour conditions rather than on the energy or emissions consequences of where people work.

2.2.2 The case of Greece

Greece is a particularly relevant, but still underexplored, setting for examining the environmental dimension of remote work. Before 2020, working from home in Greece remained limited. Only 5.3% of employed persons worked remotely in 2019, well below the EU average. Pouliakas (2020) attributes this low pre-pandemic incidence to Greece's lagging digitalisation, the sectoral structure of the economy and broader cultural and social traits. The pandemic changed this pattern abruptly, as telework was introduced on a much larger scale during the first lockdown period, including in sectors where it had previously been uncommon (Pouliakas, 2020; Stamos & Kotsopoulos, 2024).

The Greek case is notable because this rapid behavioural shift was accompanied by relatively fast institutional adaptation. Law 4808/2021 introduced specific regulations for remote work, including written agreements, working-time rules, the right to disconnect and basic occupational health requirements. This gives the Greek case a relatively clear formal regulatory basis for examining the evolution of remote work after the pandemic (Law 4808/2021; Stamos & Kotsopoulos, 2024).

The most directly relevant peer-reviewed study for the Greek context is Maipas and Chatzoglou (2025). Based on questionnaire data from the Greek population, the study

examines the relationship between remote-working arrangements and firms' environmental profile, considering factors such as electricity and water consumption, greenhouse-gas emissions and waste management. The authors find that environmental awareness is associated with more sustainable employee behaviour, including electricity use and waste separation and they report some evidence that employees behave more sustainably while at home. At the same time, the study does not identify a direct link between teleworking and energy saving, which suggests that the environmental value of remote work in Greece should not be treated as automatic or uniform.

Beyond this, research on remote work in Greece is mostly around labour-market and well-being themes. Katsaros (2025) examines employee performance in the post-COVID period, while Stamos and Kotsopoulos (2024) analyse IS-enabled telework in a Greek banking institution. Both suggest that hybrid arrangements have become more established in parts of the Greek labour market, but neither examines environmental outcomes. There is therefore clear room for primary research into how Greek remote workers perceive the environmental implications of their work and whether those perceptions are associated with their reported behaviour at home.

Greek policy has continued to develop since Law 4808/2021, with growing attention to the practical implementation, including issues such as working time, formal agreements and the right to disconnect. Hybrid work has become more visible among large Greek employers, although systematic evidence on the extent and form of these arrangements remains thin (Law 4808/2021; Stamos & Kotsopoulos, 2024). Empirical evaluation remains limited, especially on the environmental side. In practice, the relationship between remote-work intensity and environmental outcomes in Greece is still inferred more often from international evidence than measured directly through Greek employee data. This is the gap the present dissertation seeks to begin addressing.

2.3 Environmental benefits of remote work

2.3.1 Commuting impact: the primary lever

Reduced commuting is the most widely recognised environmental benefit of remote work and the area in which the evidence is strongest. In most cases, each day worked from home replaces one round-trip commute, which, for car-dependent workers, translates directly into

lower fuel consumption and lower carbon emissions (Hook et al., 2020; O'Brien & Yazdani Aliabadi, 2020). The scale of this effect depends mainly on three factors: commuting distance, the transport mode replaced and the frequency of remote work.

One of the most widely cited recent quantifications is provided by Tao et al. (2023), published in the Proceedings of the National Academy of Sciences. Using data from Microsoft employees in the US combined with broader life-cycle modelling, the study estimates that full-time remote work can reduce an employee's work-related carbon footprint by up to 54% (in a sample of car-commuting knowledge workers, excluding longer-term residential relocation), while hybrid arrangements involving two to four days of home working per week can reduce it by 11% to 29%, depending on lifestyle choices and the local electricity mix (Tao et al., 2023). The same study finds that ICT-related emissions are a small share of the total: the climate implications of remote work depend far more on travel, office use and household energy than on the digital tools themselves.

A broader perspective is provided by Hook et al. (2020), whose systematic review brings together evidence from 39 empirical studies on the energy and climate impacts of teleworking. The review indicates that teleworking is most often associated with reductions in energy use, mainly mainly through reduced commuting and in some cases reduced office energy. At the same time, the authors emphasise that the evidence remains highly heterogeneous, with results varying considerably according to the methodology used, the system boundaries adopted and the extent to which non-work travel, home energy use and other rebound effects are included. Studies using broader and more rigorous approaches tend to report smaller and more qualified benefits which is the clearest reason to treat single-lever estimates of telework's commuting benefit with caution.

City level evidence points in the same general direction. Studies of telework and travel behaviour indicate that greater use of remote work is associated with lower congestion, lower peak-hour traffic and, in some cases, reductions in transport-related emissions and air pollutants (Lachapelle et al., 2018). Italian case-study evidence also suggest that even partial adoption of telework can alter commuting patterns and reduce working-week travel demand, with implications for traffic conditions in urban areas (Ceccato et al., 2021; Campisi et al., 2022). These findings are particularly relevant for Greece, where congestion in major cities has long been an important transport and environmental issue, even though direct Greek transport-modelling studies on remote work remain limited.

A recurring theme in this literature is sensitivity to context. The same employee, working remotely for the same number of days, can produce noticeably different emissions outcomes depending on whether they previously drove a petrol car, used public transport, or walked to work (O'Brien & Yazdani Aliabadi, 2020). Frequency matters too. Very limited remote working, such as one day per week or less, often yields modest benefits because the office continues to operate close to normal capacity and workers may substitute the avoided commute with other trips during the day (Tao et al., 2024). The composition of the workforce adopting remote work also matters. Higher-income employees, who are more likely to commute by car and to live further from the workplace, account for a disproportionately large share of commuting-related emissions savings when they work from home, while lower-income workers closer to city centres generate smaller absolute savings (Tao et al., 2023; O'Brien & Yazdani Aliabadi, 2020).

2.3.2 Office energy and urban systems benefits

Beyond commuting, a second potential environmental benefit of remote work concerns the office itself. When fewer employees are physically present, office space can in principle be used more efficiently, while heating, cooling, lighting and equipment loads may be reduced. However, the size of this benefit depends heavily on whether buildings and space use are actually adjusted to lower occupancy rather than continuing to operate as before (O'Brien & Yazdani Aliabadi, 2020; Hook et al., 2020).

Simulation studies generally point to substantial savings under favourable conditions. Examining UK office buildings in the post-pandemic era, Mantesi, Chmutina and Goodier (2022) conclude that hybrid working combined with activity-based workspace design could reduce office energy demand below pre-COVID levels, with savings reaching up to 50% in some scenarios. This suggests that office-related gains are most likely to materialise where remote work is accompanied by a broader redesign of workplace use, rather than simply layered onto pre-existing office arrangements.

At the same time, empirical and simulation evidence from the pandemic period shows that office energy demand does not automatically fall when occupancy falls. Cortiços and Duarte (2022), modelling a “large-office” archetype across the capitals of Europe’s five largest economies, found that once HVAC systems were adjusted to comply with COVID

mitigation guidance, operational energy use tended to increase rather than decrease. In their scenarios, energy consumption rose by around 10% in Rome and by almost 70% in Paris, with associated increases in CO₂ emissions. Their results underline an important point: lower occupancy does not necessarily produce energy savings when buildings are ventilated more intensively and operated for longer hours.

Climate intensifies this effect. In southern European countries, including Greece, lower office occupancy could in principle reduce summer cooling loads, whereas in northern Europe the equivalent gain would come more from reduced winter heating. In both cases, the savings only materialise if HVAC controls actually follow occupancy. Many offices still operate according to fixed schedules rather than real-time conditions, which is one of the main reasons that realised savings often fall short of simulated potential. Office buildings also rarely contract in direct proportion to remote-work adoption: long leases, organisational hesitation to release space and continued near-full energy use even at half occupancy are recurring features of the post-pandemic office stock (O'Brien & Yazdani Aliabadi, 2020). Many of the office-side benefits predicted in simulation studies therefore remain possibilities that have not yet been fully realised in practice.

A more recent systematic review of corporate telework adoption argues that durable hybrid arrangements can support sustainability gains across commuting, office energy and resource optimisation, but only when integrated into corporate strategy rather than treated as an ad hoc accommodation (Ríos Villacorta et al., 2025). Evidence from Italy also points to the same conditionality. Fabiani et al. (2021) found that remote working was environmentally favourable mainly when commuting distances were relatively long, above roughly 10 km. At shorter distances, the increase in household-side energy demand cancelled much of the expected benefit.

2.4 Environmental costs of remote work: rebound effects and complications

2.4.1 Residential energy consumption

The most direct cost of remote work is the rise in household energy consumption. When employees work from home, houses that would otherwise be unoccupied during the day are heated, cooled and lit, while electronics and domestic hot water are used for longer periods

(Hook et al., 2020). The environmental cost may be transferred from the employer's office to the employee's home and may offset some of the savings achieved by reduced commuting. This is not a minor effect. Hook et al. show that the more comprehensive studies, especially those that include home energy use and non-work travel, tend to find smaller net benefits from teleworking than studies focused only on commuting.

Recent evidence from England confirms this. Shi et al. (2023) find that, once transport and domestic building emissions are counted together, working from home three to five days per week can lead to outcomes ranging from 3% less to 17% more carbon emissions than conventional work patterns, depending on heating area, heating system, heating time and required temperature. The biggest influence on building emissions comes from the heating area, followed by the number of heating hours, wall insulation and the efficiency performance and carbon intensity of the heating system. (Shi et al., 2023).

Using an activity-based model for the US, Wu et al. (2024) report smaller net effect: residential emissions rise by 1.51 kg CO₂e per person per day but total daily emissions still fall by 29% (4.06 kg CO₂e/person/day) because commuting and workplace declines are larger. The apparent gap with Shi et al. is mostly a matter of system boundaries, not a genuine contradiction. Shi et al. isolate residential heating in a country with highly variable heated area and heating systems, while Wu et al. net the residential rise against larger commuting and workplace savings. Together, both studies make the same underlying point: residential rebound is real and non-trivial and its size relative to the commuting saving depends on heating system, building stock and the displaced transport mode.

This topic is especially relevant in the Greek context. According to the IEA, Greek buildings are older than the EU and IEA average (resulting in low energy performance) and despite the rapid renewable-energy growth in recent years, the Greek electricity mix still includes natural gas and to a lesser degree, lignite (International Energy Agency, 2023). In addition, EL.STAT reports that oil remained the main heating source for 47.1% of the population in 2023 and that 88% reported no recent renovation of insulation, windows or heating systems (EL.STAT, 2024). These characteristics do not prove that remote work in Greece is environmentally worse than elsewhere, but they do suggest that residential rebound effects deserve serious attention when assessing the environmental implications of working from home.

2.4.2 Mobility rebound effects

Commuting is more complicated than a simple subtraction of home-to-work trips. When employees stop driving to the office, they do not necessarily stop driving altogether and they may take additional trips during the day for shopping, school runs, errands, or leisure (Hostettler Macias et al., 2022). These additional trips can offset part of the commuting saving and in some cases exceed it (Hostettler Macias et al., 2022). Hostettler Macias et al. (2022) identify three principal rebound channels: an increase in non-work trips on remote-work days, longer total daily distances when employees experience less time pressure and longer-term residential relocation, which lengthens any remaining commute and may reduce reliance on public transport.

Studies from England suggest that these effects can be substantial. Caldarola and Sorrell (2022) find that medium-frequency teleworkers travel approximately six miles further per week for non-work purposes than non-teleworkers, partially offsetting commute reductions. Swedish evidence is more modest: full-day teleworkers make fewer and shorter trips than non-teleworkers, but part-day teleworkers make more trips overall (Elldér, 2020). Studies from Italy and Australia describe a similar pattern of real but incomplete reductions in mobility, with rebound effects sufficiently large to merit attention in policy design (Campisi et al., 2022; Guerin, 2021). According to Caldarola and Sorrell (2022), only people who work from home three or more times a week travel less distance overall than non-teleworkers.

Greek evidence on individual remote-worker mobility behaviour is still limited, even though remote work may reshape not only commuting but also non-work trips, errands and household routines.

