POST-COVID-19: Maintaining Low CO2 Emissions in Cities

Brendan Kalish
Helene-Therese Le Roux
Henry Macdonald
Daniela Olivera Draxl
Lee Pape

Table of Contents

Case background

The COVID-19 pandemic declared by the WHO in March 2020 (Mahase, 2020) has brought about changes in various aspects of life at an unprecedented scope and pace. The fight against the virus worldwide became the primary focus of governments, and strict policies to contain the virus were implemented. Restrictions in the United Kingdom included population confinement, night-time curfews, closure of restaurants and shops as well as border closures. Consequently, industrial activity was reduced, and individual behaviour was altered. For example, people began working remotely, e-commerce purchases increased, and transportation patterns changed. Overall, these changes lead to a drastic reduction in global CO_2 emissions. Compared to 2019, a decrease of 14.5% was reported in April 2020; however, it was only 5.8% in July, and by December, emissions had already reached a 2% growth compared to the previous year (IEA, 2020). After the initial confinement period, when COVID-19 restrictions were loosened and people seemed to return in part to their past routines, CO_2 emissions increased back to previous levels.

The pandemic showed us that governments and several other stakeholders, such as corporations and individuals, must intervene to maintain emission levels as low or even lower than during confinement periods. According to the Intergovernmental Panel on Climate Change (2014), net-zero emissions must be reached, meaning net CO_2 emissions must be lowered by 50% by 2030 and getting to zero by 2050. The pandemic's unique circumstances and potentially permanent changes it brought, such as working from home, present an unexpected opportunity to progress toward that goal.

Transportation is a key element that can drive economic and social development, but it should be understood as a means and not an end in itself. It connects people and allows links between communities, opening opportunities for jobs, markets, education and many other essential activities that are fundamental for the improvement of societies and quality of life (United Nations, 2016). Lowering transport emissions may be an important way to maintain low CO_2 emissions in a post-pandemic world. According to the European Environment Agency (2018), transportation emissions account for almost one quarter of Europe's overall greenhouse gas emissions and are the primary source of air pollution in cities. During the pandemic, surface transportation accounted for approximately half the decrease in emissions (Liu et al., 2020).

To benefit today's and future generations, a shift towards low emissions surface transportation is essential. Developing and following sustainable intra-city transportation solutions requires adopting sustainable vehicle technologies, investing in climate-friendly

infrastructure, and leveraging remote work and active travel. A combination of equitable, efficient, safe, and climate-friendly mobility strategies and practices such as working from home that shift people away from carbon-emitting transport will help develop a sustainable pathway.

Introduction

The pandemic revealed how external forces can change transportation behaviour and reduce CO_2 emissions at unanticipated speeds. Emissions from surface transport alone fell by 36% (Le Quéré et al., 2020). Maintaining and perhaps even further reducing emissions could contribute to achieving net-zero emissions. Reducing emissions in cities presents a relevant starting point, accounting for more than 50% of global CO_2 emissions (IEA, 2020).

Reducing surface transport emissions is possible yet would require major shifts in behaviour (Bednar-Friedl et al., 2015). Consequently, when designing strategies to minimise surface transport emissions, one must consider individuals, their needs, motives, and ways of living in a post-pandemic world. By addressing the question *"How can we maintain low CO_2 surface transport emissions in cities beyond the pandemic?"* this paper's target is to propose efficient solutions encompassing human behaviour's determining role.

Initially, this essay will focus on the analysis of the problem based on Lewin's three-stage model of change (1947) as well as Lahlou's Installation Theory (2018). The resulting in-depth understanding of the phenomenon will build the foundation to develop recommendations for lowering surface transport emissions. The paper will conclude with a critical discussion.

To facilitate the framing of the issue, the analysis was made through a UK-centric lens, considering restrictions, structures, and resources currently available in the UK. Nonetheless, the aim is to provide an analysis that can in the future be easily transferred to other states and governmental structures.

Problem Analysis

Theoretical Framework

To address CO_2 emissions reduction in cities, we begin by identifying the factors that led to the decrease observed during the pandemic. Next, using Lewin's 3-Stage Model of Change (1947), we will analyse how these factors could contribute to generating a sustainable shift in intra-city transportation behaviour.

