# Telework, hybrid work and the United Nation's Sustainable Development Goals: towards policy coherence

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**Abstract:** With increased participation in telework expected to continue, to support emerging hybrid work models in the aftermath of the Covid-19, it is important to consider the long-term impact this practice could have on sustainability outcomes. This paper describes a systematic review of 113 academic journal articles and identifies associations between telework and sustainability, explored by previous researchers. Those associations were categorized and discussed, based on their contributions to different United Nations Social Development Goals. Most of research was found to focus on countries classified as having a very high human development index status, and regions with a low, medium or high human development index, largely ignored. The SWOT matrix technique was used to illustrate the strengths and weaknesses identified in the current literature as well as threats and opportunities for future work. This can help to ensure policy coherence and that strategies to promote one outcome, such as economic productivity improvements, does not undermine another, such as improved health. Practical implications and potential research opportunities were identified across a range of SDG impact areas, including good health and well-being, gender equality, reduced inequality, climate mitigation, sustainable cities and resilient communities. On the whole, our impression is that increased rates of telework present an important opportunity to improve sustainability outcomes, however, it will be important that integrated and holistic policy is developed that mitigates key risks.

**Keywords:** Telework; hybrid work; working from home; sustainability; UN Sustainable Development Goals; policy coherence

## 1. Introduction

The disruption from the COVID-19 pandemic has been widespread, yet the world also simultaneously faces more serious challenges; with human-induced environmental change posing potentially catastrophic risks to life on earth [1], and with all United Nations member states signing up to bold and ambitious goals to improve human welfare and environmental health across 17 sustainable development goals [2].

The COVID-19 pandemic has led to improvements in sustainability outcomes, including reduced greenhouse gas emissions [3], and improved air quality [4, 5]. Also, telework (or working from home) has made an important transition during the COVID-19 pandemic from being spearheaded by a small number of early adopters to now seeing widespread and mainstream adoption among workers [6-10], with many, such as the OECD, arguing that telework and hybrid work practices need to be more widely integrated into the business process and government planning [11]. This creates opportunities for helping to

achieve sustainable development goals [12]. [6-10], with hybrid work arrangements, which combine the benefits of both telework and office work, now widely expected to be the dominant model for the future of work [13]. The question is whether telework and hybrid work practices can provide a positive tipping point towards a more sustainable future [12, 14].

The COVID-19 pandemic resulted in what has been called 'the world's biggest work-from-home experiment' [15], as governments and businesses around the world, were suddenly forced into the adoption and integration of teleworking practices as a means of business continuity in the face of strict pandemic lockdown restrictions. It has also been argued that the widespread adoption of telework can form part of strategies with considerable potential to help communities live healthier and more productive lives, whilst simultaneously improving the chances to live within planetary boundaries [16]. Working from home practices have also been known to appear in scenarios for our future societies, with wide societal impacts [17, 18]. More recently, much focus has been on the fact that teleworking helps to reduce overall travel demand whilst also increasing active transport such as walking and cycling [19].

Many papers now link telework with impacts on sustainability, but we argue that strategies that leverage telework to achieve sustainability outcomes must be considered in a comprehensive and integrated manner, across all relevant outcomes. Therefore, this paper aims to review the key themes in the academic literature that describe any association between telework and the various dimensions of sustainability, as defined by Sustainable Development Goals (SDGs). As such, this article describes a scoping review of the current academic literature, which aims to address the research question:

RQ1 - What causal associations between telework and sustainability have been explored in the academic literature that represent either risks or opportunities for achieving sustainability goals?

When referring to sustainability goals, we primarily refer to a subset of SDGs [2]: 3) good health and wellbeing, 4) quality education, 5) gender equality, 8) decent work and economic growth, 9) industry, innovation and infrastructure, 10) reduced inequalities, 11) sustainable cities and communities, 12) responsible consumption and production, and 13) climate action.

### *1.1. The obvious impacts of telework during the COVID-19 pandemic*

Many factories, offices and shops were forced to close, and the movement of global freight was severely impacted [20], as cities around the world quickly introduced emergency measures to control the spread of the pandemic [21-23]. With many people unable to travel to their usual places of work, an office in the city, for example, a sudden shift towards 'work from home' arrangements occurred [24]. Whilst this was a challenging time for many reasons, many benefits emerged as a result of the sudden and significant reduction in commuter numbers this situation produced, especially from a sustainability perspective.

Demand for roads, public transport and commercial flights plummeted almost overnight [25]. As cities went into lockdown, streets suddenly became empty and traffic-related emissions, particularly carbon dioxide ($CO_2$) and nitrogen dioxide ($NO_2$) dropped dramatically [26]. $CO_2$ is a greenhouse gas (GHG) that is a significant contributor to global warming, and $NO_2$ is associated with atmospheric reactions which produce ozone and fine

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particulates linked with increases in human respiratory tract infections that can lead to death [27].

In November 2020, NASA used computer-generated simulations to model recorded reductions in air pollution, compared with what a 'COVID-free 2020' would have generated. It concluded that the pandemic restrictions had resulted in a global reduction in nitrogen dioxide (NO2) concentrations of nearly 20 per cent [28]. Similarly, Venter et al. [29] were able to leverage mobility data from Google and Apple, to establish a link between the decline in global vehicle transportation usage and reductions in ambient NO2 levels.

### *1.2. Telework maturing as an innovation*

Although the widespread adoption of telework was initially a short-term phenomenon and a reaction to lockdown conditions, many believe that the practice will now become entrenched. This is due in large part to a growing recognition of private and public benefits. For individuals, telework presents an opportunity for improving health and wellbeing as well as work-life balance through the reduction of non-essential journeys. For the wider economy, telework, or some form of working from home, has proven to be a promising strategy for improving economic productivity and business profitability.

### *1.3. Private benefits*

Despite the challenging circumstances, many workers reported improvements in health and work-life balance whilst working from home [7, 30]. Links between telework and lower instances of heart attacks have even been identified by hospitals in Finland and the USA [31]. With many noting a preference for working from home; in turn, this has impacted decision-making regarding where people want to live in the longer term. If workers no longer need to commute to a city office 5 days a week, perhaps they can live further away, in a larger home in a more affordable area? For example, recent US research analysed real estate data to understand the impact COVID-19 had on housing demand. It identified a pronounced shift away from high population density areas and contributed this reduction in demand to "the diminished need of living close to telework-compatible jobs and the declining value of access to consumption amenities" [32].

#### 1.3.1. Economic benefits for business

In many cases, overall productivity did not decline, but rather it has been argued that telework can in fact help improve productivity [11]. Many businesses instead have seen significant economic gains from allowing their staff to work from home and some seized the opportunity to reduce costs by minimising expenditures on office space [33-35].