2.4.3 The hybrid work paradox

If remote work clearly reduces emissions when undertaken full-time and full-time office attendance is the baseline, the intermediate hybrid case might be expected to deliver intermediate environmental outcomes. The literature shows that this is often not the case. Poorly managed hybrid arrangements can underperform both extremes, a pattern sometimes described as the "hybrid paradox" (Tao et al., 2024).

In a hybrid arrangement, office facilities continue to operate every working day because some employees are always present, so heating, cooling and lighting systems remain at near-full load (Tao et al., 2024). At the same time, on the days they work from home, employees consume residential energy that would not otherwise be required during working hours (Shi et al., 2023). Two physical workspaces are effectively run for the same job. As Tao et al. (2024) report, one day of working from home per week cuts carbon footprint by only 2%, while two to four days reduce emissions by 11% to 29%, which indicates that occasional hybrid work may deliver only limited environmental gains.

Reviewing the energy, climate and sustainability of hybrid work, Tao et al. (2024) conclude that hybrid arrangements deliver net environmental benefits primarily when accompanied by office downsizing or active occupancy management and when the share of remote workdays is sufficient to justify reduced office capacity. This is particularly relevant in current European context, where the most common hybrid pattern is two to three days per week from home (Eurofound, 2022). At those rates, the organisational margin for environmental gain (office downsizing, occupancy-based HVAC, space consolidation) is largely closed unless employers actively manage it (Mantesi et al., 2022; Ríos Villacorta et al., 2025). What remains within reach is the behavioural margin in the home. This is the analytical entry point of the present dissertation: in a hybrid-dominated baseline, employee-level residential energy behaviour is no longer a peripheral consideration but one of the main levers through which the net environmental effect of remote work is determined.

2.5 Behavioural perspective: insights from the Theory of Planned Behaviour and the attitude-behaviour gap

2.5.1 Core concept

To interpret how the perceptions of remote workers may or may not be reflected in their reported household practices, this dissertation is informed by the Theory of Planned Behaviour (TPB), developed by Icek Ajzen and now one of the most widely used frameworks in social psychology and applied behavioural research (Ajzen, 1991). TPB explains intentional behaviour through three predictors: attitudes towards the behaviour, subjective norms and perceived behavioural control. Attitudes capture whether a person judges a behaviour positively or negatively. For instance, whether saving energy at home seems worthwhile or trivial. Subjective norms capture the perceived social pressure from

colleagues, family, and managers to perform or avoid the behaviour. Perceived behavioural control captures how easy or hard the person believes the behaviour will be, given their resources, knowledge, and constraints (Ajzen, 1991). Together these shape behavioural intention, which in turn is expected to influence actual behaviour. The present study does not test the full model. It focuses on the attitudinal component, through employees' perceived environmental sustainability of remote work.

This framework is a useful interpretive lens for the present dissertation because many environmentally relevant behaviours in remote work are intentional rather than automatic. Examples include switching off equipment, limiting heating or cooling, using natural light where possible, recycling at home or choosing lower-impact transport on non-office days. These behaviours depend not only on environmental concern, but also on what people think others expect of them and on practical constraints within the home environment. (Ajzen, 1991; Yuriev et al., 2020).

The theory also accepts that intentions do not always translate into behaviour. A remote worker may believe that saving energy is important, but still fail to reduce heating or electricity use if the home is poorly insulated, if other household members are present or if the person feels that they have little control over the heating system. In this sense, perceived behavioural control is especially important for this dissertation, because residential energy behaviour is shaped by both motivation and the practical conditions of the household (Ajzen, 1991; Kollmuss & Agyeman, 2002).

2.5.2 Evidence from Research

TPB has been widely applied in environmental behaviour research and even partial applications on a subset of its constructs have generated useful insights. Yuriev et al. (2020) confirm that attitudes, subjective norms and perceived behavioural control are consistently examined as key predictors of environmental intentions and behaviours, although their relative influence varies across contexts and types of behaviour. The review further highlights that contextual factors, such as organisational settings and situational constraints, can shape the strength and significance of these relationships (Yuriev et al., 2020).

Studies focused on the workplace provide further support for using TPB. Greaves et al. (2013) applied TPB to environmental behavioural intentions in the workplace, including

behaviours such as switching off computers, recycling and using video conferencing instead of travel. Their findings support the relevance of TPB constructs for explaining employees' environmental intentions in organisational contexts (Greaves et al., 2013).

2.5.3 The attitude-behaviour gap

A common finding across pro-environmental research is the attitude-behaviour gap. People often express strong environmental concern but fail to act on it consistently. Kollmuss and Agyeman (2002) attribute this gap to a combination of internal factors (habit, values, knowledge, emotional involvement) and external factors (infrastructure, cost, practical barriers). The implication for remote work is direct: a positive evaluation of remote work as environmentally beneficial, based on the visible commuting saving, may not translate into careful management of household energy during work-from-home hours (Kollmuss & Agyeman, 2002; Hook et al., 2020).

Two consequences follow for the present study. The first is that measuring favourable perceptions alone is not sufficient. Perceptions and reported behaviour must be operationalised as distinct variables so the relationship between them can be tested rather than assumed (Ajzen, 1991; Greaves et al., 2013). The second is that self-reported pro-environmental behaviour is itself prone to social-desirability bias, with respondents tending to overstate energy-saving practices and understate higher-consumption routines (Kollmuss & Agyeman, 2002). Anonymous online administration mitigates but does not eliminate this risk, so high mean scores on behaviour items should be interpreted with caution in the empirical chapters. Practical household constraints, such as heating system, residence characteristics and the presence of other household members, enter the empirical model through the residence control variables introduced in Chapter 3, serving as a proxy for the perceived-behavioural-control dimension of TPB without claiming to measure it directly (Simon & O'Brien, 2023; Fameli et al., 2021).

2.6 Employee environmental awareness in remote work settings

A consistent finding across post-pandemic studies is that remote workers exhibit selective awareness of their environmental footprint. The avoided commute is the most visible benefit and the easiest to recognise, because it is attached to a daily routine the employee has

stopped performing (Hook et al., 2020). Less visible effects like additional household heating and cooling, duplicated equipment, ICT load, non-work trips and longer-term residential relocation are systematically underestimated (Hook et al., 2020; O'Brien & Yazdani Aliabadi, 2020; Hostettler Macias et al., 2022).

Selective awareness has a behavioural consequence: pro-environmental practice is unlikely to be uniform across domains. Ziomek and Furmańczyk (2024) show that remote work can reshape everyday practices in shopping, food choices and media use, but employees may act sustainably in some areas while remaining inattentive in others. Remote work does not automatically produce environmentally responsible behaviour; it changes the context in which behaviour occurs (Moglia et al., 2021). This is the empirical reason for measuring residential behaviour across several distinct practices: heating and cooling, lighting, devices and appliances, rather than asking for a single global self-evaluation.

Knowledge of environmental issues moderates which impacts employees are equipped to notice. Stronger sustainability literacy is associated with greater attention to less visible domains such as household electricity load and ICT use (Blok et al., 2015; O'Brien & Yazdani Aliabadi, 2020). Without it, attention tends to remain on the obvious: reduced travel, less printing, waste reduction (Ziomek & Furmańczyk, 2024). Awareness, in other words, depends not only on concern but on the ability to locate where the main impacts actually arise.

Residential factors also determine what employees can act on. Residence size, insulation, heating system, daytime occupancy and the degree of control the employee has over the indoor environment all set the practical envelope for residential energy behaviour (O'Brien & Yazdani Aliabadi, 2020; Simon & O'Brien, 2023). The Greek context is particularly relevant here: heating practices vary considerably across households and an employee in an apartment with central or building-wide heating typically has less behavioural control than one with individual gas or electric heating (Fameli et al., 2021). This is why residence type, heating system, size and occupancy enter the empirical model as controls rather than as variables of theoretical interest in their own right.

The COVID-19 period introduces an additional layer of complexity. For some employees, extended home working increased their awareness of household energy consumption; for others, it normalised higher domestic consumption as part of working life (Fabiani et al.,

2021; O'Brien & Yazdani Aliabadi, 2020). These two trajectories generate opposite predictions for the relationship between remote-work intensity and residential behaviour, which is one reason this relationship should be tested empirically rather than assumed in either direction (Hook et al., 2020).

2.7 Research gap

The literature reviewed above identifies a clear gap. System-level research (Tao et al., 2023, 2024; Hook et al., 2020; Shi et al., 2023; Wu et al., 2024) has produced detailed estimates of how remote work affects commuting, residential energy, office use and non-work travel. These studies consistently show that the net environmental balance of remote work is conditional and that rebound effects can offset commuting savings. However, employee behaviour and perceptions tend to be treated as an assumed input rather than as a measured variable. As a result, the question of whether employees themselves perceive these environmental effects and whether such perceptions are associated with how they act on household energy use while working from home, remains under-examined.

The Greek context adds a second layer to this gap. Maipas and Chatzoglou (2025) provide one of the few peer-reviewed studies linking remote work with environmental outcomes in Greece, but operate at the organisational and environmental-profile level rather than at the level of individual perceptions and household practices. Other Greek studies focus on performance, well-being or telework adoption, without addressing the environmental dimension (Katsaros, 2025; Stamos & Kotsopoulos, 2024). Employee-level evidence on the perception-behaviour link in the Greek setting is therefore largely absent.

This dissertation addresses both aspects of the gap. It does not attempt to measure environmental impact, energy consumption or emissions. Instead, it asks whether remote-work intensity is associated with how employees perceive the environmental sustainability of remote work and with how they report managing energy-related practices at home. The contribution is both empirical and interpretive. Empirically, it provides Greek employee-level evidence on the relationship between remote-work intensity, perceived environmental sustainability and reported residential behaviour. Interpretively, it connects system-level environmental research with behavioural perspectives such as the Theory of Planned

Behaviour and the attitude-behaviour gap, while staying focused on the variables the survey actually measures.

3 Research Methodology

The literature review set out the theoretical and empirical evidence on remote work and its environmental implications was examined in detail. Two points from that review carry directly into this study. First, the environmental effect of remote work is conditional rather than uniform: although remote work often reduces commuting-related emissions, part of this benefit may be offset by household energy use and other rebound-related effects, especially in hybrid arrangements and in residential settings with energy constraints (Hook et al., 2020; Hostettler Macias et al., 2022). Second, individual-level evidence on how employees perceive and respond to this trade-off, especially in Greece, is still limited. Much of the existing work relies on modelling, simulation, or large secondary datasets to estimate environmental outcomes, rather than on employee perceptions and self-reported household practices (Hook et al., 2020; Tao et al., 2023; Wu et al., 2024).

This chapter explains how the conceptual model of the dissertation was translated into an empirical study. It presents the research design, the conceptual framework, the research questions and hypotheses, the target population and sampling approach, the questionnaire design, the operationalisation of the variables, the procedure followed for data collection and the analytical methods. It then addresses ethical considerations and the limitations of methodology.

The study focuses on the relationship between current remote-work intensity, employees' perceptions of the environmental sustainability of remote work and their self-reported residential energy-related behaviours during work-from-home periods. Residence-related characteristics are also included in the analysis, as the literature consistently shows that household conditions shape how remote work is experienced and the extent to which environmentally relevant practices can be adopted at home (O'Brien & Yazdani Aliabadi, 2020; Fameli et al., 2021; Tleuken et al., 2022).

3.1 Research design

The research followed a quantitative, explanatory, cross-sectional design implemented through an online survey. A quantitative approach is appropriate because the objective is to examine statistical relationships among predefined variables derived from the literature. A cross-sectional design is also suitable for the scope of the dissertation, as data were collected at a single point in time and the analysis focuses on associations among variables as reported by participants during the study period (Creswell & Creswell, 2018).

The design is explanatory rather than purely descriptive. It does not only describe employee perceptions and reported household practices, but also examines whether current remote-work intensity is associated with residential energy-related behaviour and whether this relationship is linked to employees' perceptions of the environmental sustainability of remote work. This approach is consistent with the gap identified in Chapter 2, where the environmental consequences of remote work were shown to be far better explored at the system level than at the level of employee perceptions and household behaviour (Hook et al., 2020; Tao et al., 2023).