The first stage, *unfreezing*, describes the destabilisation of old behavioural patterns in preparation for the change (Burnes, 2004). Often, this stage is artificially induced by the changemaker after a careful evaluation of various criteria such as determining what needs to change, creating the need for change, and managing doubts and concerns. Yet, in the case of decreased intra-city transportation emissions during the pandemic, the unfreezing step is atypical, having been a by-product of necessary widespread confinement measures (see table 1). The second phase refers to the actual change generated, where new behaviours are adopted.

However, without reinforcement, change usually doesn't last. Thus, the third stage of the model, called Refreezing, describes the solidification of the desired change. The latter requires group norms and routines to be adjusted, so the changes have a long-term effect (Burnes, 2004). Regarding transportation behaviours, the new day-to-day routines altered by the pandemic will likely return to pre-pandemic standards unless strategies are implemented to transition to more sustainable habits.

To better understand how to change transportation behaviour, we also incorporate Installation Theory. It allows us to examine the influence of three different layers– material affordances, embodied competences and social regulations– on behaviour (Lahlou, 2018). Intra-city transportation responds to many different variables such as individual habits, infrastructure in place, and societal norms. Hence, Installation Theory enables the identification of key drivers of change in a structured manner, facilitating the development of possible interventions.

Stakeholder Breakdown

In addition to the theoretical frameworks, we look at the problem through the lens of three layers of stakeholders. All of these have a significant role to play in mitigating CO_2 emissions in cities. To enable long-lasting, sustainable change, we analyse the role of:

1. The government and the public sector at the **macrolevel**

2. Businesses and organisations at the **mesolevel**

3. Individuals and their daily behaviour at the **microlevel.**

Unfreezing Stage Analysis by Stakeholder

First, at a macrolevel, significant changes in social regulations as a response to the COVID-19 outbreak could be observed. Lockdowns and social-distancing measures were introduced, which comprised restrictions for travelling, tourism, entertainment activities, and socialising, to name a few. Changes in the physical affordances accompanied these regulations: public transport frequency was diminished; capacity in stores, transportation and other public places was reduced. Many public establishments (e.g., non-essential businesses, restaurants etc.) were frequently closed. Infrastructural modifications also included increased space for cycling and pedestrian-only street closures. This type of measures caused changes in intra-city movement by changing people's motives and encouraged certain behaviours (e.g., working remotely, walking or cycling, increased time at home).

Second, at a mesolevel, one of the main regulations introduced by organisations was remote work, except for essential workers. Companies probably decided to stop or reduce their business travelling, virtual meetings became the standard, and internal procedures were adapted. At the layer of physical affordances, offices and communal places were closed, and technology systems gained importance to maintain communication and day-to-day work activities. This context provided a unique opportunity to *unfreeze* the current way of operating and experience a new way of working where most people stay at home, commute less and rely more on technology to connect.

Lastly, at a microlevel, the pandemic changed individuals' behaviours. Most of these changes were caused by embodied barriers. For instance, fear of covid propagation decreased inter-personal meetings and thus, decreased movement within cities. Similarly, the discomfort of wearing a mask discouraged individuals from using shared transportation (e.g., car-sharing, Underground, buses etc.) and encouraged walking or cycling instead. It also deterred them from visiting enclosed public spaces (e.g., museums, shops etc.). Overall, with many individuals being forced to spend unprecedented amounts of time indoors at home, there was a greater desire to spend time outdoors and use walking or cycling as transportation. Finally, the forced time spent at home and the scale of the unforeseen epidemiological and economic crisis caused by Covid-19 has for many inspired a greater susceptibility to our global environment (Fransen, Jolivet, & Fernandes, 2020), with many wishing to embrace new ecological initiatives, inform themselves through books and documentaries, and make plans to enjoy the outdoors in the future.