#### 1.3.2. Telework is here to stay

For this paper, we assume that the trend towards increased telework will continue, albeit in a non-linear fashion that includes first some level of 'bounce back' to somewhere below pre-COVID-19 levels, and secondly after that an ongoing acceleration of telework practices in the future. This assumption is based on an understanding of behaviour change through a complex process of innovation diffusion that involves multiple actor types, similar to what was described for other types of behaviour changes [36, 37], and consideration of telework as a social practice that can be described through the theory of planned behaviour [38], and with an understanding that:

- The current move to telework is occurring in addition to an existing trend that has been gathering pace over the last couple of decades [39-46]

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- Key factors that have so far influenced the prevalence of telework are associated with previously limited management and staff confidence of being able to productively work from home, employers' limited adoption of IT systems and policy frameworks to support telework, and a previous lack of awareness of the benefits of working from home [7, 8]. Having a positive experience working from home is one of the strongest predictors of wanting to work from home [6, 47] and the dominant experience by and large by most of those who have now worked from home is that it has been a very positive experience [6, 47-49]
- As many workers and employers have overcome previous negative perceptions and barriers to telework [48, 49], this means that from a behavioural change perspective, we can expect many more people to want to work from home, and many more to have employers that allow them to do so. This is reinforced by many surveys that indicate large proportions of working populations embracing some level of telework as their preferred mode [6, 7, 47, 49, 50]. As many workers and employers have overcome previous negative perceptions and barriers to telework [48, 49], this means that from a behavioural change perspective, we can expect many more people to want to work from home, and many more to have employers that allow them to do so. This is reinforced by many surveys that indicate large proportions of working populations embracing some level of telework as their preferred mode [6, 7, 47, 49, 50].

## 2. Materials and Method

### *2.1 Systematic Literature Review*

The method adopted for this investigation is the systematic literature review (SLR) method, which provides researchers with an unbiased, objective framework for selecting and analysing a defined and representative sample of academic literature on a chosen topic [51]. The method carefully documents all steps and decisions made by the researchers in establishing the boundary and rules for their investigation and the subsequent analysis of the sample of literature [51, 52]. This method benefits from the removal of bias from the article selection process, and follows a recursive and iterative process, for defining and refining a set of search terms [53, 54].

Seuring and Gold [55] have popularised a four-step process for conducting systematic literature reviews, derived from Mayring [56], which has been adopted by this research:

i) Material collection,
ii) Descriptive analysis,
iii) Category selection and
iv) Material evaluation.

To investigate associations between telework and sustainability in the current body of academic literature, these search terms were used:

("telework" OR "work from home" OR "flexible work" OR "remote work") AND "sustainab*"

Scopus was used as the database for accessing high-quality peer-reviewed articles, with the following delimiters employed to specify the boundary of the search:

- Only include articles published in English,

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- Include articles from all years,
- Due to limited access, we include published journal articles only (i.e. no book chapters, conference papers or working papers, etc.),
- Articles in press, and those which have been accepted for publication but not yet assigned to a journal volume/issue, were included to capture the most up-to-date research in this area,
- No articles were excluded based on the quality ranking of the journal.

The searches were conducted on June 9th 2021 and, after removing any duplicates, resulted in an initial sample of n=113 articles for analysis. At this stage, the authors independently reviewed the abstracts from all 113 papers, to further assess their appropriateness for the study and to decide which SDG(s) they believed each paper aligned best with. The authors then came back together again, to discuss their results as a group, and make decisions on any discrepancies that arose. This process resulted in a set of n=90 papers, featuring potential links between telework and 9 different SDG areas, with 23 articles being excluded from the analysis due to them no longer being deemed appropriate for this investigation. The articles were then divided between the three authors, based upon their discipline expertise, for full-text analysis.

After this final stage in the material selection process, an additional 17 articles were excluded from the sample, and 6 were reclassified as having closer alignment to different SDGs than originally thought. This resulted in a final sample of 73 papers, as illustrated in Table 1. It is noted that whilst the final sample of papers was n=73, some of the papers were found to discuss multiple SDGs and appear in more than one category.

After analysing the final sample of papers, backward snowballing was then employed, which is a process that uses the reference lists from the original articles to help identify additional articles not captured in the original search. 19 additional articles were captured using this process, which were later discussed to provide context and illustrate several knowledge gaps (see Section 3.5) but these were not included in the final sample of articles.

**Table 1.** Articles for SLR, by SDG area

| SDG # | No. of articles incl. | Articles with relevant contributions from the search included in the results section | Snowballing articles and/or added for context | Excluded (outside of scope or conference article or book chapter) |
|---|---|---|---|---|
| **3** | 16 | [10]; [57]; [58]; [59]; [60]; [61]; [62, 63]; [64]; [65]; [66]; [67]; [68]; [69]; [70]; [71]; [72] | [73]; [4, 5, 74-77]; [78] | [79]; [80] |
| **4** | 3 | [81]; [82]; [83] | | [84] |
| **5** | 5 | [85]; [86]; [9]; [87]; [88] | [89] | [90]; [91]; [92] |
| **8** | 14 | [61] ; [93] ; [63] ; [94] ; [93] ; [95] ; [96] ; [97] ; [62] ; [69] ; [98] ; [99] ; [100] ; [101]; | | [102]; [103]; [104]; [105]; [106]; [107]; [108] ; [109]; [110]; [111]; [112] |

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| | | | | |
|---|---|---|---|---|
| **9** | 14 | [113]; [114]; [115]; [116]; [117]; [118]; [119]; [120]; [121]; [122]; [123]; [124]; [87] ; [125] | | [126]; [127] ; [90] ; [128] ; [129] ; [130] ; [131] ; [132] ; [133]; [134]; |
| **10** | 1 | [135] | | |
| **11** | 15 | [136]; [137]; [138]; [139]; [140]; [141]; [142]; [143] ; [144]; [145] ; [146]; [147]; [148]; [149]; [47] | [150-154]; [155]; [156] | [157]; [158]; [159]; [160]; [40]; [161]; [162]; [163]; [164]; [165] |
| **12** | 3 | [140, 166]; [167]; | [168]; [169] | [170]; [164] |
| **13** | 15 | [43, 44, 138, 140, 167, 171-173]; [136]; [174]; [175]; [176]; [177]; [178]; [179] | [180] | |
| **N/A** | | | | [181-183] |

*2.2 SWOT Analysis*

SWOT analysis is a strategic management tool, dating back to the 1950s, which was designed to assist in the identification of Strengths, Weaknesses, Opportunities and Threats in an organization, plan, project, person or activity [184, 185]. It commonly involves the development of a 2 x 2 'SWOT Matrix,' which visualizes internal strengths and weaknesses, alongside external opportunities and threats [186].

For this investigation, the researchers have adopted the SWOT technique for identifying and categorizing the strengths, weaknesses, opportunities and threats related to SDGs due to the practice of telework, as documented in the literature. It is hoped this process will lead to the recognition of weaknesses and gaps in the current body of academic knowledge, and the identification of future research opportunities.

## 3. Results and Discussion

*3.1 Analysis of Articles by Year of Publication*

Articles exploring links between telework and sustainability were found to first emerge in 2000 and grew slowly over the following two decades until a steep and sudden increase was observed in recent years. In 2019 only n=5 articles were found to discuss the presence of these links, but this rose to n=16 in 2020 and then a projected n=28 by the end of 2021, probably due to the increased significance of the field of telework as a result of COVID-19, which started in early 2020 (see Figure 1).