The questionnaire-based format is appropriate for this purpose. It allowed the collection of primary data from employees with remote-work experience in Greece and it made it possible to examine several dimensions of the issue within one design, including work-from-home intensity, environmental perceptions, reported home energy-related practices and household context. Because the study rests on self-reported survey data, the results are read as evidence of employee-level perceptions, reported practices and statistical associations rather than as direct measurements of household energy consumption, carbon emissions, or the overall environmental impact of remote work (O'Brien & Yazdani Aliabadi, 2020; Hook et al., 2020).

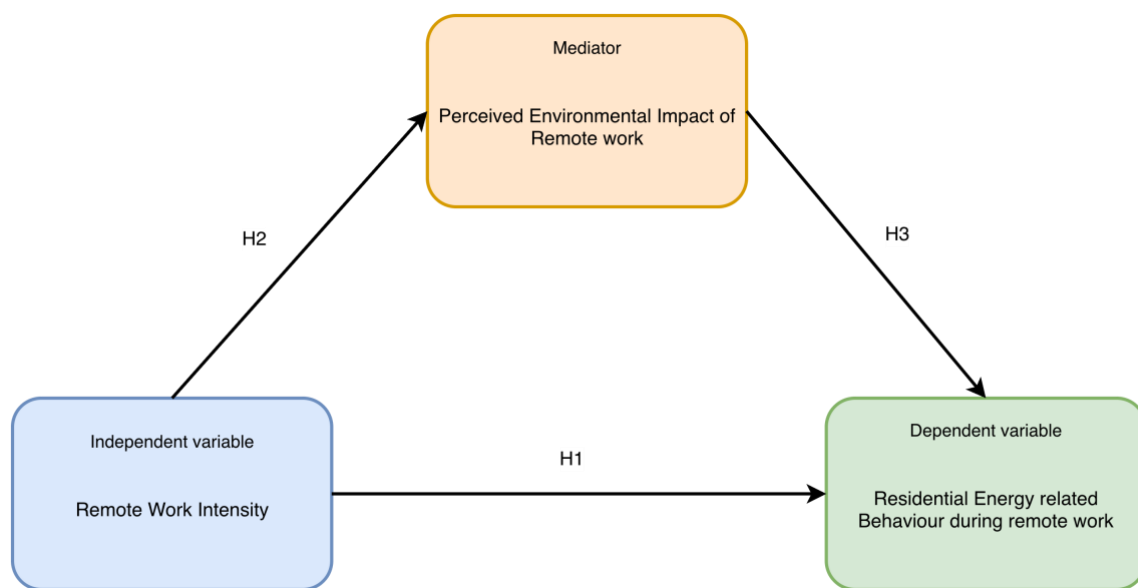
3.2 Conceptual framework, research questions and hypothesis

The conceptual model examines whether remote-work intensity is associated with self-reported residential energy-related behaviours during remote work and whether this relationship is linked to employees' perceptions of the environmental sustainability of remote work. It also includes selected residence-related characteristics as control variables, since household conditions such as residence type, heating system, residence size and

household occupancy may influence home energy practices independently of remote-work patterns (Fameli et al., 2021; O'Brien & Yazdani Aliabadi, 2020; Tleuken et al., 2022).

Figure 3.1 presents the conceptual model of the study. In this model, current Remote Work Intensity (RWI) is treated as the independent variable, Perceived Environmental Sustainability of Remote work (PESR) is treated as the mediating variable, and Residential Energy-Related Behaviours during remote work (REB) are treated as the dependent variable. Residence-related characteristics are entered as control variables.

Figure 3.1: Conceptual model



The primary research question (PRQ) of the study is:

To what extent is remote-work intensity associated with self reported residential energy-related behaviour during work-from-home periods and how is this relationship linked to employees' perceived environmental sustainability of remote work?

This is supported by four secondary research questions (SRQs):

SRQ1. How is current remote-work intensity associated with residential energy-related behaviours during work-from-home periods?

SRQ2. How do employees perceive the environmental sustainability of remote work?

SRQ3. Does perceived environmental sustainability of remote work mediate the relationship between remote-work intensity and residential energy-related behaviour during remote work?

SRQ4. How do specific home-working practices related to heating - cooling, lighting, and electronic device use - appear in the reported behaviour of remote workers?

On the basis of these questions, the study tests four hypotheses. All hypotheses are expressed in the direction of the pro-environmental coding of the dependent variable:

H1. Remote work intensity is positively associated with pro-environmental residential energy-related behaviours during remote work.

H2. Remote work intensity is positively associated with perceived environmental sustainability of remote work.

H3. Perceived environmental sustainability of remote work is positively associated with pro-environmental residential energy-related behaviour during remote work.

H4. Perceived environmental sustainability of remote work mediates the relationship between remote work intensity and residential energy related behaviour during remote work.

3.3 Population and sampling

The target population of the study consists of employees in Greece who have experience with remote or hybrid work either currently or in the recent past. Industry, role and seniority are not used as filters, in order to retain variation across sectors. Industry is collected as a descriptive variable for sample-profile reporting.

The unit of analysis is the individual employee, since the study focuses on personal perceptions and self-reported household energy behaviour during remote work, rather than organisational outcomes.

A non-probability sampling strategy was used, combining convenience and snowball sampling. The questionnaire was distributed online through professional networks, workplace contacts, personal contacts in different sectors and respondents were invited to share the link with colleagues and acquaintances who met the inclusion criteria. Non-probability sampling is widely used in employee-level survey research where a complete

sampling frame is not available and where access depends on professional networks (Saunders et al., 2019).

The target sample size was approximately 150 to 250 valid responses. This range is consistent with general guidance for multiple regression and bootstrapped mediation analysis using the PROCESS macro, where samples in this size typically provide adequate power to detect medium-sized effects (Field, 2018; Hayes, 2022). It is also in line with samples used in recent telework and pro-environmental behaviour studies (Greaves et al., 2013; Khalid et al., 2022; Maipas & Chatzoglou, 2025).

The limitations of this sampling strategy are recognised. Because the sample is non-probabilistic, the findings cannot be generalised statistically to the full population of Greek employees. They should be interpreted as evidence from a relevant but non-random sample of employees with remote-work experience in Greece.

3.4 Survey instrument and variable operationalization

Data were collected through a structured questionnaire consisting of 20 items organised into four sections.

Section 1. Remote Work Intensity (Q1, Q2)

Section 2. Perceived Environmental Sustainability of Remote Work (Q3-Q6)

Section 3. Residential Energy related Behaviours during Remote Work (Q7-Q15)

Section 4. Residence and Sector Controls (Q16-Q20)

The full questionnaire is provided in Appendix A.

Section 1 captures remote work intensity in two ways. Q1 (ordinal, categorical) records the typical number of days per week worked remotely, with response options ranging from 0 to 5 days. The 0-day option allows the study to include respondents who had recently transitioned back to full-time office work but still had relevant remote-work experience. Q2 (ordinal, categorical) records the duration of remote-working experience, with response options ranging from less than six months to more than two years. Together, the two items capture both current work-from-home intensity and accumulated exposure to remote or hybrid working.

For the main hypothesis testing, Q1 is treated as the primary indicator of current Remote Work Intensity. It captures the respondent's present level of home-working more directly than duration does and so aligns more closely with the behaviour items, which ask about current or recent household practices during remote work. Q2 is kept as a supplementary indicator of exposure and as a descriptive characteristic of the sample.

Section 2 measures perceived environmental sustainability of remote work through four positively framed five-point Likert items, ranging from 1 = Strongly disagree to 5 = Strongly agree. These items capture general beliefs about the environmental implications of remote work: commuting reduction, comparison with office work, overall sustainability contribution and a cost-benefit judgement. This kind of measure is consistent with prior questionnaire-based research on telework and sustainability perceptions, which has frequently relied on employees' general evaluations of telework's environmental implications rather than on objective measurements alone (Loia & Adinolfi, 2021; Maipas & Chatzoglou, 2025).

Section 3 measures residential energy-related behaviour during remote work through nine five-point Likert items. These items cover several household practices that are relevant to domestic energy use while working from home: heating and cooling, use of artificial versus natural lighting, simultaneous use of multiple electronic devices, leaving work equipment on when not actively used, increased use of major household appliances, use of background electronics during work, and active energy-saving efforts such as switching off devices and limiting heating or cooling to necessary hours. These dimensions are consistent with the telework-energy literature, which identifies household heating, cooling, lighting, device use, and appliance use as key channels through which remote work may shift environmental pressures from the office to the home (Hook et al., 2020; O'Brien & Yazdani Aliabadi, 2020; Shi et al., 2023; Wu et al., 2024).

Items Q7 to Q12 are phrased as energy-intensive household practices during remote work. In order to construct a composite measure in which higher scores consistently reflect more pro-environmental, lower-impact residential behaviour during remote work, these items are reverse-coded prior to analysis. Items Q13 to Q15, which are already phrased as energy-saving behaviours are retained in their original direction. For analytical purposes, the nine behaviour items are then combined into a composite Residential Energy-related Behaviour

(REB) score, where a higher value indicates a more pro-environmental household profile during remote work.

Section 4 collects residence-related controls. These are residence type (Q16), primary heating system (Q17), residence size (Q18), and household occupancy during typical working hours (Q19). These variables are included because residential energy demand depends not only on employee behaviour, but also on the physical and social conditions of the home environment, including dwelling characteristics, heating arrangements, and the presence of other household members during the day (O'Brien & Yazdani Aliabadi, 2020; Fameli et al., 2021; Tleuken et al., 2022). Q20 records the respondent's industry or sector and is treated as a descriptive variable for sample profiling.

Table 3.1: Variable operationalisation

Construct	Variable type	Operational definition	Items / measure	Hypotheses
Remote Work Intensity (RWI)	Independent variable	The extent to which respondents perform their work remotely rather than on the employer's premises.	Q1: ordinal categorical, typical remote days per week (primary indicator) Q2: ordinal categorical duration of remote-work experience (supplementary indicator)	H1, H2, H4
Perceived Environmental Sustainability of Remote work (PESR)	Mediating variable	The degree to which respondents perceive remote work as environmentally beneficial overall	Q3-Q6: 5-point Likert scale (1 = Strongly disagree to 5 = Strongly agree)	H2, H3, H4
Residential Energy related Behaviour	Dependent variable	Self-reported household practices related to heating, cooling, lighting, device	Q7-Q15: 5-point Likert scale (Q7-Q12 reverse-	H1, H3, H4

during remote work (REB)		use, appliance use, and energy-saving actions during remote work	coded so that higher scores indicate more energy-conscious behaviour)	
Residence type	Control variable	Type of dwelling in which the respondent resides.	Q16: nominal categorical	Control
Heating system type	Control variable	Primary heating system used in the respondent's residence.	Q17: nominal categorical	Control
Residence size	Control variable	Approximate size of the respondent's residence.	Q18: ordinal categorical	Control
Household occupancy during work hours	Control variable	Presence of other household members in the home during a typical remote workday.	Q19: multiple-response item, recoded into binary indicator (0 = alone during work hours, 1 = at least one other person present)	Control
Industry / Sector	Descriptive variable	Economic sector in which the respondent's employer operates.	Q20: nominal categorical	Descriptive

3.5 Data collection procedure

Data were collected through an anonymous online questionnaire administered via Google Forms between March 2026 and May 2026. Before the main data collection phase, the survey was pilot-tested with a small number of respondents in order to check clarity, wording, questionnaire flow and approximate completion time. Minor revisions were made before the questionnaire was distributed more widely.

Participation was voluntary and anonymous. The first page of the questionnaire included a short information note explaining the purpose of the study, the academic nature of the

research, the estimated completion time and the respondent's right to discontinue participation at any time. No directly identifying personal data were collected.

The use of an online format was appropriate for the present study for practical reasons. It allowed efficient access to respondents in different locations and it was compatible with a population already familiar with digital forms of communication and work organisation. Online anonymous administration also helps reduce the pressure on respondents to present themselves in a socially desirable manner when reporting environmentally relevant behaviour, although it cannot eliminate this risk fully (Kollmuss & Agyeman, 2002).

3.6 Data analysis methods

The data were analysed in SPSS using descriptive statistics, reliability checks, bivariate analysis, regression analysis with standard OLS diagnostics, bootstrapped mediation analysis and supporting item-level descriptive interpretation of residential behaviours.