Analysis: Unfreeze and Change

	Unfreezing *Factors that caused the shift*	**Change** *Changes that occurred based on the unfreezing factors*
Macrolevel	**Social Regulation** - Enforced lockdown - Penalising of those who did not abide by the law (e.g., monetary fine) - Governmental restrictions and encouragement for remote work - Restrictions on leisure activities - Social distancing measures - Restricting out of country and intra-country travel - Post-travel self-isolation reducing tourism and thus movement throughout cities - Mandatory self-isolation	- Overall limited physical movement within the city - Reduced motivation to move throughout the city - Remote work limiting travel - Walking and cycling becoming social activities
	Physical affordances - Diminished public transport frequency - Limited capacity of public transport (e.g., Limitation on number of people allowed in buses, shops) - Off-limit establishments (e.g., no entrance in museums, bars, etc. during certain periods) - Closing down of airport gates diminishing need to drive to airports - Reduction in flights diminishing need to drive to airports - Installation of cycle lanes facilitating transport by cycling	- Diminished public transport frequency and capacity - Diminished quantity of leisure/dining/shopping establishments available - More walking and cycling
Mesolevel	**Social Regulation** - Remote work if possible - Virtual meetings and online gatherings replaced face-to-face meetings/socials - New company policies limiting international and domestic travel	- Remote work limiting need to travel - Less commuting and travel
	Physical affordances - New systems and installation technology for remote work - Office closures - Closures of communal places (e.g., cafeterias) encouraging remote work	- People working from home - Less commuting - People started experiencing advantages of remote work
Microlevel	**Embodied Competences** - Fear of COVID-19 propagation discouraged movement to see others - Mandatory wearing of masks discouraged people from being in closed spaces, e.g. undergrounds - Increased time spent indoors (i.e. at home) increased the desire to spend time outside - Increased awareness of our susceptibility to our global environment	- Increased willingness to walk/cycle - Decreased intra-city movement - Creation of new sustainable habits: walking, cycling - Increased consideration/appreciation of sustainable options

Table 1. Analysis of stage 1 (unfreezing) and 2 (change) of Lewin's Change Model (1947) for the three levels of stakeholders involved. Both stages have been analysed based on the three dimensions (embodied, social, physical) of Installation Theory (2018).

Solutions: Refreeze

Based on our analysis, several solutions emerged that could aid in refreezing low carbon intra-city transportation (see figure 1).

Inspired by the German Federal Ministry for Economic Cooperation and Development, we applied the A-S-I approach (GIZ, 2014). It entails three pillars: Avoid, Shift and Improve. First, solutions within the category "avoid" seek to reduce transportation as a whole. This can be done by leveraging remote work, implementing Low-Traffic Neighbourhoods (LTNs) or setting up co-working spaces. Second, the "shift" solutions target the improvement of individual trip efficiency, for instance, through a shift towards low-emitting transportation, such as electric vehicles, cycling and walking. Third, the "improve" instruments aim at improving the efficiency of existing solutions. For example, 15-minute cities' setup and electric vehicles' efficiency should be improved to mitigate CO_2 emission.

Ideally, a successful solution would be conducted on many fronts in parallel. However, due to the scope of this essay, we will focus on the two most feasible solutions from an economic and social standpoint. For both, recommended actions from all three fronts– macro-, meso-, and microlevel– will be given to facilitate a more efficient and sustainable outcome.
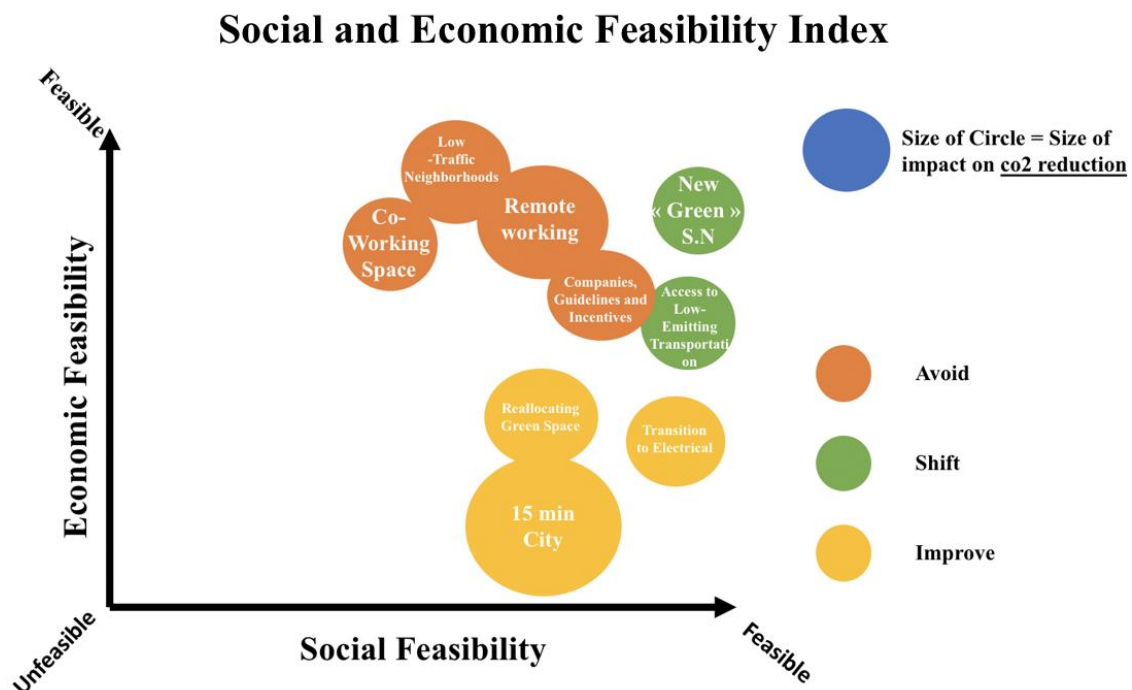