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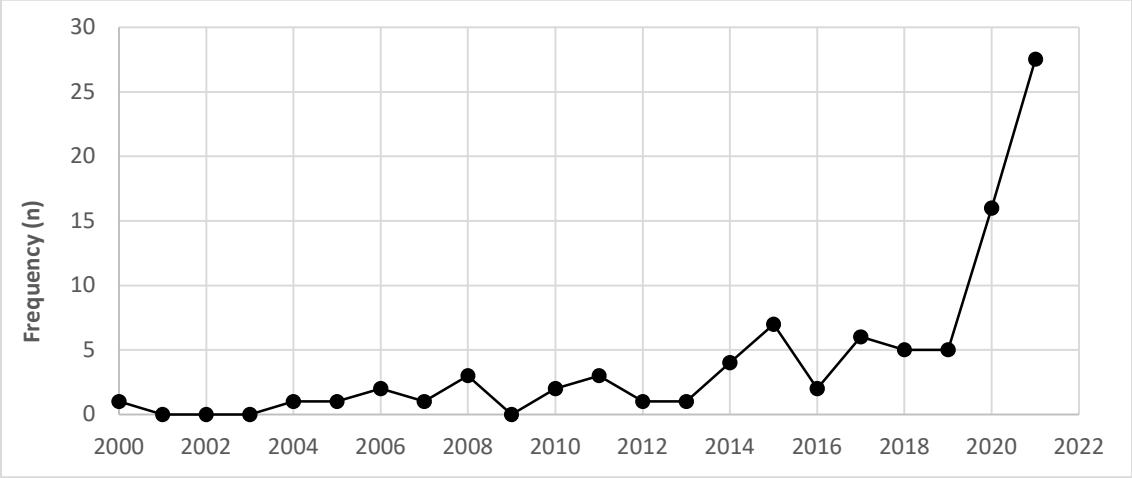


**Figure 1.** Articles linking telework and sustainability over time (2000-2021)
**Note**: the number of papers for 2021 have been extrapolated based on current papers published at an equal rate for the remainder of the year, i.e. does not adequately consider exponential growth, and also does not fully consider early or delayed publication of papers.

*3.2 Regions of Study*

Here we provide a breakdown of articles in terms of their geographic focus, based on where the research was conducted, and the location of the first authors' institutes. 88% of the articles were found to come from countries with a very high human development index status, 5% from countries with a high human development index, and only 5% come from countries with a low or medium human development index [187]. 42% of articles originated in the European Union, 21% of articles originated from the United States, and a further 21% of articles originated from the English-speaking block consisting of the United Kingdom, Canada, South Africa, Australia and New Zealand. Beyond this, 14% of articles originated in Asia, of which 7% originated from East Asia (Japan, China, South Korea and Taiwan). Only 1% originated in the South and Central Americas and, similarly, only 1% originated in Africa. This shows a considerable bias towards western high-income countries [see Table 2 and Figure 2].

***Table 2.*** *Articles featuring links between telework and sustainability, by country and UN Regional Group*

| Country | n | UN Region | Country | n | UN Region |
|---|---|---|---|---|---|
| United States | 15 | Europe and Northern America | Colombia | 1 | Latin America and the Caribbean |
| Australia | 8 | Australia and New Zealand | Cyprus | 1 | Europe and Northern America |
| Netherlands | 5 | Europe and Northern America | Germany | 1 | Europe and Northern America |
| Canada | 5 | Europe and Northern America | Japan | 1 | Eastern and South-Eastern Asia |
| Sweden | 5 | Europe and Northern America | Nigeria | 1 | Sub-Saharan Africa |

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| | | | | | |
|---|---|---|---|---|---|
| Spain | 4 | Europe and Northern America | Norway | 1 | Europe and Northern America |
| India | 3 | Central and Southern Asian | Poland | 1 | Europe and Northern America |
| Finland | 3 | Europe and Northern America | Romania | 1 | Europe and Northern America |
| Italy | 3 | Europe and Northern America | Singapore | 1 | Eastern and South-Eastern Asia |
| Belgium | 2 | Europe and Northern America | Taiwan | 1 | Eastern and South-Eastern Asia |
| China | 2 | Eastern and South-Eastern Asia | Ukraine | 1 | Europe and Northern America |
| Ireland | 2 | Europe and Northern America | South Korea | 1 | Eastern and South-Eastern Asia |
| United Kingdom | 2 | Europe and Northern America | Vietnam | 1 | Eastern and South-Eastern Asia |
| Austria | 1 | Europe and Northern America | | | |

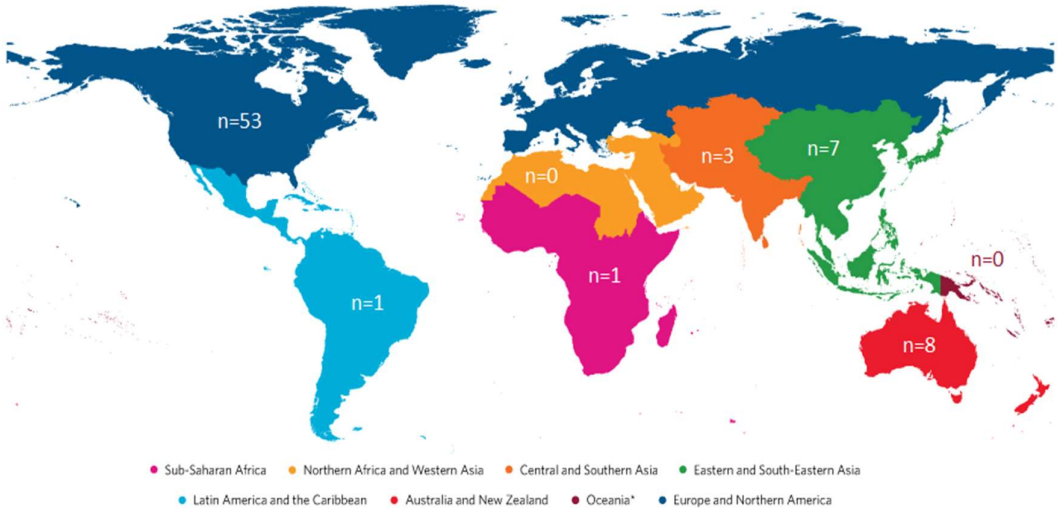


***Figure 2.*** *Telework and sustainability literature by UN Regional Groupings*

### *3.3 Prominent Journals*

The key journal for research in this field, that appeared in the greatest number of results using the search terms described, was found to be *Sustainability*, which featured fifteen (n=15) articles discussing possible links between telework and sustainability. The title appearing the second most times in the sample was *Transport Policy* (n=4), followed by *European Journal of Transport and Infrastructure Research*, *Human Relations*, *Indian Journal of Science and Technology*, and *Transportation Research Part A: Policy and Practice* (all n=2). No other journal titles appeared more than once in the sample [see Figure 3].

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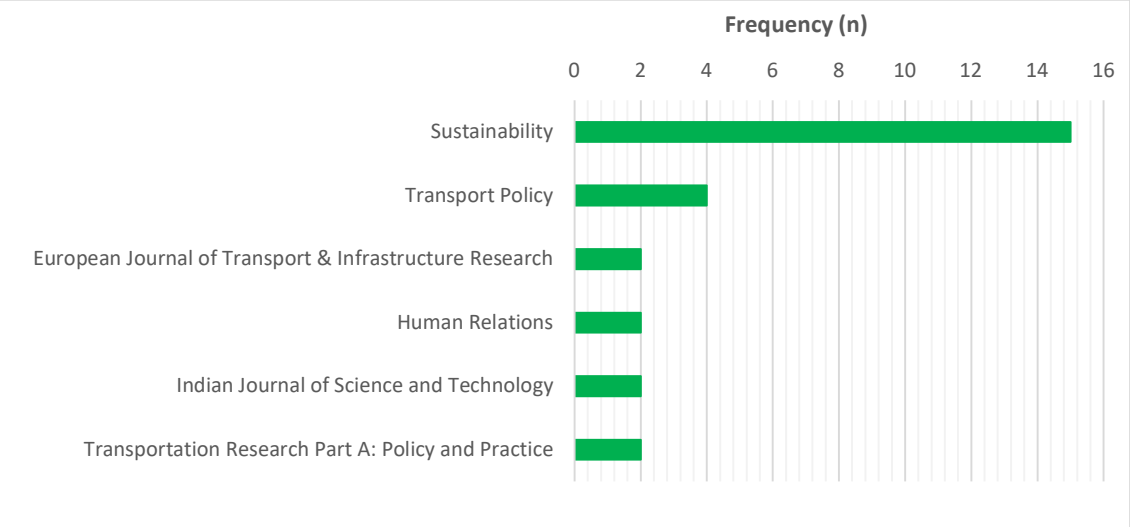


**Figure 3.** Key journals

To illustrate the diversity in the focus of the journals appearing in the sample, they ranged from the likes of *Journal of Transport Geography* and *Sustainability Accounting & Reporting*, to *Infectious Diseases of Poverty* and *Midwifery*. This variety underlines the extremely multidisciplinary nature, and extensive reach, of the subject matter.