3.6.1 Data preparation and screening

The dataset was checked for missing values, response patterns indicating low engagement (for example, uniform responses across all Likert items) and outliers. Composite scores were then calculated for the mediator (average of Q3-Q6) and for the dependent variable (average of Q7-Q15, with Q7-Q12 reverse-coded so that higher scores indicate more pro-environmental residential behaviour and Q13-Q15 retained in their original direction). This follows standard practice in questionnaire-based analysis when composite measures are constructed from multiple items that share the same response scale (Field, 2018).

As noted in Section 3.4, current remote-work intensity was operationalised mainly through Q1, while Q2 (duration of experience) was kept for descriptive purposes. This keeps the independent variable conceptually aligned with the behaviour items, which refer to current or recent practice.

Residence-related control variables were recoded into analysis-ready form prior to model estimation. Categorical controls were transformed where necessary so that they could be included appropriately in the regression models. In the case of household occupancy during work hours (Q19), the original multiple-response item was recoded into a binary indicator:

respondents who selected "No one (I am alone)" were coded 0, and those who reported at least one other person at home during typical remote-work hours were coded 1. This captures whether the respondent worked alone or within a shared home environment during the working day, while avoiding unnecessary fragmentation of the control variable in the regression models. Finally, categories that had few responses considering Heating system (Q17) and Industry (Q20) were grouped under "Other".

3.6.2 Descriptive statistics

Descriptive statistics were used to present the profile of the sample and the general distribution of the study variables. Frequencies and percentages were reported for categorical variables. Means and standard deviations were reported for the main composite variables and where useful, for individual Likert-type items. Item-level means are also examined as a basis for interpreting which residential practices appear more or less responsive to environmental concern in the sample.

3.6.3 Reliability assessment

Internal consistency was examined for the Perceived Environmental Sustainability of Remote Work (PESR) measure and for the Residential Energy-related Behaviour (REB) measure. Cronbach's alpha was used as the main indicator of internal consistency, while item-total correlations were also examined where relevant. In line with common practice in social-scientific research, alpha values around or above 0.70 were treated as indicating acceptable internal consistency, while lower values were interpreted in relation to the conceptual content of the items and the broader purpose of the scale or index (Field, 2018).

In the case of the REB measure, reliability statistics were interpreted with particular care, since the nine behaviour items represent several related but distinct household practices rather than one narrow psychological attribute. For this reason, the REB measure is used primarily as a composite behavioural index of residential energy-related practices during remote work, not as a claim that all nine items necessarily reflect a single homogeneous construct.

Because PESR and REB were both measured through self-reported Likert items administered in the same questionnaire, the possibility of common method bias was assessed

using Harman's single-factor test (Podsakoff et al., 2003). An unrotated principal component analysis was conducted on the thirteen PESR and REB items, with the REB items entered in their pro-environmental direction. A first-factor variance below the conventional 50% threshold was treated as evidence that no single factor dominated the response patterns.

3.6.4 Bivariate analysis

Bivariate analysis was conducted in order to obtain an initial view of the relationships among the main variables before the multivariate models were estimated. Because the dataset combines ordinal, categorical, and composite variables, rank-based (Spearman) correlations were used for the ordinal and recoded variables, while the relationships among the principal composite measures were inspected using standard correlation coefficients where appropriate. This approach was adopted in order to remain methodologically consistent with the structure of the questionnaire and the type of data collected.

The purpose of this stage was not to draw final conclusions, but rather to inspect the direction and approximate magnitude of the main associations and to support the interpretation of the subsequent regression and mediation analyses. It focused on current remote-work intensity, perceived environmental sustainability of remote work, the composite residential energy-related behaviour measure and the relevant control variables.

3.6.5 Hypothesis testing

Hypotheses H1 to H3 were tested through regression models in which the relevant dependent variable was regressed on the appropriate predictor or predictors, with residence-related controls included where applicable. Current remote-work intensity, measured through Q1, was used as the principal independent variable in these models. The composite PESR and REB scores were treated as the main continuous outcome variables for the purposes of estimation, which is common practice when multi-item Likert-based composites are used in applied social research and interpreted at the scale level rather than at the single-item level (Field, 2018).

H1 was tested by checking whether employees who work remotely more often (RWI) report more pro-environmental residential behaviour (REB). H1 is supported if the relationship is positive and statistically significant.

H2 was tested by checking whether employees who work remotely more often (RWI) hold more favourable views of remote work as environmentally sustainable (PESR). H2 is supported if the relationship is positive and statistically significant.

H3 was tested by checking whether employees with more favourable environmental perceptions of remote work (PESR) report more pro-environmental residential behaviour (REB), after accounting for how often they work remotely. H3 is supported if the relationship is positive and statistically significant.

H4, the mediation hypothesis, was tested through the PROCESS macro for SPSS (Model 4), using current remote-work intensity (RWI) as the predictor, PESR as the mediator, REB as the outcome, and residence-related variables as controls. Bootstrapped 95% confidence intervals for the indirect effect were generated based on 5,000 samples. H4 is treated as supported when the confidence interval for the indirect effect did not include zero and the indirect effect was positive, meaning that more frequent remote work is associated with more favourable environmental perceptions, which are in turn associated with more pro-environmental residential behaviour (Hayes, 2022). A statistically significant indirect effect with a negative sign would be reported and discussed as evidence consistent with rebound effects or attitude–behaviour-gap interpretations of the data, rather than as support for H4 as formulated.

The level of statistical significance was set at $p < 0.05$ throughout. Effect sizes and confidence intervals are reported alongside p-values so that the strength of each relationship can be judged on its own terms, rather than from significance testing alone (Field, 2018; Hayes, 2022).

In addition to the formal hypothesis tests, the chapter contains an item-level descriptive interpretation of residential behaviours. The purpose of this final step is to examine which household practices appear most and least responsive to environmental concern in the sample and to relate the observed patterns to the residential and household context. This descriptive interpretation is not used to test additional hypotheses, but to provide context for

the main findings and to address the residential dimension of the secondary research question SRQ4.

3.7 Ethical considerations

The study followed established principles of research ethics: informed consent, voluntary participation, anonymity, confidentiality and proportionate handling of personal data.

On the first page of the questionnaire, participants were informed about the purpose of the research, the academic context (MBA dissertation), the type of information requested, the approximate time required and the right to withdraw at any moment without consequence.

The questionnaire collected no direct personal identifiers. Demographic items were limited to those needed for the analysis (residence characteristics and industry sector) and no special-category data within the meaning of the General Data Protection Regulation (Regulation (EU) 2016/679) were requested. Responses were stored in the survey platform's secured environment, accessed only by the researcher, used solely for the purposes of this dissertation and deleted after the conclusion of the academic process.

3.8 Methodology limitations

Several limitations should be acknowledged before the empirical findings are interpreted.

Self-reported behaviour. The dependent variable is measured through self-reports, which are sensitive to social desirability bias, particularly for environmentally relevant behaviour (Kollmuss & Agyeman, 2002). Respondents may overstate energy-saving practices and understate higher-consumption routines. Anonymous online administration is intended to mitigate, though not eliminate, this risk.

Cross-sectional design. The study captures associations at a single point in time and therefore cannot establish causal direction. The conceptual model assumes that intensity and perceptions influence behaviour, but the reverse direction cannot be ruled out empirically without experimental data (Hayes, 2022).

Non-probability sampling. Convenience and snowball sampling restricts the statistical generalisability of findings to the broader population of Greek employees. Sample

composition is likely to over-represent knowledge-economy sectors and digitally connected respondents.

Behaviour vs direct energy measurement. The study does not measure actual household energy consumption, electricity usage, heating usage, or residential emissions directly. It cannot therefore determine whether remote work objectively reduces or increases environmental impact. Instead, it examines self-reported residential energy-related practices during remote work and the results should be interpreted as behavioural and perceptual evidence, not as a carbon-footprint assessment.

Composite dependent variable. The dependent variable combines several related household practices, including heating, cooling, lighting, equipment use, appliance use, and energy-saving actions. Although this allows the study to capture the residential dimension of remote work in a broader and more realistic way, it also means that the measure reflects a composite behavioural profile rather than one narrowly defined form of action. Item-level descriptive interpretation is used to address this point and to highlight which specific practices drive the overall pattern.

4 Data analysis and findings

This chapter presents the empirical analysis of the survey data. The analysis covers data preparation and screening, sample profile, descriptive statistics, reliability assessment, bivariate analysis, regression-based hypothesis testing, mediation analysis. It closes with additional descriptive insights into specific residential behaviours.

The final dataset consisted of 180 valid responses. The survey file contained no missing values, and no respondent gave identical answers across all the Likert items, so no cases were dropped for missing data or straight-lining. For the analysis, current remote-work intensity was operationalised through Q1, while Q2 was retained for descriptive and supplementary interpretation.

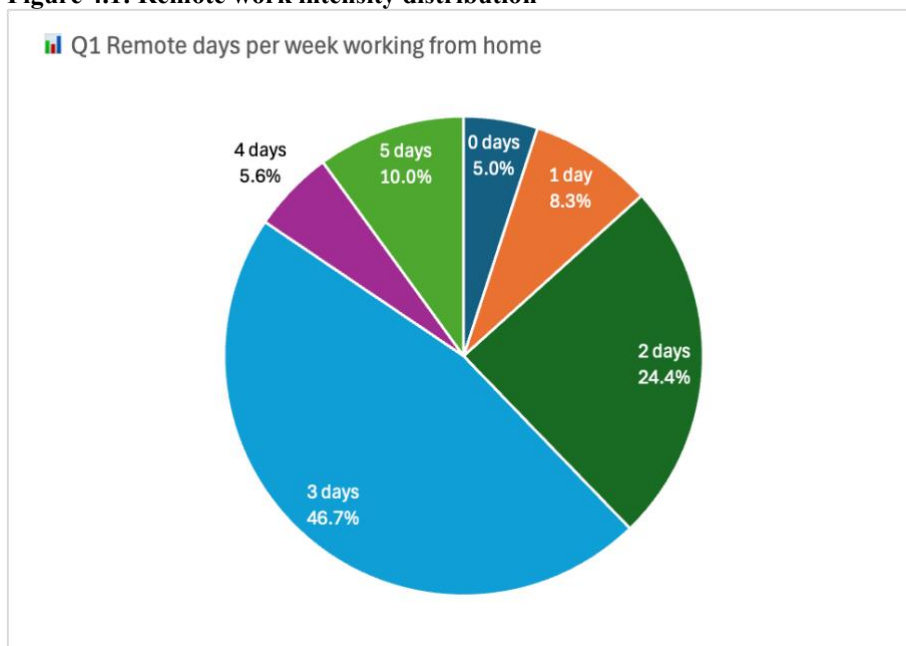
The REB composite was created by reverse-coding Q7-Q12 and retaining Q13-Q15 in their original direction. This coding is consistent with the hypothesis that higher REB scores indicate more pro-environmental residential behaviour.

For household occupancy, Q19 was recoded into a binary indicator where “0” represented working alone during typical remote-work hours and “1” represented the presence of at least one other person in the home. A small number of responses combined “No one (I am alone)” with another household category. In those cases, the responses were coded as “1” since the analytical purpose of the variable was meant to distinguish between shared and non shared home-working environments. Categories with few responses in Q17 (Heating system) and Q20 (Industry) were grouped under “Other”.