Figure 1. Overview of solutions to maintain low intra-city CO_2-emissions. The x-axis represents the social feasibility of the solution, while the y-axis shows how feasible the solutions are from an economic standpoint. The size of circle represents an estimation of the impact the individual solution could have on mitigating intra-city CO_2 emissions.

Solution 1: Low Traffic Neighbourhoods (LTNs) and pedestrianised roads

Urban infrastructure directly influences transport activity and has therefore gained increased policy attention across Europe (Bednar-Friedl et al., 2015). Therefore, low traffic neighbourhoods (LTNs) and pedestrianised roads are a simple, cost-effective way for governments to discourage automobile use and encourage active travel. Private cars accounted for 35% of daily trips in London in 2019 (Transport for London, 2020). Pedestrianised roads are closed to automobile traffic entirely. LTNs are created by blocking some neighbourhood entrances to automobile traffic. Sometimes an opening is left wide enough for emergency vehicles to pass through, and a camera catches prohibited vehicles. Sometimes the road is entirely blocked. The intent is to shift rat-runners, drivers who cut through neighbourhoods to save time, to the main thoroughfares.

LTNs can help to reduce carbon emissions primarily in two ways. First, automobile use and ownership would be reduced, becoming less convenient in an LTN. With some routes blocked, residents would take slightly longer to leave or enter their neighbourhood. Secondly, with fewer automobiles on the side streets, residents would feel safer walking and cycling in their neighbourhoods, thus reducing the use of carbon-emitting vehicles. LTNs have been shown to reduce car ownership and use in the outskirts of London (Aldred & Goodman, 2020).

Macrolevel Perspective

Importance of this stakeholder. The government plays a crucial role in the construction, operation, and maintenance of LTNs and pedestrianised roads. The fact that lockdown policies created an environment where people drove less and spent more time outside in their neighbourhood marks this stakeholder's power in bringing forward sustainable change.

Transport for London made use of the situation to plan potential LTNs throughout the city, funded by the national government's pledged £2 billion investment in active travel. Local governments approve, finance, and install the physical barriers to create LTNs. Further, they may implement deliberate policies to increase modal shares of walking and cycling, which has already been a success in Copenhagen, Melbourne and Bogota (Gemzøe & Gehl, 2013).

The construction of LTNs may address the motives of several government departments. Local politicians have a vested interest in boosting a borough's reputation as a sustainable and progressive place to live. Schools want their students to be able to walk and cycle to school safely. The National Health Service (NHS) is interested in reducing traffic accidents and improving their patient's health through a more physically active lifestyle. A 2012 study found

that encouraging active travel in urban areas in England and Wales could save the NHS £17 billion (Jarrett et al., 2012).

Obstacles. Politicians sometimes oppose LTNs out of sincere conviction or under pressure from constituents. Opposition to LTNs is rooted in the status quo bias (Samuelson & Zeckhauser, 1988). Residents are accustomed to driving the most direct routes out of their neighbourhoods. They sometimes resist changes, especially when they are implemented without prior notice. Another difficulty concerns the fact that the construction of LTNs may require communication and agreement across multiple governmental departments. Lastly, a common concern is that LTNs may shift traffic to areas where poorer people tend to live (Furness, 2020).