3.1. Range of SDGs linked to telework

Links between telework and nine (n=9) different SDG areas were identified, in this sample of academic literature exploring causal associations between telework and sustainability, with SDG3 (Good health and well-being) (n=16), SDG13 (Climate action) (n=15), and SDG11 (Sustainable cities and communities) (n=15) featuring most prominently [see Figure 2].

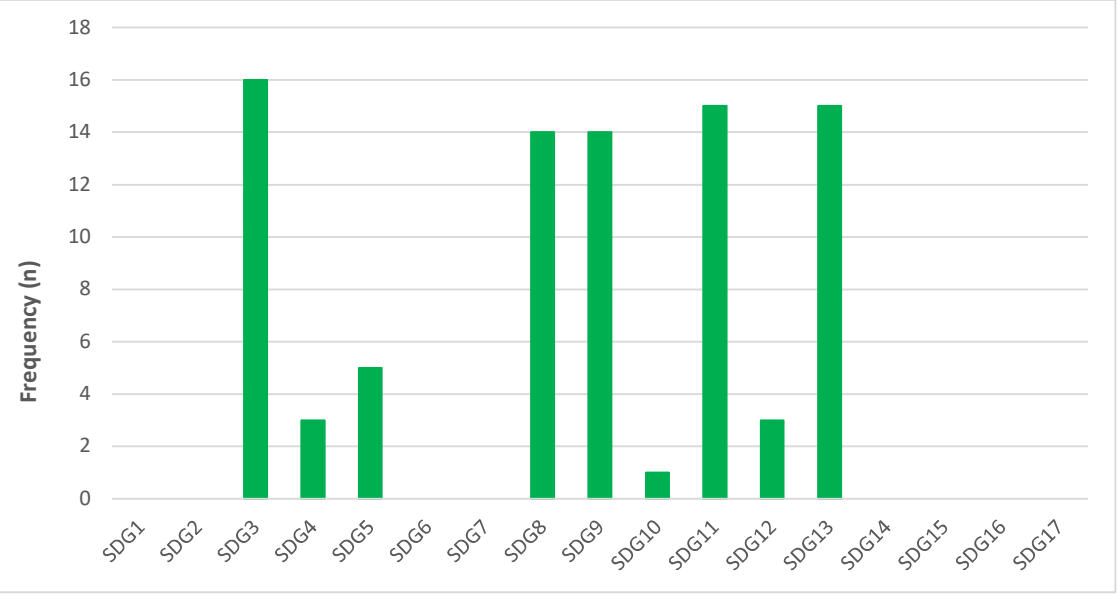


***Figure 4.*** *The number of articles in the search mapped to each of the SDGs*

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The links between telework, and these key nine SDG areas, will now form the basis of a detailed discussion.

### *3.4 Links between Telework and the UN Sustainable Development Goals*

This investigation utilises the UN's list of 17 SDGs, as a framework for classifying associations between telework and sustainability, which are present in the current body of academic literature. We now provide a summary of the key insights from the sample concerning how telework is seen as supporting sustainability and promoting specific UN's sustainable development goals (SDG).

#### *3.4.1. SDG 3: Good Health and Wellbeing*

Relevant targets for this goal [2] are shown in Text box 1.

**Text box 1: SDG 3 targets relevant to telework.**

**3.3** By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases

**3.4** By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being

**3.5** Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol

**3.6** By 2020, halve the number of global deaths and injuries from road traffic accidents

**3.9** By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.

Communicable diseases (3.3): Telework was most obviously a matter of health during the COVID-19 pandemic when it served to protect employees from disease. Belzunegui-Eraso and Erro-Garces [10] note this protective function and also suggest that telework may protect health and productivity during severe disasters, such as earthquakes or the 9/11 attacks.

Non-communicable diseases (3.4): Less directly, Hoffman et al. [57] addressed telework during COVID-19 lockdowns for employees in radiation oncology, radiation physics, and experimental radiation oncology, and found significant reductions in self-reported burnout among teleworking employees. Drywień et al [72] found that amongst a group of Polish women that unhealthy dietary habits and high amounts of screen time during COVID-19 lockdown significantly led to unhealthy weight gains and increased risks of lifestyle diseases. Importantly, however, telework is strongly linked with work-related flexibility [71], and there is evidence to indicate that flexible work arrangements broadly, particularly for married, professional women, may increase satisfaction and reduce burnout [58]. Relatedly, presenteeism, or showing up in the workplace while ill, is often viewed as antithetical to telework, but Karanika-Murray and Biron [59] note that many benefits of presenteeism, particularly in terms of social support, may only be accessed through telecommuting when a contagious disease or mobility hindrance is involved. Their work implicitly suggests that telework during the COVID-19 lockdowns may have provided valuable social supports which were not available to employees who simply could not perform their jobs. Relatedly, telework as part of broader flexible work policies might facilitate return to work after strokes [60]. Telework which involves substantial job autonomy can improve work-life balance and thereby reduce the incidence of burnout [61]. The issues of job autonomy and control as

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central to telework promoting work-life balance appears in other studies as well [62, 63]. Schellhammer et al. [64] argue that telework which provides job autonomy and control can be used by employees for primary preventive health care, such as ensuring sufficient sleep or breaks, or setting time aside when emails are not read. They argue that these coping strategies can reduce stress and burnout.

On the positive side, telework as part of efforts to create walkable, sustainable communities could be associated with increased levels of exercise in terms of walking [65]. Further, some evidence suggests telework frees up time for adult children to care for ageing parents [66]. Additionally, COVID-19 lockdowns initially led to substantial mobility from dense, urban areas to rural, tourist areas [73], and Vesala and Tuomivaara [67] found in an experiment that telework in rural areas reduced subjective time pressures and interruptions, and was associated with lower levels of exhaustion, and higher levels of job satisfaction, suggesting such mobility may have positive health effects.

However, it is also possible for telework to promote sedentary behaviours which have adverse health effects [68], and isolation which may have adverse effects on mental health [69]. Further, telework may create subjective time pressure, which can particularly affect women and parents [70].

Substance abuse (3.5): Despite an expectation based on common public discourse that telework could impact the prevalence of substance abuse, none of the chosen articles explored such a link.

Traffic accidents (3.6): Based on the estimated reduction in traffic and congestion, Alonso and colleagues [175] in the context of Madrid, Spain, have estimated several thousand fewer traffic accidents over a couple of decades, as a likely result of teleworking practices. Apart from this, beyond rudimentary statements relating to the reduction in traffic accidents, such as statements online that state telecommuting can save thousands of lives [188], there seems to be a lack of studies that confirm a reduction in traffic accidents. Nonetheless, telework would appear very likely to play a key role in reducing global deaths and injuries from traffic accidents.