4.1 Sample profile

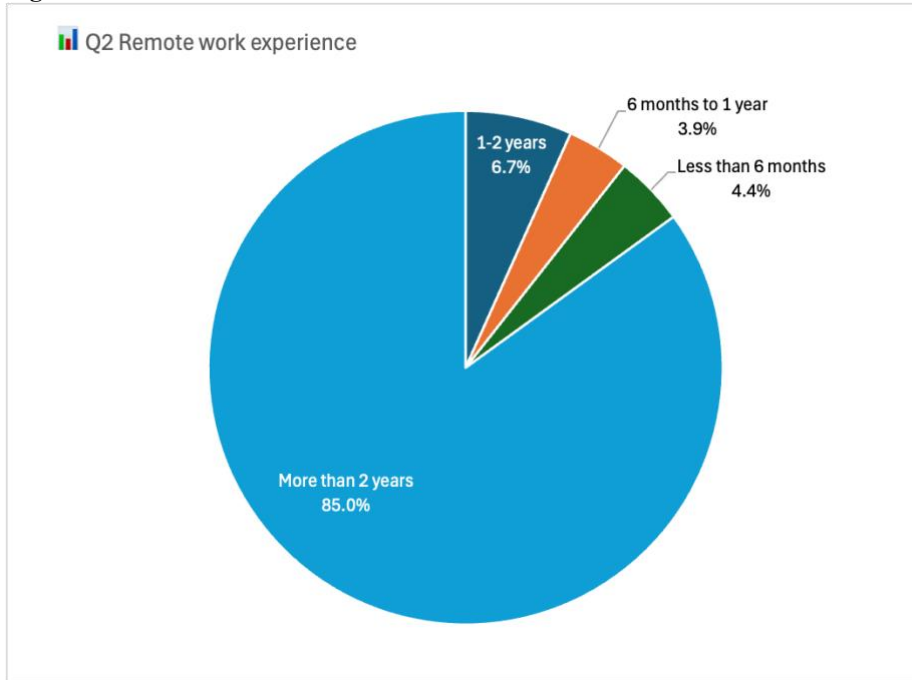
The sample was concentrated in hybrid work arrangements. Almost half of respondents (46.7%) reported working remotely three days per week, while 24.4% reported two days per week. Fully remote work (five days per week) accounted for 10.0% of the sample, whereas 5.0% had recently returned to full-time office work.

Figure 4.1: Remote work intensity distribution



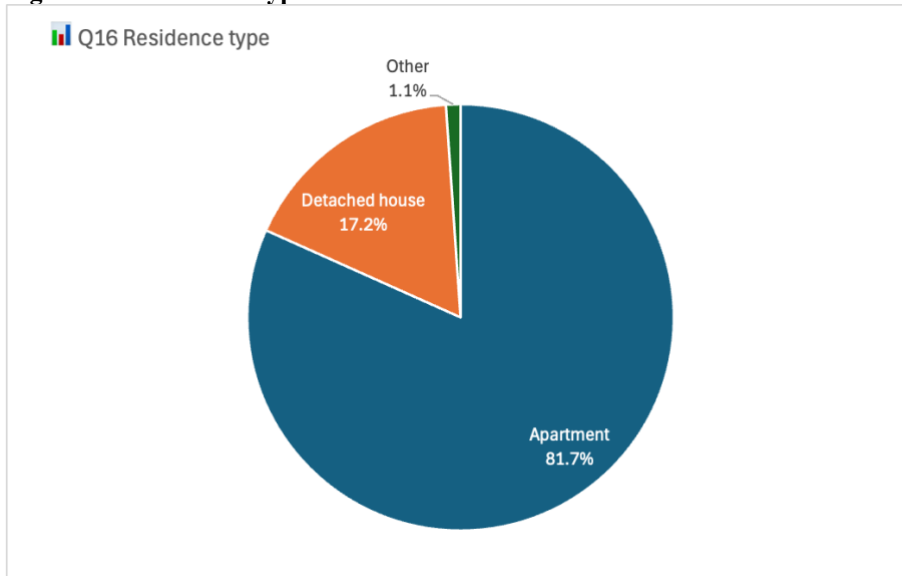
Remote-work experience was relatively long: 85.0% had been working remotely or in hybrid form for more than two years.

Figure 4.2: Remote work duration



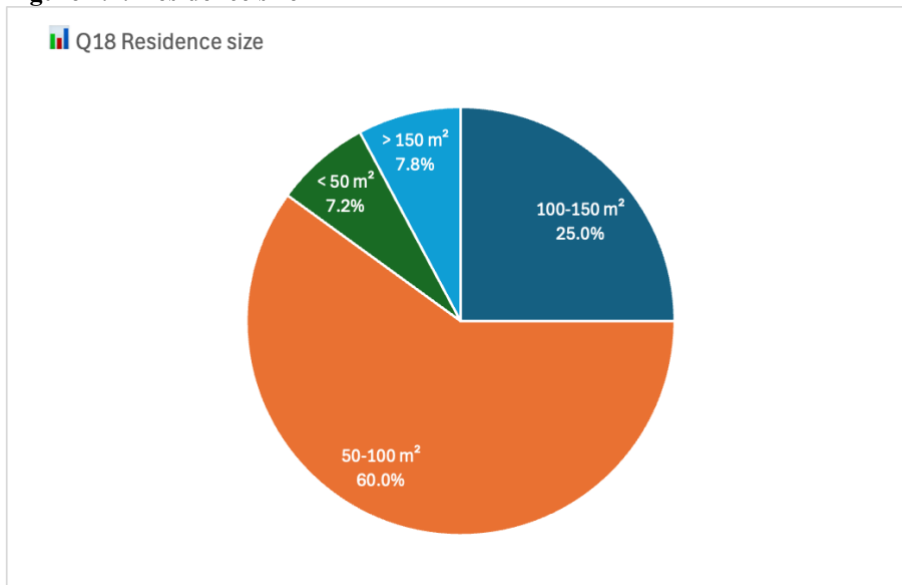
The residential profile was dominated by apartments (81.7%), followed by detached houses (17.2%).

Figure 4.3: Residence type



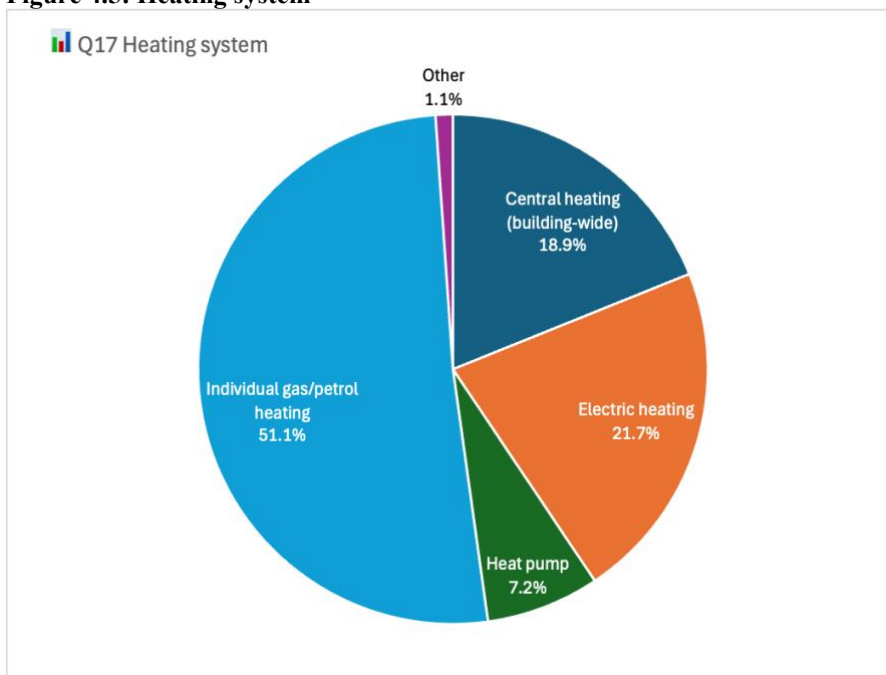
The most common residence size category was 50-100 m² (60.0%).

Figure 4.4: Residence size



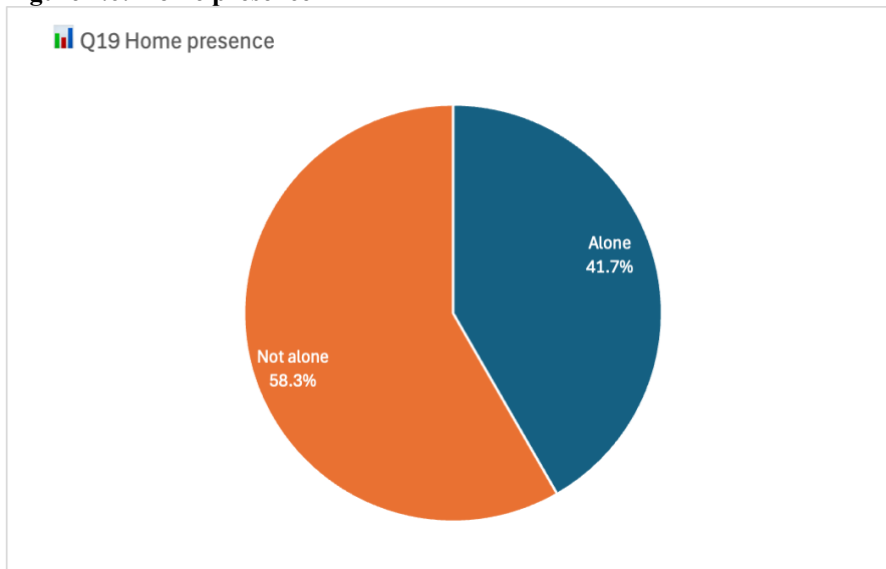
The most common heating system was individual gas or petrol heating (51.1%).

Figure 4.5: Heating system



A majority of respondents (58.3%) reported that at least one other person was typically at home during remote-work hours.

Figure 4.6: Home presence



Finally, the sample was highly concentrated in Technology / IT / Telecommunications (81.1%), which should be taken into account when interpreting generalisability.

Figure 4.7: Industry/sector

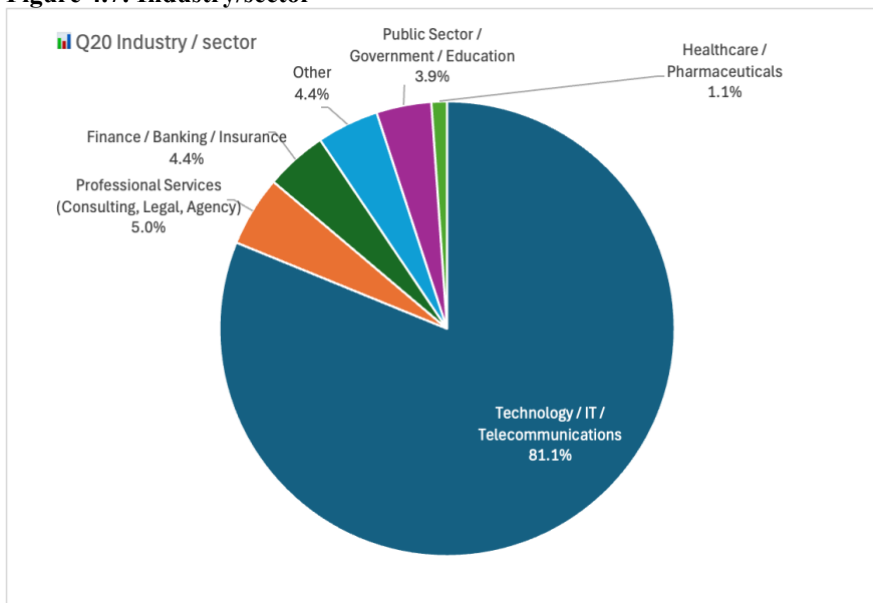


Table 4.1: Sample data summary

Category	Group	n	%
Remote-work intensity	0 days (recently back full-time office)	9	5.0
	1 day	15	8.3
	2 days	44	24.4
	3 days	84	46.7
	4 days	10	5.6
	5 days	18	10.0
Remote-work duration	Less than 6 months	8	4.4
	6 months to 1 year	7	3.9
	1-2 years	12	6.7

	More than 2 years	153	85.0
Residence type	Apartment	147	81.7
	Detached house	31	17.2
	Other	2	1.1
Heating system	Individual gas/petrol heating	92	51.1
	Electric heating	39	21.7
	Central heating	34	18.9
	Heat pump	13	7.2
	Other	2	1.1
Residence size	Less than 50 m ²	13	7.2
	50-100 m ²	108	60.0
	100-150 m ²	45	25.0
	More than 150 m ²	14	7.8
Household occupancy	Alone during work hours	75	41.7
	At least one other person present	105	58.3
Industry	Technology / IT / Telecommunications	146	81.1
	Finance / Banking / Insurance	8	4.4
	Professional Services	8	4.4
	Public Sector / Government / Education	7	3.9
	Healthcare / Pharmaceuticals	2	1.1
	Other	9	5.0