Solutions. When implementing LTNs, councils need to take residents' concerns into account and be transparent about the ongoing processes in order to cope with potential resistance (Lowndes & Sullivan, 2008). Residents should also be given advanced notice of planned LTNs and show how they fit into the bigger picture of reducing carbon emissions from vehicles while making the city safer for pedestrians and cyclists. Indeed, making sudden changes can aggravate an already strong status quo bias. They can make use of dynamic social norms (e.g. citing the testimony of existing LTN residents) to win support for LTNs by emphasising the growth of LTNs and active travel throughout the city or region (Sparkman & Walton, 2017).

Mesolevel Perspective

Importance of this stakeholder. The creation of LTNs and the increase of pedestrianised streets would be a cost-effective way to boost the local economy through its local businesses. Indeed, it could benefit the owners of local restaurant businesses by enabling the establishment and expansion of outside seating areas. This may also provide a natural marketing tool and increase in-house traffic by making them more noticeable to passers-by. Ultimately, these businesses could increase their capacity, increasing business and revenue. Also, having low traffic streets and pedestrianised streets could greatly increase consumer spending in local businesses. Indeed, according to a study by TFL, over a month, people who walk to the high street spend up to 40% more. In addition, high street walking, cycling and public realm improvements can increase retail sales by up to 30% (Lawlor, 2013). This would be especially efficient for hospitality businesses as pedestrian and cycling streets seem to lead to a 216% increase in people stopping, sitting and socialising. High street improvements by decreasing car traffic and increasing cycling and walking tend to significantly decrease retail

vacancy and increase retail rental values (Carmona, Gabrieli, Hickman, Laopoulou, & Livingstone, 2018). Further, by lowering noise pollution, the consumer experience within different places (e.g., spas, restaurants, etc.) is likely to improve. Finally, this may reduce stress levels for workers within the neighbourhood.

Obstacles. Organisational barriers should be considered when implementing LTNs and pedestrian roads. Indeed, businesses may resist this transition initially as it could complicate the delivery and shipment of goods. It may also restrict or slow down access for restaurant delivery drivers not using cycles. An adaptation period may be needed from local workers still driving to work, who may oppose this transition. Overall, the transition to LTNs should be gradual, starting with restricted car access within specific streets and transitioning into the establishment of pedestrian-only streets. Thus, this would allow organisations to face complaints and issues and organically find alternative methods.

Solutions. Many mutually benefiting arrangements could be made between organisations and other stakeholders to make the implementation of LTNs as efficient as possible. For instance, governments and local businesses could create a "pedestrian-only discovery root through London" for tourists, with a map and a list of local activities. This efficient partnership would encourage tourism in London while advertising local businesses and increasing pedestrian traffic. In addition, hospitality businesses' terrace expansion could be encouraged through discounted permit prices. Indeed, while this could greatly benefit businesses, increasing visibility, spending, and traffic could also benefit the government by increasing revenue from restaurant permits and increasing tax revenue from a boosted local economy.

Microlevel Perspective

Importance of this stakeholder. Lastly, the setup of LTNs will affect citizens. Successful implementation is crucial, as it requires the buy-in of people. Indeed, if citizens don't recognise the LTN as beneficial for them, they will resist change. LTNs have been shown to reduce car use (Aldred & Goodman, 2020), thus improving air quality (Hudda, Simon, Patton, & Durant, 2020). They are also safer for walking and cycling, facilitating active travel and improving people's physical and mental well-being (Living Streets, 2020; Saunders, Green, Petticrew, Steinbach, & Roberts, 2013).

Obstacles. To avoid obstacles, LTNs should involve individuals in the implementation process and communicate advantages clearly. Research on goal-setting and performance highlights the importance of goal acceptance for performance. Indeed, acceptance can be

enhanced through participation, increasing individuals' feelings of control over the goal-setting process (Bandura, 1977; F. Kanfer, 1991). If not involved in the implementation process of LTNs, citizens may feel excluded by the government's decision-making process. Ultimately, individuals may criticise the inability to drive a car on every street, more traffic on major roads, and increased travel time.