Deaths from air pollution (3.9): Globally, 9 out of 10 people breathe air that exceeds WHO guidelines and as a result, 4.2 million deaths occur each year as a result of exposure to ambient air pollution [189]. Several studies have shown that telework when it reduces traffic and congestion also has considerable benefits in terms of improved air quality [4, 5, 74-77]. However, some of these results will be conflated by the current lockdowns which have made the telework scenario more extreme; yet there are good indications that the number of deaths and injuries arising from poor air quality could be considerable reduced through higher adoption of telework.

*3.4.2. SDG 4: Quality Education*

Themes aligning with SDG 4 were prominent in three (n=3) articles included in the literature sample. Relevant targets for SDG4 [2] are shown in Text box 2.

**Text box 2: SDG 4 targets relevant to telework.**

**4.3** By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university

**4.A** Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all

Equal access to ongoing and employment relevant education (4.3): The findings from a 2021 academic literature review, conducted to forecast

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what impact the sudden increase of telework due to COVID-19 would have on future working life, suggested one area which was lacking from previous studies was the relationship between telework and lifelong learning [81]. The authors felt this was important as, 'research about telework and lifelong learning has the potential to contribute to sustainable working life in terms of providing more flexible arrangements for employees and to support the lifelong learning that takes place in contexts such as the office, home, online meetings, and virtual reality [81].

Accessible education for all groups (4.3): Online education is an alternative for providing widespread access to education for all types of groups. Kizilcec et al. [84] discovered that the recent uptake in telework, along with large-scale work retrenchment and the expansion of home schooling, gave rise to a significant surge in demand for online learning during COVID-19. Their investigation sought to understand whether this move to online learning could be leveraged to address long-term US workforce skills gaps, equitably and sustainably, and concluded that 'these online platforms can provide an accessible and inclusive environment to learn new skills' [84]. Importantly, Dekenberger, Way and Pearce [82] investigated how telework, along with remote training and education, can be combined to offer skilled employment opportunities to isolated communities. They concluded that the Internet has opened up many new telework and education opportunities, to people choosing to remain in remote communities for family, religious, philosophical or other reasons, and has the potential to help these people 'out of poverty, reduce inequality overall, and provide those communities with viable means of employment security, now, and in the future' [82].

**Text box 3: SDG 5 targets relevant to telework.**

**5.B** Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women

**5.5** Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life

*3.4.3. SDG 5: Gender Equality*

The aim of SDG 5 is to advance commitments of gender equality. Relevant targets for SDG 5 [2] are shown in Text box 3.

Use technology to promote the empowerment of women (5.B): Telework has the potential to promote increased diversity and social sustainability in terms of employees' ability to access flexible work arrangements. This theme was discussed in both Chitrao's [85] and Blake et al.'s [86] papers. Each paper highlighted the contribution to work-life integration for women of being able to access telework arrangements. Blake et al. also highlighted that flexible work arrangements such as telework are often 'gendered' as more women than men are more likely to access flexible work arrangements. This often leads to hypervisibility that can lead to conflict between motherhood and career expectations. Also, the study by Nguyen and Armoogum [9] is one of the first studies that provide a gender-based understanding of factors affecting the perception and the preference for WFH during the era of COVID-19 in a developing country (i.e., Vietnam). More women than men (56% versus 45%) reported having a positive perception of WFH when social distancing was enforced because of the pandemic. Exploring the field of flexible careers, and the impact institutions have upon individuals' career decisions across their working lives, Tomlinson et al. [87] discussed the role of telework for helping women sustain employment and following maternity, citing the work of Chung and Van der Horst [89].

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Women's full and effective participation and equal opportunities for senior careers (5.5): Fathima and colleagues [88] undertook a multicentric cross-sectional study that gathered data from all SDG regions across the world about the challenges and coping strategies faced by female scientists. The researchers found several intrinsic (personal) and extrinsic (institutional) factors that are important for improving female scientists' wellbeing and productivity. Support from the workplace was the third most commonly employed coping strategy by female scientists in the study. Relevant to our discussion, is the scientists identified FWAs such as being able to work from home and telework as an important human resource change that would enable them to reconcile their home and work responsibilities. Ling and Leow's [92] reported on a study of female construction graduates in Singapore and concluded that women in this traditionally male profession would be encouraged to stay if they were provided with flexible work schedules and opportunities to work at home so they could combine their work and home roles more effectively. Despite the popularity of FWAs such as working from home (teleworking and telecommuting), these policies were found to be rare in Singapore in 2010. The Singapore Labour Force Survey found while women constitute 42% of the local labour force, only 15% in the construction sector are women, and of those women who graduate in construction, 33% leave the construction industry. Interestingly women considered home-based work could be a solution post-COVID-19 to solve the burden existing pre-COVID-19 and increasing in COVID-19. It was seen as a potential strategy to help balance work and family duties such as caring for children and family members. The women surveyed identified benefits of teleworking, including having flexible working time, avoiding long commute distances, and reducing exposure to pollution. Males, by contrast, were less likely to favour home-based work because in Vietnamese culture the breadwinner norm for men is strong and so they tended to report higher levels of pleasure derived by being at work. This study highlights that it is important for governments to consider the potential gender inequality effects of telework on the lives of citizens, especially female ones, in developing countries.

#### 3.4.4. *SDG 8: Decent Work and Economic Growth*

Telework can support workers' access to full and productive employment. Relevant targets for SDG8 [2] are shown in Text box 4.

**Text box 4: SDG 8 targets relevant to telework.**

**8.5** By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value

**8.8** Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment

Full and productive and full employment for all (8.5): Dima et al. [61] find that telework associated with substantial job autonomy and work-life balance may generate enhanced economic circumstances, including greater professional opportunities for young mothers, and reduced unemployment in rural areas. Furthermore, telework among older employees may help to respond to problems associated with an ageing population in many developed nations.

Population ageing has two problematic economic effects: shrinkage of the tax-paying labour force, and growth of the elderly in need of caregiving resources. Research in Singapore found that many older individuals who had retired would likely return if employment involving part-time/flexible work in locations close to the home [93], while

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research in the US suggests that older employees value flexible work arrangements more than their younger counterparts [63]. Telework could support these two conditions, particularly for occupations where results are measurable, and hence make developed economies more sustainable. Angeloni and Borgonovi [94] note that older employees may extend retirement age if, among other job characteristics, they are provided opportunities for interaction and social involvement. More broadly, research suggests that flexible work arrangements may play a role in extending the retirement age [93, 95]. Telework may therefore expand opportunities for continued work as workers age in terms of flexible work arrangements but also as a tool for continued social interactions for individuals who become mobility impaired. On the other hand, in-person work might better facilitate social interactions, undercutting the case for telework among older workers.

Furthermore, it is possible that sustainable employment for employees with various disabilities, such as those associated with multiple sclerosis [96], could be facilitated by telework. The flip side of this relationship is that caregivers of family members often maintain employment by engaging in flexible work arrangements [97], and generally value flexible work arrangements [63].