4.2 Descriptive statistics

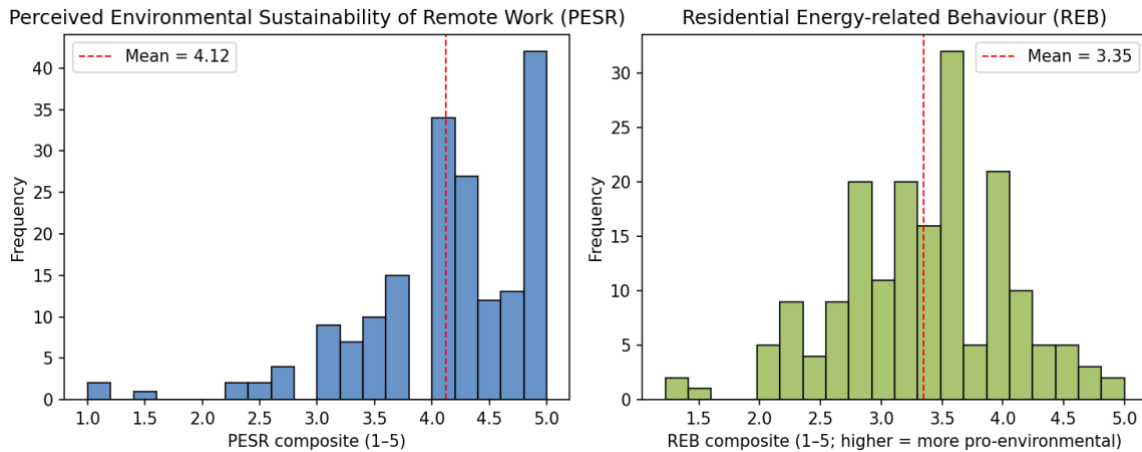
Current remote-work intensity averaged 2.69 days per week (SD = 1.18), which is consistent with a mainly hybrid sample. The mean PESR score was 4.12 (SD = 0.78) on a five-point scale, showing that respondents generally saw remote work as environmentally sustainable. The mean REB score was 3.35 (SD = 0.68), suggesting a moderately pro-environmental residential behaviour profile overall.

Table 4.2: Descriptive statistics for the main study variables

Variable	N	Mean	SD	Min	Max
Remote-work intensity (Q1, 0-5 days)	180	2.694	1.182	0.000	5.000
Remote-work duration (Q2, 1-4)	180	3.722	0.740	1.000	4.000
Perceived environmental sustainability of remote work (PESR)	180	4.119	0.780	1.000	5.000
Residential energy-related behaviour during remote work (REB)	180	3.349	0.684	1.222	5.000

Note. PESR = Perceived Environmental Sustainability of Remote work. REB = Residential Energy-related Behaviour during remote work, scored so that higher values indicate more pro-environmental behaviour.

Figure 4.8: Distributions of the PESR and REB composite scores (N = 180).



At item level, the strongest PESR agreement appeared on Q3 (“Remote work reduces environmental pollution by decreasing commuting”), with a mean of 4.34 and 87.2% of respondents selecting Agree or Strongly Agree. The most restrained perception appeared on Q6 (“The environmental benefits of remote work outweigh its potential environmental costs”), although this item still had a positive mean of 3.92 and 70.0% agreement.

The REB items were more uneven. Across the nine behaviours, item means ranged from about 2.6 to 3.7, so respondents were far more energy-conscious in some areas than others. Table 4.3 reports the full set, and the individual practices behind this spread are interpreted in Section 4.6.

Table 4.3: Item-level descriptive statistics for PESR and REB

Item	Abbreviated item content	Mean	SD
Q3	Remote work reduces environmental pollution by decreasing commuting.	4.344	0.861
Q4	Overall, remote work is more environmentally sustainable than working in a traditional office.	4.106	0.931
Q5	Remote work practices contribute positively to environmental sustainability.	4.111	0.877
Q6	The environmental benefits of remote work outweigh its potential environmental costs.	3.917	0.871
Q7r	I heat or cool my entire residence during work hours, rather than just the room I am working in.	3.300	1.320
Q8r	I use artificial lighting in my workspace even when natural light is available.	3.517	1.262
Q9r	I use multiple electronic devices (e.g., laptop, monitor, printer) simultaneously while working remotely.	2.578	1.237
Q10r	I leave my computer or work equipment on even when they are not actively used.	3.400	1.284
Q11r	I run major household appliances (e.g. oven, dishwasher, washing machine) more frequently now that I work from home.	3.111	1.209
Q12r	I keep background electronics (TV, Radio, Smart Speakers) running while I am working.	3.711	1.106
Q13	I consciously try to reduce electricity consumption while working from home.	3.317	1.044
Q14	I make a conscious effort to switch off electronic devices when they are not in use during my workday.	3.472	1.136
Q15	I limit the use of heating or cooling to only the hours when it is necessary during my workday.	3.733	1.001

Note. Q7–Q12 are presented in their reverse-coded, pro-environmental direction.

Figure 4.9: Mean scores for the four PESR items

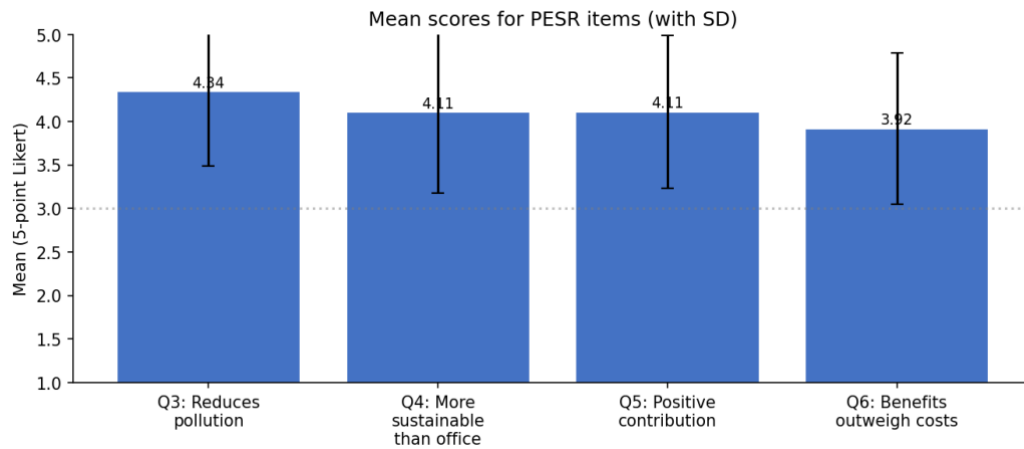
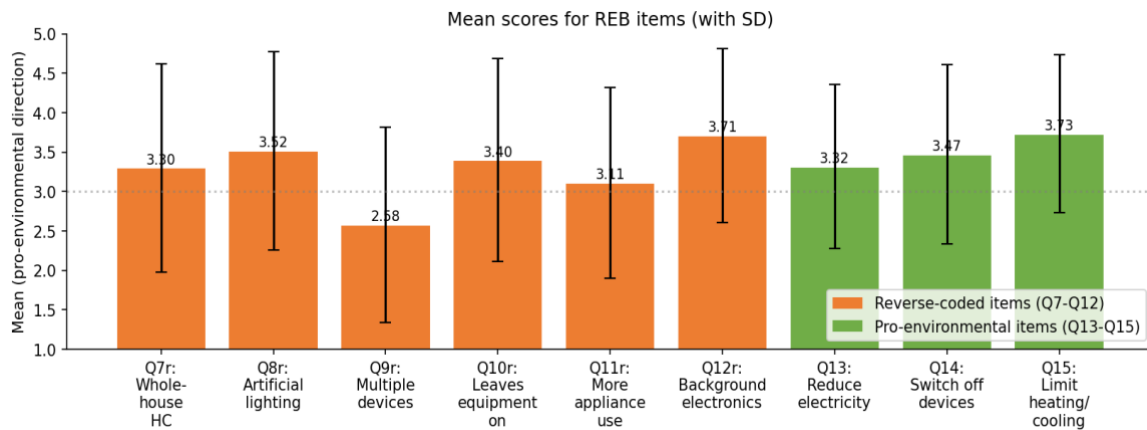


Figure 4.10: Mean scores for the nine REB items (pro-environmental direction)



Two points stand out. Firstly, the sample is generally favourable toward remote work as environmentally sustainable. Secondly, reported residential energy-related behaviour is more mixed. Respondents appear to recognise the commuting benefit of remote work more clearly than they consistently report energy-conscious household practices.

Normality checks showed that PESR was left-skewed because many respondents gave favourable answers (Shapiro-Wilk $W = 0.890$, $p < .001$; skewness = -1.17). REB approximates a normal distribution (Shapiro-Wilk $W = 0.989$, $p = .182$; skewness = -0.29). For this reason, both Pearson and Spearman correlations are considered in the bivariate analysis.

4.3 Reliability assessment

Cronbach's alpha was computed for the two composite measures used in the analysis. The PESR scale demonstrated excellent internal consistency (Cronbach's $\alpha = .904$). Item-total correlations ranged from .716 to .856, indicating that all four items contributed strongly to the same perception construct.

The REB scale also showed acceptable internal consistency (Cronbach's $\alpha = .751$). Item-total correlations ranged from .340 to .595. Although the REB items cover different household practices, the alpha value supports their use as a composite behavioural index. Inspection of the "alpha if item deleted" values confirm that no single item significantly improves reliability if removed. Deletion of any item changes alpha only marginally, with the index remaining within a narrow band of approximately 0.70-0.75.

Table 4.4: Reliability statistics

Scale	Items	Cronbach alpha	Min item-total r	Max item-total r
PESR	4	0.904	0.716	0.856
REB	9	0.751	0.340	0.595

Because PESR and REB were both measured through self-reported Likert items collected in the same questionnaire, common method bias was also checked using Harman's single-factor test. The first unrotated factor explained 31.22% of the total variance, well below the conventional 50% threshold. The next three components explained 12.64%, 10.19% and 9.48% respectively. Although the test cannot fully rule out method bias, this result indicates that no single factor dominates the response.

4.4 Bivariate analysis

Bivariate associations among the main variables were inspected using both Spearman and Pearson coefficients, which is appropriate given that RWI is an ordinal variable and that PESR is asymmetrically distributed. Spearman and Pearson conclusions were consistent.

Table 4.5: Spearman correlations

	RWI (Q1)	Duration (Q2)	PESR	REB
RWI (Q1)	—	0.150	0.145	0.033
Duration (Q2)	0.150	—	0.137	0.093
PESR	0.145	0.137	—	0.385
REB	0.033	0.093	0.385	—

Three observations stand out from the above table. Current remote-work intensity (Q1) is essentially uncorrelated with self-reported residential energy related behaviour ($\rho = .033$, $p = .663$). The same conclusion was reached when Pearson's coefficient was used ($r = .032$, $p = .670$). This suggests that working remotely more often did not automatically correspond to more pro-environmental household behaviour. Current remote-work intensity is only weakly and marginally positive associated with environmental perceptions ($\rho = .145$, $p = .053$). This indicates that respondents who worked remotely more often did not necessarily view remote work as substantially more environmentally sustainable. The clearest relationship was between perceptions and behaviour, which was moderate and positive ($\rho = .385$, $p < .001$; Pearson $r = .400$, $p < .001$). Thus, employees who viewed remote work as more environmentally sustainable also tended to report more energy-conscious household practices.

Overall, the results suggest that the strongest relationship in the data is not between remote-work intensity and behaviour, but between environmental perceptions and behaviour.

4.5 Hypothesis testing

Hypotheses H1, H2 and H3 were tested using OLS regression, with current remote-work intensity (RWI) as the principal independent variable, PESR as the mediating variable and REB as the dependent variable. Residence-related controls were included in the multivariate models. These controls were residence type, residence size, household occupancy, and heating system. Multicollinearity diagnostics for the full model show all variance inflation factors below 2 (maximum VIF = 1.87), well within acceptable thresholds ($VIF < 5$). Hypothesis H4 was tested through a bootstrapped mediation analysis (5,000 resamples) with the same set of controls.

4.5.1 Remote work intensity and residential behaviour

H1 stated that remote work intensity would be positively associated with pro-environmental residential energy related behaviour during remote work.

The simple regression examined whether RWI predicted REB during remote work. The analysis showed that RWI was not a statistically significant predictor of REB ($B = 0.019$, $SE = 0.043$, $t = 0.43$, $p = .670$). The explanatory power of the model was negligible ($R^2 =$

.001), indicating that the frequency of remote work was not meaningfully associated with the level of reported pro-environmental household behaviour.