Solutions. To strengthen an individual's acceptance of LTNs, their motives and preferences have to be considered. Based on the Nudging principle (Thaler & Sunstein, 2008), making LTNs attractive should be prioritised to enhance acceptance. For instance, LTNs' advantages could be disclosed through local campaigns (e.g., air quality improvement, reduction in cardiovascular and pulmonary diseases, safer environment etc.) (Hedley et al., 2002; McCubbin & Delucchi, 1999). Pedestrianised streets could free up public spaces for local entertainment activities. LTNs could improve road safety and reduce collision rates and accidents. With these benefits highlighted, the acceptance among residents may increase.

Participation can increase goal acceptance (Erez, Earley, & Hulin, 1985). Thus, community engagement should be prioritised. Giving individuals perceived control over LTN setup and making implementation a social process might additionally strengthen the local community (e.g., conducting resident surveys on the perception of the area issues and general feedback). Neighbours can also be further involved by inviting them to create artwork that is used as road blockers.

Finally, more has to be done to remove potential barriers to active travel. Namely, the installation of on-street cycle hanger lanes (car-sized cycle storage units typically storing six bicycles) in converted parking spots may be beneficial. Additionally, leveraging the information generated by activity tracking apps can serve as feedback that helps to take up these new habits (Naimark, Madar, & Shahar, 2015; Walsh, Corbett, Hogan, Duggan, & McNamara, 2016). Activity tracking apps (e.g., AppleHealth*,* GoogleFit, Pacer) can help as a visual incentive for people to monitor their progress, showing you routes (e.g., MapMyWalk), coordinating charity donation runs (e.g., CharityMiles) or even facilitating online activity sharing (e.g., HabitShare). Thus, these may increase active travelling by inspiring friendly competition. Finally, sharing progress and change in routines could be promoted through social media platforms with specific hashtags and campaigns, encouraging the discovery of a more active lifestyle.

Solution 2: Remote Work

COVID-19 has caused a structural shift in the way people work, pushing millions of people towards working from home and away from commutes in carbon-emitting vehicles. Technological advances, for instance, new communication networks, facilitated this shift and provide opportunities to leverage remote work even beyond the pandemic. According to a study by McKinsey (Lund, Madgavkar, Manyika, & Smit, 2020), up to one quarter of the workforce in advanced economies may potentially work remotely three to five days a week, with the finance, management, professional and information sectors having the largest potential for remote work. This could drastically reduce the number of people commuting and hence the CO_2 emissions that would typically result from it.

Macrolevel Perspective

Importance of this stakeholder. The government plays a crucial role to provide feasible paths for new modalities of work. Establishing a legislative framework and setting up regulations that guide employers and protect employees is essential to encourage organisations to move towards new ways of operating. The public sector should also prioritise working remotely. Not only will they serve as an example of change, but having hands-on experience with remote work may result in better ideas when it comes to developing appropriate policies.

Obstacles. The public sector needs to address significant cybersecurity risks (Adelmann & Gaidosch, 2020). It is difficult for governments to take a stance that is too strong on remote working as it may encourage inequality (e.g., if small companies are fined because they couldn't afford remote working structures). In addition, any law that would be passed would need to be very complex as it would need to adapt to every business's specific situation (nature of the business, size, risks, etc.). Ultimately any law that doesn't account for these limitations risks provoking a backlash and resistance from the stakeholders involved.

Solutions. Much of the structure for remote work should be left to organisations as they are the most informed to assess what would be most advantageous economically and for their employees. Nonetheless, the government can still play an important role in implementing these solutions further. For instance, governments could create a series of policies targeted explicitly at the protection and welfare of remote workers to facilitate employees' willingness to work remotely and ensure that organisational laws regarding remote work are optimal for all of their stakeholders. Besides, the government could create campaigns highlighting the economic and social benefits of remote working to organisations and employees to improve the assimilation of that shift in both stakeholder groups. There could also be a set of government

recommendations in the ways organisations could organise their remote work. Companies could incorporate different types of flexible work, for example, modalities like job sharing could help boost employment recovery during/after the health crisis and, at the same time, reduce the number of people being mobilised every day throughout the city. Finally, they could also provide specialist government advisors consulting for organisations in order to help adapt organisations' structures and systems to the shift to remote work.