Promote safe and secure working environments for all workers (8.8): Telework might directly facilitate family caregiving in tandem with employment. Galvez et al. [62] argue that organizations supportive of telework in the sense of setting objective goals, and providing job autonomy and control, support sustainable jobs and communities generally. Taking this approach further, Reed et al. [69] argue that telework implementation should involve all stakeholders in designing the specific policies, timing, and performance measures. In the absence of such involvement, some employees may be forced into telework at home in family settings that are disruptive of work, or surveillance of telework employees may infringe upon individual privacy. A Ukrainian study [98] argue that there is a need to develop and adopt a more comprehensive set of labor laws and codes around the area of remote work to preserve the labor rights of employees and which also meet modern requirements of international and European labor law. This echoes arguments put forward by Hynes [101] in 2014 who argued that without such types of protections, the practice will be disorganised, and may not be as successful as it otherwise could be.

On the negative side, telework might be associated with overwork [69], and the type of mandated telework associated with COVID-19 lockdowns may have increased work-family conflict as well [63]. This is particularly problematic given it is often linked to 24/7 access of employees by employers and customers. In response, Petryshyn and Hyliaka [99] note that in 2016, France enacted a law enabling employees to turn off all digital communication during non-traditional working hours. More generally, many employees benefit from policies allowing segmentation of work and family time for teleworkers [63]. It is not obvious that strict standardization would make sense in all countries, but the notion of restricting the reach of work into time spent on other aspects of life could help to make telework more sustainable in the long run.

An alternative form of telework may provide many of the advantages just mentioned without the physical isolation of work-from-home: co-working places [100]. As Kojo and Nenonen [100] note, co-working spaces have existed since the 1960s and can provide a workplace that is in close proximity to employee homes, flexible hours of operation and length of the lease. Relative to traditional work-from-home telework, co-working places can enhance social supports among relevant employees, ensure access to relevant resources,

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such as high-speed internet, reduce interruptions, and provide face-to-face work opportunities for teams while minimizing commuting time.

**Text box 5: SDG 9 targets relevant to telework.**

**9.1** Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all

**9.4** By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities

*3.4.5. SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation*

The aim of SDG 9 is to build resilient infrastructure and to promote inclusive and sustainable industrialization and foster innovation. This was found to be a popular theme in the academic literature, as part of the broader conversation discussing the relationship between innovative new technologies and sustainability [117, 118, 120, 121, 125].

Develop quality, reliable, sustainable and resilient infrastructure (9.1): Baker et al. [125] found that technology, and technology-related organisational support, played a crucial role in the growth of telework, and underlined the importance of providing telework training for non-telecommuting workers and managers to encourage further participation. The large-scale disruption caused by COVID-19, and telework has improved resilience against such disruptions and is seen as a significant opportunity for fundamental change towards a more sustainable economy by Bezemer [116], who discussed why the pandemic has accelerated six changes that can influence policymaking, including the accelerated adoption of IT. Middleton [121] explored the argument that broadband Internet can be used as a tool to substitute physical activities with digital alternatives, such as work travel and meetings with telework and videoconferencing. However, it was found that the use of broadband to support telework, as well as other functions like online education and telemedicine etc., was still in its infancy at the time of the research.

Upgrade infrastructure and retrofit industries to make them sustainable (9.2): Chitrao [117] believes Generation Y's increased focus on work-life balance will have a significant impact on the future of work, resulting in more flexibility around times that work is conducted, and suggests technologies like videoconferencing will reduce the overall requirement for work-related travel. They also predicted that human resource departments will need to offer employees a 'compelling mix of rewards tailored to suit the individual employee's unique needs and preferences,' and support initiatives that enable flexible work hours, cater for a variety of different work-life choices, and enable employees to fully develop their potential [117]. As part of a study investigating task antecedents of work engagement, and how task characteristics affect work engagement, Lee, Shin and Baek [120] examined whether it is necessary to have a decentralized and flexible work model to secure organizational sustainability in a rapidly-changing environment. They concluded that technologies can significantly assist workers in working together because of the reduced time and space constraints they offer, and give workers more flexibility for maintaining personal relationships around their work commitments. Conversely, Fuchs [118] questioned the widespread belief that telework reduces overall travel, suggesting it generates new social

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relationships, which then lead to more travelling. However, the research was conducted at a time when teleworkers only made up a small proportion of the total workforce, and work-related travel was believed to contribute only a small amount of CO2 emissions, so this may be worth revisiting from a post-COVID context.

**Text box 6: SDG 10 target relevant to telework.**

**10.4** Adopt policies, especially fiscal, wage and social protection policies, and progressively achieve greater equality

*3.4.6. SDG 10: Reduce inequality within and among countries*

The relevant target for SDG5 which aims to reduce inequality [2] are shown in Text box 6. Generally, academic literature linking telework with SDG 10, which aims to reduce inequality within and among countries, is lacking in our sample. One article (n=1) was found to discuss the potential to reduce inequality within and among countries. Nwokocha and Iheriohanma [135] believe that globalization has increased the mobility of today's labour market and that Nigeria can better compete on a global stage if they adopt several sustainability practices, one of which is flexible working to improve employees' work-life balance. It hints that higher acceptance of remote work would allow greater regionalisation of workers, as well as an increased employment opportunity for those working remotely and even in different countries to participate in labor markets, and this could work to reduce inequality.

**Text box 7: SDG 11 targets relevant to telework.**

**11.1** By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums.

**11.2** By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons

**11.7** By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities

**11.B** By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels

*3.4.7. SDG 11: Sustainable Cities and Communities*

Teleworking has important implications for cities and communities to become more safe, resilient and sustainable. Relevant targets for SDG11 [2] are shown in Text box 7.

Urban form and housing (11.1): Kawai [65] explores, in the context of a Californian town, the potential benefits for vitalising a city by integrating teleworking policies in a holistic manner that incorporates appropriate urban design, housing stock, economic development and ICT infrastructure. Generally, people living in more affluent areas and those with less public transport access are more likely to work from home [145]. Moos and Skaburskis [136] note the risk of urban sprawl arising from teleworking as those working from home tend to live in larger single-family homes, indicating the need to consider the mix of housing to support telework practices. Urban sprawl and low-density urban form are widely considered to be

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problematic in terms of sustainability outcomes [150-154], although a higher urban density does not necessarily lead to the desired outcomes [156].

Traffic congestion (11.2): The link between telework and traffic congestion has long been studied [144]. This is not surprising because traffic congestion causes major social and economic costs for cities and societies [155], and it is widely argued that as telecommuting reduces car travel in cities, this also reduces traffic congestion [137, 139, 141]. However, the size of the effect is unsurprisingly a function of how often individuals tend to work from home and their usual mode of transport [138]. As an illustrative example that indicates the size of potential benefits, Hensher et al [137] quantified the annualised time and monetary cost savings for Sydney in 2020 at $3.6 billion that resulted from an extreme teleworking scenario during the lockdowns. In a post-COVID-19 world where teleworking has become a more widely spread practice, there are opportunities for measuring and quantifying these effects in more detail.

Community resilience (11.B): It has been noted that teleworking can support community resilience to a range of shocks, for example, Campisi and Basbas note that teleworking is a mode of transport that allows work to keep going despite fuel shocks, pandemics, or even natural or man-made disasters [140]. Hakovirta and Denuwara [142] note inequalities and associated vulnerability because this transport mode is primarily only available to those with internet-ready homes that are set up for teleworking, indicating an issue of possible inequity. This also shows the important role of abundant internet-ready homes in a resilient modern society. Bohman and colleagues [143] also noted that telework may exacerbate known differences in mobility-related gender and geography and noted that this needs to be considered in transport policy.

### 3.4.8. *SDG 12: Ensure sustainable consumption and production patterns*

Telework changes the way that households consume natural resources, how they travel, and it has the potential to shift communities towards a more digitally enabled future. The relevant targets for SDG12 [2] are shown in Text box 8.