Adding residence-related controls does not change this ($B = 0.001$, $SE = 0.045$, $t = 0.03$, $p = .975$, $R^2 = .025$, $F(8, 171) = 0.56$, $p = .812$) with no control variable reaching statistical significance. The coefficient was extremely small and close to zero, so the number of remote-work days showed no meaningful link to reported pro-environmental household behaviour.

Therefore, the results did not support H1. In this sample, employees who worked remotely more often did not report more pro-environmental residential energy-related behaviour.

4.5.2 Remote work intensity and environmental perceptions

H2 stated that remote-work intensity would be positively associated with perceived environmental sustainability of remote work.

The simple regression showed that the relationship was positive but statistically non-significant ($B = 0.054$, $SE = 0.049$, $t = 1.10$, $p = .273$). The model explained less than 1% of the variance in PESR ($R^2 = .007$), indicating that the frequency of remote work was not meaningfully associated with the level of reported pro-environmental perceptions.

The same conclusion was reached when residence-related controls were added. Remote-work intensity again failed to reach statistical significance ($B = 0.045$, $SE = 0.051$, $t = 0.88$, $p = .380$) and the model explained only a small share of variance in PESR ($R^2 = .042$).

Although the relationship remained positive, the result was weak and statistically non-significant. H2, was therefore not supported : in this sample, more frequent remote work was not associated with more favourable environmental perceptions.

4.5.3 Perceived environmental sustainability and residential energy related behaviour

H3 stated that perceived environmental sustainability of remote work would be positively associated with pro-environmental residential energy related behaviour during remote work.

In the simple regression, unlike the previous models, PESR was found to be a statistically significant positive predictor of REB ($B = 0.351$, $SE = 0.061$, $t = 5.79$, $p < .001$; standardised $\beta = .400$). The model explained 16.0% of the variance in REB ($R^2 = .160$, $F(2, 177) = 16.89$,

$p < .001$). This finding suggests that employees who viewed remote work as environmentally sustainable also tended to report more energy-conscious residential behaviour while working from home.

The result remained virtually unchanged after adding residence-related controls. PESR continued to be a statistically significant predictor of REB ($B = 0.352$, $SE = 0.062$, $t = 5.67$, $p < .001$) and the full model explained 18.0% of the variance in REB ($R^2 = .180$, $F(9, 170) = 4.15$, $p < .001$). Remote-work intensity remained non-significant in this model ($B = -0.014$, $p = .729$).

In practical terms, a one-point increase in PESR was associated with roughly a 0.35-point rise in REB, holding remote-work intensity and residence-related variables constant. This is a meaningful relationship for social-science research. It suggests that when household characteristics are controlled for, employees who view remote work as environmentally sustainable are also more likely to report energy-conscious behaviour at home.

Standard OLS diagnostics did not indicate serious violations of the regression assumptions. The standardised residuals were approximately normally distributed (Shapiro-Wilk $W = 0.995$, $p = .841$) and homoscedasticity checks did not raise concerns (Breusch-Pagan test $LM = 6.32$, $p = .707$). Inspection of influential cases did not alter the interpretation of the PESR effect. Therefore, the H3 finding can be treated as stable within the limits of the dataset.

H3 is supported.

Figure 4.11: Perception-behaviour relationship (scatter of PESR and REB with OLS fit)

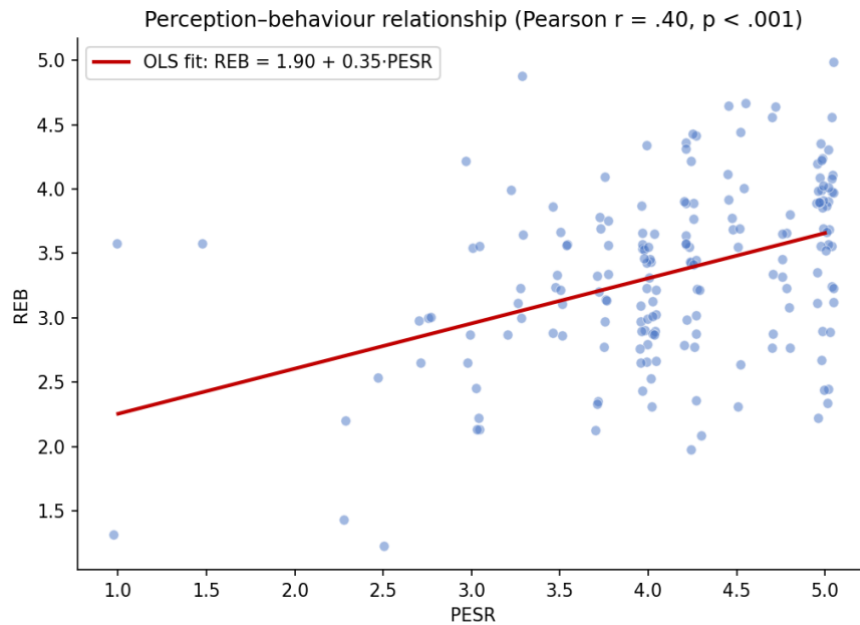


Table 4.6: Main regression results summary (unstandardized coefficients) for H1, H2, H3. Controls: residence type, heating system, residence size, household occupancy.

Model / Predictor	B	SE	t	p	R ²
H1: REB ~ RWI					.001
RWI	0.019	0.043	0.43	.670	
H1: REB ~ RWI + controls					.025
RWI	0.001	0.045	0.03	.975	
H2: PESR ~ RWI					.007
RWI	0.054	0.049	1.10	.273	
H2: PESR ~ RWI + controls					.042
RWI	0.045	0.051	0.88	.380	
H3: REB ~ RWI + PESR					.160***
RWI	-0.001	0.040	-0.01	.989	
PESR	0.351	0.061	5.79	<.001	
H3: REB ~ RWI + PESR + controls					.180***
RWI	-0.014	0.041	-0.35	.729	
PESR	0.352	0.062	5.67	<.001	

Note. *** $p < .001$.

4.5.4 Mediation analysis

H4 stated that perceived environmental sustainability of remote work would mediate the relationship between remote-work intensity and residential energy related behaviour. Mediation was tested using bootstrapped indirect effects (5,000 bootstrap samples and 95% bias-corrected confidence intervals), with current remote-work intensity (RWI) as the predictor, PESR as the mediator, REB as the outcome and residence-related variables as controls.

Three path coefficients were calculated. The a path (RWI → PESR) was positive but not statistically significant ($B = 0.045$, $SE = 0.051$, $p = .380$). The b path (PESR → REB, controlling for RWI) was positive and statistically significant ($B = 0.352$, $SE = 0.062$, $p < .001$). The total effect of RWI on REB (c path) was essentially zero ($B = 0.001$, $SE = 0.045$, $p = .975$) and the direct effect of RWI on REB controlling for PESR (c') was also non-significant ($c' = -0.014$, $SE = 0.048$, $p = .729$). The indirect effect ($a \times b$) was small, positive but statistically non-significant ($B = 0.016$), with a 95% bootstrap confidence interval that included zero $([-0.031, 0.059])$. The standardised indirect effect was negligible ($abcs = 0.027$). On this basis, H4 is not supported.

Table 4.7: PROCESS macro for SPSS (Model 4) analysis (RWI → PESR → REB), controlling for residence type, heating system, residence size and household occupancy. 5,000 bootstrap resamples.

Path	Coefficient (B)	SE	p	95% Bootstrap CI
a (RWI → PESR)	0.045	0.051	.380	[-0.080, 0.164]
b (PESR → REB)	0.352	0.062	<.001	[0.197, 0.511]
c (Total RWI → REB)	0.001	0.045	.975	[-0.108, 0.101]
c' (Direct RWI → REB)	-0.014	0.048	.729	[-0.109, 0.059]
$a \times b$ (Indirect)	0.016	0.022	-	[-0.031, 0.059]
Standardised indirect (abcs)	0.027	-	-	-

In practical terms, the mediation chain breaks at the first link. Because the total effect is not significant and the a-path is weak, the conditions for traditional mediation are not met. While more positive environmental perceptions are clearly associated with more pro-environmental residential behaviour (the b path), current remote-work intensity is not robustly associated with environmental perceptions in linear terms. As a consequence, the indirect path from intensity to behaviour through perceptions is statistically indistinguishable from zero in the present sample.

4.5.5 Summary of hypothesis results

The hypothesis tests produced a clear pattern. Remote-work intensity was not a significant predictor of neither residential energy-related behaviour nor perceived environmental sustainability. Perceptions, by contrast, were a significant positive predictor of behaviour, and the mediation hypothesis failed because the indirect path from intensity to behaviour through perceptions was non-significant.

Table 4.8: Hypothesis summary

Hypothesis	Statement	Decision
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H1	Remote work intensity is positively associated with pro-environmental residential energy behaviour.	Not supported
H2	Remote work intensity is positively associated with perceived environmental sustainability of remote work.	Not supported
H3	Perceived environmental sustainability of remote work is positively associated with pro-environmental residential energy behaviour.	Supported
H4	PESR mediates the relationship between RWI and REB.	Not supported

4.6 Additional descriptive insights on residential behaviours

Although the main hypothesis testing used the composite REB index, the item-level data offer useful context for interpreting the residential behaviour profile of the sample. This provides a clearer answer to SRQ4, which asks how specific home-working practices related to heating, cooling, lighting, and electronic-device use appear in the reported behaviour of remote workers.

The strongest pro-environmental responses appeared in two areas: limiting heating or cooling to necessary hours (Q15, mean = 3.73) and avoiding background electronics such as television, radio or smart speakers during work (Q12r, mean = 3.71). Using natural light instead of artificial lighting (Q8r, mean = 3.52) and consciously switching off devices (Q14, mean = 3.47) followed closely behind.

The weakest pro-environmental responses concerned device intensity and appliance use. Simultaneous use of multiple electronic devices (Q9r, mean = 2.58) was the weakest item in the entire REB measure, with most respondents indicating that they usually work with several devices in parallel. This is unsurprising given that remote work generally requires a combination of laptops, monitors, peripherals and continuous connectivity. Running major household appliances more frequently while at home (Q11r, mean = 3.11) and conscious electricity reduction (Q13, mean = 3.32) were also close to the middle point, suggesting that these practices are less actively managed than heating and lighting choices.

Table 4.9: Descriptive interpretation of residential behaviour domains

Behavioural area	Relevant items	Main descriptive insight
Heating and cooling	Q7r, Q15	Respondents report some effort to limit heating/cooling, but behaviour is mixed when whole-residence heating/cooling is considered.
Lighting	Q8r	Respondents show moderately positive behaviour in avoiding artificial lighting when natural light is available.
Electronic devices	Q9r, Q10r, Q12r, Q13, Q14	Device-related behaviour is mixed. Switching off devices and avoiding background electronics are relatively positive, but simultaneous use of multiple devices is the weakest behaviour.

Household appliances	Q11r	Appliance use is close to the midpoint, suggesting variation among respondents.
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These findings add detail to the main REB result. The overall residential behaviour profile is moderately pro-environmental, but not in a uniform way. Respondents appear more attentive to visible or easy-to-control actions, such as switching off devices or limiting heating/cooling hours. They appear less able, or less willing, to reduce behaviours that are closely tied to the practical requirements of remote work, especially the simultaneous use of multiple electronic devices.

Two patterns within the residence-related descriptive data deserve a final comment. First, a majority of respondents (58.3%) reported that at least one other person was typically present in the home during remote-work hours, which broadens the set of household activities (lighting, cooking, appliance use) that may operate in parallel with the working day. This may explain part of the relatively weak pattern on the appliance and electricity items, since household demand at those hours is not driven by the remote worker alone. Second, individual heating systems (gas/petrol, electric or heat pump) dominated the sample, accounting for approximately 80% of respondents, while only 18.9% reported central building-wide heating. Item-level inspection suggests that respondents on individual heating systems reported slightly lower scores on heating and cooling restraint than those on central systems. This is consistent with the Greek residential context, where individual systems offer more direct control over residential energy use during the working day but also more opportunity to use it freely (Fameli et al., 2021).