**Text box 8: SDG 12 targets relevant to telework.**

**12.2** By 2030, achieve the sustainable management and efficient use of natural resources

**12.A** Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production

Reduce natural resource use (12.2): Telework is widely assumed to reduce the environmental impact and resource use of our societies [47, 147], but Heinonen and Kuosa argued that this benefit is not automatic, and rather telework needs to be designed to provide environmental benefits [146]. The association between telework and environmental sustainability depends on non-linear and dependent on context [148] and car-dependence can in some circumstances be maintained in teleworking households [149]. Also, during lockdowns in response to COVID-19, considered to be an extreme case of teleworking practices, residential water demand increased by 18% in Germany [168] and by 20% in the UK [169]. This increase in residential water demand was likely matched by decreases in commercial water demand; nonetheless, shifting of demand patterns raises the issue of understanding how in a scenario of high rates of teleworking, water infrastructure needs to be adapted to meet a new situation. There will be implications for pressure management, wastewater flows and treatment, as well as long term infrastructure investments.

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Furthermore, during the recent lockdowns across the world, there are reports of large increases in cycling and walking [140, 166]. To put this into context, the OECD also report the potential for significant improvements to productivity arising from the widespread adoption of telework [11]. It is also yet to be established whether teleworking practices that improve work-life balance will lead to more sustainable consumption patterns.

Scientific and technological capacity to move to sustainability (12.A): Teleworking has a broad impact on consumption more generally. For example, perhaps currently conflated by impacts of the current COVID-19 pandemic, telework tends to lead to accelerated adoption of IT systems, and reduced demand for aviation [166]. The adoption of IT systems in turn has been identified as an opportunity for implementing "smart cities" [167] which can enable more efficient traffic, waste management and energy management, etc.

*3.4.9. SDG 13: Take urgent action to combat climate change and its impacts*

Several studies have contended that telework has an important role to play in climate action in jurisdictions such as the EU [176] and India [177] and that telecommuting should be embedded as an integral part of climate policies. The relevant target for SDG13 [2] is shown in Text box 9.

**Text box 9: SDG 13 targets relevant to telework.**

**13.2** Integrate climate change measures into national policies, strategies and planning

Integrate climate change measures into national policies, strategies and planning (13.2): Telework has a significant potential to reduce greenhouse gas emissions. It is estimated that telework generally reduces greenhouse gas emissions through less car-based mobility being required for commuting [43, 44, 138, 140, 167, 171-173]. It has however been noted that telecommuters sometimes have to make additional trips for activities that were normally carried out whilst commuting, generally leading to an increase in non-commuting travel [43, 136, 138, 174], although evidence suggests that the increase in non-commuting travel is likely significantly less than the expected reduction in car-based commuting travel [172]. It has also been widely noted that the overall reduction of greenhouse gas emissions is a function of the travel mode of commuters and the number of days worked from home [172, 174, 175]. Furthermore, based on a US study, negating some of the benefits of telework, Zhu and Mason [173] found that workers who telecommute tend to be more car-dependent and also on average travel more than their office-based counterparts, and that this effect increases the longer they have worked from home. There is, however, very large variability in estimates of changes in travel-based greenhouse gas emissions in different studies [174], with many studies, such as Alonso et al [175], based on a study in Spain, reporting a large reduction in emissions. Moos and Skaburskis [136] may explain the findings by Zhu and Mason [173] in that people that work from home to a greater extent tend to live in larger single-family dwellings which are associated with urban sprawl and higher car dependence. Indications are that the net positive effect of telework is greater in cities with less sprawl and car dependence. This indicates an important nexus between the availability of appropriate housing, urban mobility and telework, with critical implications for greenhouse gas emissions [172, 174, 175].

Energy use: The other hypothesized change in greenhouse gas emissions arises from the reduction in energy use in the office being greater than the increased energy use at home [174]. During the COVID lockdowns, the net electricity demand indeed reduced in several

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locations [167, 178], with an increase in residential electricity use more than offset by larger reductions in commercial electricity use. The increase in residential energy use can furthermore be mitigated through fairly simple energy efficiency measures and the adoption of solar PV systems and batteries [178]. Research also indicates that unless there is widespread adoption of telecommuting – beyond "just a day or two a week", the reduction in office energy use may be only marginal [174, 180]. This is in part because even unoccupied office buildings tend to use nearly half of the energy of fully occupied buildings [179]. A hypothesized change in greenhouse gas emissions arises from the reduction in energy use in the office being greater than the increased energy use at home [174]. This shows that when telecommuting is embedded into climate policies, it is important to acknowledge the risk of further urban sprawl, and increased car dependence that this may trigger, and that policies to promote telecommuting should be combined with policies that promote 1) a shift away from car-dependence to low-carbon transport modes such as active or public transport, and 2) increased adoption of residential energy efficiency and solar PVs or batteries when appropriate.

### *3.5 Analysis of Strengths, weaknesses, opportunities and threats*

The SWOT analysis technique was adopted as a means to visualize the key strengths, weaknesses, opportunities and threats to sustainability, arising from its causal associations with telework, as explored in previous academic literature (see Figure 5).

Examples of some of the key strengths that were identified include the overarching fact that telework supports flexible work arrangements, promotes work-life balance, helps new parents sustain employment, reduces congestion, and improves air quality and traffic safety. However, weaknesses were also identified, and include the potential for homes and cars getting bigger due to telework, the possibility of net increases in electricity demand/usage occurring, and rebound effects limiting the long-term potential of any environmental benefits gained from increased telework. Futhermore, when considering the threats posed by an expansion of telework, it has been suggested that it might actually result in more travel, contribute to an increase in urban sprawl, require expensive changes to current infrastructure, and create an unequal gender distribution for unpaid care and household work.

Most importantly, this technique has enabled the researchers to identify and illustrate a number of key opportunities for future research. One area which warrants further investigation is telework's capacity for offering skilled employment to people living in isolated communities who may have previously been excluded from many opportunities due to geographical distance. Advances in this area could contribute to a greater globalising of labour, and tackle the inequalities that currently exist within and between countries.

Similarly, further research is needed into the role of flexible work initiatives, and how they can be designed to support different work-life choices and circumstances. This line of investigation could examine the role of telework in supporting lifelong learning, and in offering more employment opportunities to people with disabilities, new parents, carers, or anyone excluded from current employment opportunities due to the requirement of being physically present during work hours.

Future research could also investigate telework's potential to promote sustainable urban forms, act as the focal point for smart city technology and transport solutions, and for breaking down traditional gender norms.

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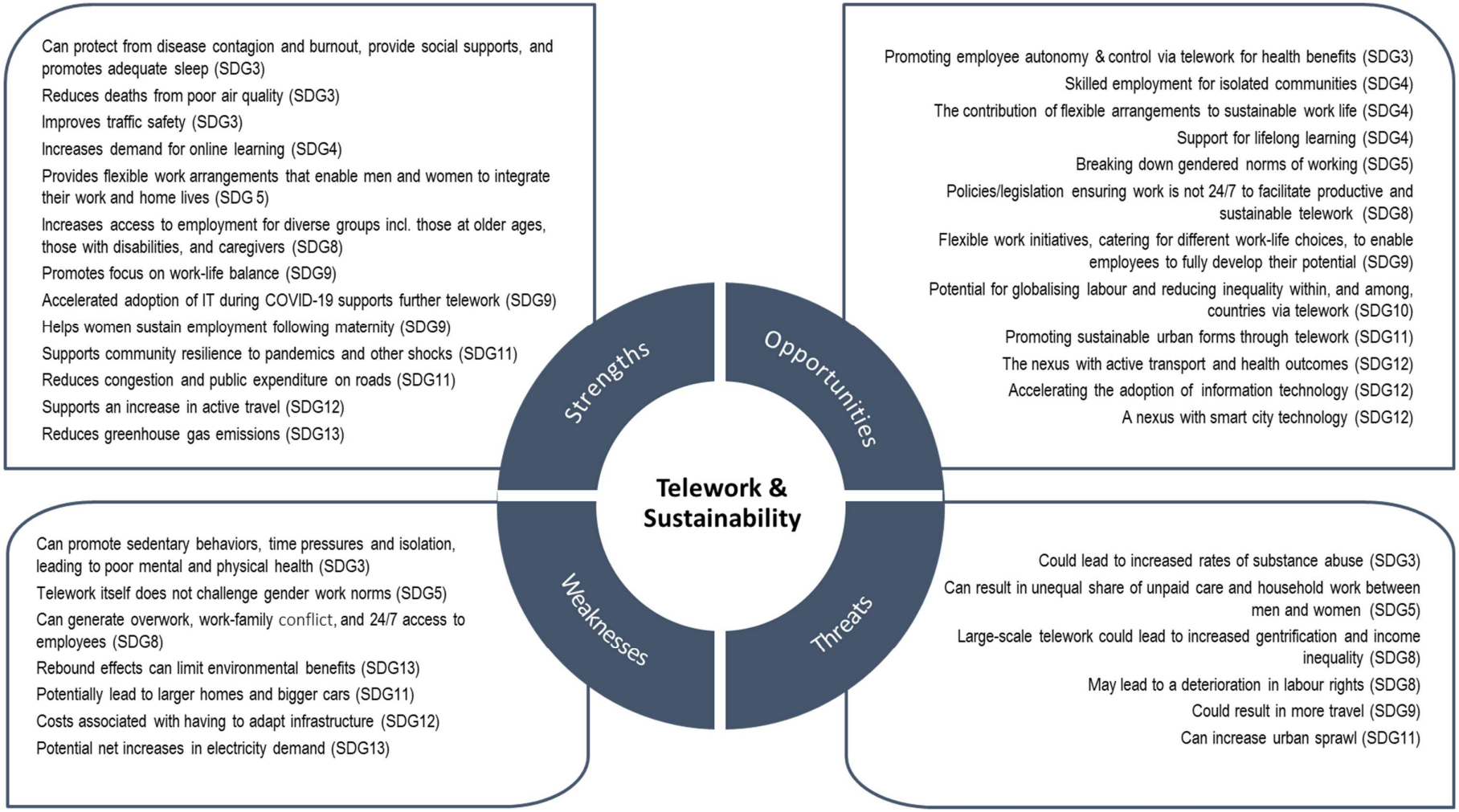


**Figure 5.** SWOT analysis

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## 4. Knowledge gaps

Our research has identified several knowledge gaps that need to be explored further if telework is to be integrated into comprehensive plans to achieve SDGs. These are further explored below.

Telework and policy integration/coherence: We have found a large number of academic articles exploring how different dimensions of telework may impact a series of SDGs, indicating that any policy on telework that aims to promote SDGs needs to carefully consider trade-offs, the potential to mitigate any negative consequences, as well as any strategy to maximise benefits. From a policy perspective, this indicates 1) the need for academic articles that explore telework in a more holistic sense across multiple SDGs, 2) an urgent need for academic research leading to a comprehensive policy framework that ensures that efforts to achieve one SDG do not undermine efforts to achieve another – in other words policy coherence. In other words, there is a strong need for policy integration and holistic decision-making around telework, in alignment with discussions by Bornemann and Weiland [190] as being necessary to achieve the UN 2030 agenda and associated SDGs. It is recommended that further research is undertaken to explore how policy coherence for telework can be ensured.

Developing countries: It is worth noting that the vast majority of academic articles (84%) in our review come from developed nations, whilst the UN SDGs to a large extent refer to issues in developing nations; thus it is reasonable to question whether benefits and risks arising from telework are the same in all contexts and whether results are applicable in areas where the SDGs primarily apply. There is a need to further explore the impacts of telework in regions not currently well-covered by academic literature (see Table  and Figure 2).

Substance abuse: No articles explore the link between telework and substance abuse. However, a desktop scan of articles found using a Google Scholar search, shows this is a topic that perhaps should be explored further. For example, one online article [191], describes psychologists who report on their clients struggling with increased alcohol abuse as an indirect result of lockdown and working from home; and activist organisation American Addiction Centers found through a survey that about one-third of those working from home were likely to be drinking more alcohol [192].

Equality implication: Several articles noted the improved access to employment that could arise from greater adoption of telework, but only one article explored the impact of telework on equality in more detail. Given the existing inequality in access to telework, and the appropriate housing that needs to support home-based work, this is an under-explored research topic.

Gender equality and domestic abuse: A topic commonly encountered in the public discourse associated with COVID-19 lockdowns concerns the increase in domestic abuse that has occurred during lockdowns, and this issue is to some extent explored in the academic literature [193-197]. However, we did not encounter any research in our sample that linked this effect with telework, and further research appears to be necessary to explore this link.

Environmental impacts and urban form: Whilst the weight of evidence strongly points in the direction that there are some significant environmental benefits associated with telework, this to some extent hinges on how the city supports the shift in population

behaviour. Further research is required to explore what type of urban form, urban planning and infrastructure will simultaneously support environmental sustainability, economic productivity, and employee flexibility.

## 5. Conclusions

The motivation for this study began with the emergence of the hybrid work model, as a popular work arrangement for many organisations in the post-COVID-19 era, which will mean many workers continue to practice telework in the future, at least part of the time. The authors were motivated to investigate what long-term impacts that this might have on sustainability outcomes, and how it could even be a tipping point towards greater sustainability. We identified this as an important gap in the current body of academic knowledge. We also identified that further knowledge about this issue will help to develop an integrated and holistic telework policy framework, in a way that can promote coherence.

In addressing the research question, the authors were able to confirm the existence of a range of associations between telework and sustainability, as explored in the existing academic literature. Research into these links has increased significantly in recent years, and includes discussions regarding both positive and negative impacts, across nine different UN SDG areas. The final sample of relevant literature (n=73) was considered to be small, especially when the overall scope of this field is considered, leading the authors to support the continuing growth of research that is occurring in this domain. The presence of a geographic knowledge gap was also detected, with the vast majority of research having been conducted in the 'Europe and North America' region (73 per cent, n=53), underlining the need for more research in countries classified as having a low or medium human development index, particularly Oceania, Northern Africa and Western Asia, where no previous academic studies were detected.

The adoption of the SWOT technique assisted in highlighting several strengths and weaknesses from the previous research, in addition to identifying risks and opportunities for future research, with significant potential for influencing sustainability outcomes across nine different SDG areas. However, links between telework and eight other SDG areas did not emerge from the search of the literature, meaning there may be opportunities for future research that investigates possible relationships between telework, and the likes of *no poverty*, *zero hunger* and *affordable clean energy*.

The authors believe this work makes a significant contribution, to the academic body of knowledge in an area that intersects a wide range of economic, societal and environmental interests. It is also intended to act as a guide to inform practitioners and policy makers seeking to better understand the wider implications for long-term telework and assist them to mitigate any negative consequences and promote the positive aspects of telework.

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