5 Conclusion

5.1 Discussion of findings

This dissertation set out to examine how remote-work intensity is related to employees' environmental perceptions and to their self-reported residential energy-related behaviours during remote work. The study focused on employees in Greece with remote or hybrid work experience and examined three main constructs: Remote Work Intensity (RWI), Perceived Environmental Sustainability of Remote work (PESR), and Residential Energy-related Behaviour (REB). Taken together, the results provide a more careful understanding of

remote work and sustainability, because they show that remote work should not be treated as automatically environmentally beneficial only because it reduces commuting.

The first finding is that remote-work intensity was not significantly associated with residential energy-related behaviour. Employees who worked remotely more days per week did not necessarily report more pro-environmental household practices. The number of remote-work days, on its own, does not explain how employees manage heating, cooling, lighting, electronic devices, or appliance use while working from home. This matters because the simple view of remote work often assumes that more remote work leads to better environmental outcomes. The literature points the other way: remote work can shift part of the environmental burden from the office to the home, mainly through residential heating, cooling and electricity use (Hook et al., 2020; O'Brien & Yazdani Aliabadi, 2020). The finding therefore supports a more balanced interpretation: remote work may reduce commuting, but that does not automatically mean that residential behaviour becomes more energy-conscious.

The second finding is that remote-work intensity was not significantly associated with perceived environmental sustainability. The relationship was positive but weak and statistically non-significant. Employees who work remotely more often do not necessarily develop stronger environmental perceptions about remote work. One possible explanation is that environmental perceptions may be shaped more by general beliefs about reduced commuting than by how often a person actually works from home. This is consistent with the literature showing that commuting is the most visible environmental benefit of remote work and is often the easiest for employees to recognise (Hook et al., 2020; Tao et al., 2023), while the less visible effects, such as household energy use, equipment use and rebound travel, may be less obvious to employees (Hostettler Macias et al., 2022; O'Brien & Yazdani Aliabadi, 2020). Working from home more often, in itself, may not be enough in order to increase awareness of the full environmental trade-off.

The strongest finding of the study was the positive relationship between perceived environmental sustainability and residential energy-related behaviour. Employees who saw remote work as more environmentally sustainable also reported more energy-conscious behaviour at home. This supports the behavioural logic of the dissertation: perceptions matter and employees who view remote work as environmentally meaningful, seem more likely to act in line with that view. The result is aligned with the Theory of Planned

Behaviour, where attitudes are important in shaping behaviour, although behaviour is also affected by control factors and situational constraints (Ajzen, 1991). It is also consistent with broader environmental research, which shows that environmental concern can support pro-environmental action, but does not always translate into behaviour automatically (Kollmuss & Agyeman, 2002).

The mediation hypothesis was not supported. Perceived environmental sustainability did not mediate the relationship between remote-work intensity and residential energy-related behaviour. This result is mainly explained by the weak first link in the mediation chain: remote-work intensity did not significantly predict environmental perceptions, so there is no pathway running from remote-work frequency through perceptions to behaviour. The null mediation result does not however weaken the perception-behaviour relationship. PESR remains directly and significantly associated with REB. What the data does not support is the full pathway from how often someone works remotely to how they behave at home, via perceptions.

This distinction is important for the interpretation of the study. Remote-work intensity appears to be a structural condition, but not a sufficient behavioural driver. It tells us how often employees work from home, but not how they understand the environmental implications of this arrangement or how they act inside the home. This supports the attitude-behaviour gap perspective, because environmental behaviour is not determined simply by being in a given situation, but is also shaped by awareness, habits, practical barriers and perceived control (Kollmuss & Agyeman, 2002). One employee may work remotely several days per week but still run multiple electronic devices, heat or cool the whole residence, or run appliances more often during the day. Another may work remotely less often but behave more carefully because they are more conscious of residential energy use.

The item-level findings add depth to this interpretation. Respondents reported relatively stronger pro-environmental behaviour in areas that are visible and easy to control: limiting heating or cooling to necessary hours, avoiding background electronics and switching off devices. The weakest area was the simultaneous use of multiple electronic devices. This is understandable, given that remote work often requires laptops, monitors, chargers, internet equipment and other devices. Household context matters too. Some 58.3% of respondents reported that at least one other person was usually at home during remote-work hours, so part of the daytime energy use may reflect shared household routines rather than the remote

worker's own choices. Two things follow. First, some energy use is hard to cut because it is tied to the practical requirements of the job. Second, residential energy behaviour during remote work is not a single behaviour but a set of distinct practices, each with its own level of control.

Overall, the findings confirm the main argument of the dissertation: the environmental implications of remote work should be understood through both structural and behavioural dimensions. Remote work can reduce commuting, but it can also increase household energy demand and trigger rebound effects. Because the study does not measure actual emissions or energy use, it cannot say whether remote work is environmentally positive or negative overall. What it does show is that employees' perceptions are meaningfully linked to their reported behaviour at home. Sustainability in remote work, then, depends not only on how often employees work from home, but also on how well they understand and manage the its household side.

5.2 Implications and recommendations

The findings carry a clear message for how remote work is treated in sustainability terms. Because remote-work intensity was not associated with residential behaviour, the number of days worked from home is a weak guide to the environmental quality of remote work. Counting remote days, whether by employers reporting commuting savings or by researchers using frequency as a proxy, captures only the most visible part of the picture and misses what happens inside the home. The stronger and more useful result is that perceptions were linked to behaviour, which points to employee awareness, rather than remote-work frequency, as the more promising lever for improving the household side of remote work.

For organisations, this means remote-work policies should not be presented as environmental measures on the strength of reduced commuting alone. Where employers want remote and hybrid work to support sustainability goals, the more effective focus is the behavioural margin in the home: practical guidance on heating and cooling, switching off idle equipment and managing device use during work-from-home hours, supported by awareness that draws attention to the less visible effects employees tend to overlook (Hook et al., 2020; O'Brien & Yazdani Aliabadi, 2020). This matters most under the hybrid

patterns now common across Europe, where offices keep running on home-working days and the room for office-side savings is limited unless space and occupancy are actively managed (Tao et al., 2024; Mantesi et al., 2022). In a hybrid-dominated setting, the home is where much of the remaining environmental margin sits.

For policy, the Greek case points to a gap worth closing. Law 4808/2021 gave remote work a clear regulatory basis, but like most telework frameworks it deals with labour conditions and leaves the energy and environmental dimension aside (Moglia et al., 2021). This omission is not trivial in a country where the housing stock is older than the EU average and oil still heats a large share of homes, so that residential energy use during remote work weighs more heavily than it might elsewhere (International Energy Agency, 2023; EL.STAT, 2024). Linking telework policy to practical energy-efficiency guidance, and encouraging employers to treat home-working support as part of their environmental strategy, would help remote work deliver the benefits it is so often assumed to provide.

5.3 Limitations and suggestions

Several limitations should be considered when reading these findings. The most important is the use of self-reported data. Residential energy behaviour was measured through respondents' own answers, rather than through observation or actual energy consumption data. This creates the possibility of social desirability bias, because respondents may present themselves as more environmentally responsible than they actually are. This is a common problem in environmental behaviour research, especially when the questions concern socially approved practices such as saving electricity or limiting energy use (Kollmuss & Agyeman, 2002). Future research should combine self-reported survey data with more objective measures, such as household electricity bills, heating consumption, smart-meter data, or measured device usage.

A second limitation is the cross-sectional research design. The study collected data at a single point in time, so it can identify associations but cannot establish causality. The positive relationship between PESR and REB may mean that environmental perceptions encourage more energy-conscious behaviour, but it is equally possible that employees who already behave more sustainably are more likely to view remote work as environmentally beneficial. A longitudinal design would help examine whether environmental perceptions

and behaviours change over time as employees gain more experience with remote or hybrid work.

The sampling approach is a third limitation. The study used convenience and snowball sampling, which limits the generalisability of the findings. The sample was also highly concentrated in Technology, IT and Telecommunications. This is understandable, because remote work is more common in digitally enabled sectors, but it means that the results should not be treated as representative of all employees in Greece. Future research should use more diverse samples across sectors such as education, finance, public administration, professional services and healthcare, which would also make it possible to examine whether the relationship between remote work, perceptions and residential behaviour differ by sector or occupation.

A fourth limitation is that the study did not measure actual environmental impact. It did not include commuting distance, transport mode, office energy use, household energy consumption, heating fuel, insulation quality, or carbon emissions. The findings should therefore be read as evidence about perceptions and reported behaviours, not as a carbon-footprint assessment. Combining behavioural data with environmental data would allow a more accurate estimate of the real environmental balance of remote and hybrid work.

A fifth limitation relates to the measurement of remote-work intensity. RWI was measured mainly through the number of days worked remotely per week. This is clear and practical, but it does not capture qualitative differences in remote work. Two employees may both work remotely three days per week, yet one avoids a long car commute while the other skips a short public-transport journey. Their environmental impact would be very different. Future studies should include commuting distance, transport mode, hours worked at home and office attendance patterns.

Finally, future research could examine specific residential behaviours separately rather than only through a composite REB index. Heating, cooling, lighting and device use may have different drivers and constraints and a more detailed analysis could show which behaviours are most strongly tied to environmental perceptions and which are mainly shaped by household conditions. Qualitative interviews would also be useful, explaining why employees take up some practices but not others and clarifying the practical barriers to sustainable remote work.

The study points to a clear conclusion: remote work is best understood as an environmental opportunity, not an automatic environmental solution. The number of remote-work days alone was not enough to explain residential energy-related behaviour. What mattered more was how employees perceived the environmental sustainability of remote work and those perceptions were the factor most closely linked to pro-environmental practices at home.

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Appendix A: “Questionnaire”

Section 1: Remote Work Intensity

Q1. On average, how many days per week do you work remotely (from home)? (1 day, 2 days, 3 days, 4 days, 5 days, 0 days (recently transitioned back to office full-time))

Q2. How long have you been working remotely (either fully or hybrid)? (Less than 6 months, 6 months to 1 year, 1-2 years, More than 2 years)

Section 2: Perceived environmental sustainability of remote work: 5-point Likert scale

Q3. Remote work reduces environmental pollution by decreasing commuting.

Q4. Overall, remote work is more environmentally sustainable than working in a traditional office.

Q5. Remote work practices contribute positively to environmental sustainability.

Q6. The environmental benefits of remote work outweigh its potential environmental costs.

Section 3: Residential energy behaviors during remote work: 5-point Likert scale

Q7. I heat or cool my entire residence during work hours, rather than just the room I am working in.

Q8. I use artificial lighting in my workspace even when natural light is available.

Q9. I use multiple electronic devices (e.g., laptop, monitor, printer) simultaneously while working remotely.

Q10. I leave my computer or work equipment on even when they are not actively used.

Q11. I run major household appliances (e.g. oven, dishwasher, washing machine) more frequently now that I work from home.

Q12. I keep background electronics (TV, Radio, Smart Speakers) running while I am working.

Q13. I consciously try to reduce electricity consumption while working from home.

Q14. I make a conscious effort to switch off electronic devices when they are not in use during my workday.

Q15. I limit heating or cooling to the hours when it is necessary during my workday.

Section 4: Residence Factors

Q16. What type of residence do you live in? (Apartment, Detached house, Other)

Q17. What type of heating system is primarily used in your residence? (Central heating (building-wide), Individual gas heating, Electric heating, Heat pump, Wood/pellet stove, Other)

Q18. What is the approximate size of your residence? (Less than 50 m² , 50-100 m² , 100-150 m² , More than 150 m²)

Q19. During your typical remote workday (e.g., 9:00 AM – 5:00 PM), who else is at home? (Select all that apply) (No one (I am alone), Other adult(s) (also working remotely),

Other adult(s) (not working) or pre-school children, Children (school-age, at home during day))

Q20. What industry or sector best describes the company you work for? (Technology / IT / Telecommunications, Finance / Banking / Insurance, Professional Services (Consulting, Legal, Agency), Public Sector / Government / Education, Healthcare / Pharmaceuticals, Other)

Author's Statement:

I hereby expressly declare that, according to the article 8 of Law 1559/1986, this dissertation is solely the product of my personal work, does not infringe any intellectual property, personality and personal data rights of third parties, does not contain works/contributions from third parties for which the permission of the authors/beneficiaries is required, is not the product of partial or total plagiarism and that the sources used are limited to the literature references alone and meet the rules of scientific citations.