Mesolevel Perspective

Importance of this stakeholder. As reported by Capgemini (2020), when possible, employees will work remotely on average for 2.4 days per week following the pandemic. A move to remote work can lead to increased profits for organisations due to cutting costs by reducing office space, in-office amenities, and increased productivity (Capgemini Research Institute, 2020). Additionally, remote work implementation could lead to an improved brand image, diversity, and employee well-being.

Obstacles. At the start of the pandemic, a large number of companies worldwide have faced the challenge of setting up technologies that enable teams to work virtually since they were not prepared to migrate entirely to remote work. Many businesses are still trying to adjust while other companies have already invested in infrastructure and processes to make this possible and are now equipped to continue. As mentioned before, cyber threats also present a threat for companies.

Regarding performance, although many studies highlight that remote work enhances productivity (Choudhury, Foroughi, & Larson, 2021; Hunter, 2019), others found that productivity decreased (Gajendran & Harrison, 2007). A common explanation of reduced productivity is that it stems from negative mental health consequences remote workers face. Thus, organisations should prioritise mental health, well-being and job satisfaction while ensuring high performance (Lojeski & Reilly, 2020).

Remote work and limited social interaction at work can also present significant challenges for maintaining a common culture, managing cohesive teams and building trust across the company (Lund et al., 2020).

Solutions. To overcome these obstacles, organisations need to rethink the implementation of remote work and be adaptive to the specific needs and capacities of the company as well as its employees. Moreover, attention should be paid to creating a supportive environment where employees feel welcome to voice their concerns. Some actions that could contribute to this are:

1) Conduct surveys to understand the employee's preferences regarding the remote work method (be it a few days every week, one week every month, or one month every year). Ultimately, the model chosen must permit a certain level of interaction that helps employees build relationships and trust, and extremes should be avoided (Alexander, De Smet, & Mysore, 2020).

2) Establish work at home structures adapting to the role of their employees and the general dependence or independence that they may have. This could be established according to the position one has in the organisational hierarchy (e.g., interns vs managers) and/or the job's nature (sales vs computer engineer).

3) Provide a range of technological solutions that enables teamwork, like video calls licences, cloud services, online collaboration tools, etc. Also, provide training spaces to become familiar with them.

4) Offer leadership development opportunities (coaching or training), so leaders can strengthen the skills needed to lead virtual teams. Leaders will need to be less hierarchical and more inspirational, changing their approaches to interactions with colleagues and relying more on role modelling (Alexander et al., 2020).

5) Revisit the talent management processes. A performance assessment based on objectives may be more suitable to manage teams in a hybrid model (e.g. Netflix focusing on achievements rather than limiting paid time off) (Alexander et al., 2020).

Remote work can bring new opportunities for companies. For instance, being more flexible with employees' location enables companies to access a wider talent pool and recruit professionals based in other parts of the country or even in other countries. Moreover, flexible types of working, such as hybrid working, can bring a balance between remote work and face-to-face interaction. Such models may aid in mitigating feelings of loneliness and increasing employee well-being. Further, giving employees more flexibility may result in increased perceived autonomy, a factor associated with job satisfaction.

Microlevel Perspective

Importance of this stakeholder. The individual is affected by remote work the most, given that it may significantly affect employees' daily routines and way of working. Hence, workers' compliance is essential for the whole remote work concept to become a success.

Obstacles. Some barriers might hinder employees from wanting to work from home even if their employer allows it. According to a study by Capgemini (2020), 48% of remote

workers in the UK stated that they fear being monitored by technology in a remote setting. Thirty-seven per cent reported feeling micromanaged, and out of those respondents, 66% reported overworking and feeling burnt out. Other investigations highlight challenges such as increased distraction, vanishing barriers between work and private life, lack of human interaction, loneliness, and communication issues, to name a few. Simultaneously, some workers may prefer an office environment to be more productive than at home or connect with colleagues more easily (Bartik, Cullen, Glaeser, Luca, & Stanton, 2020).

Solutions. As mentioned at the organisational level, trainings and learning spaces are necessary to ensure leaders and employees have the embodied competences to shift to more remote work. Hard and soft skills need to be developed to use new technological tools and interact differently with others. From a relational perspective, workers could decide to spend at least one or two days at the office per week to increase face-to-face interaction and prevent feelings of social isolation. To improve concentration and productivity, they could apply different strategies: designate a good workspace (lighting, ergonomic conditions), establish a work schedule at home and working hours with fixed blocks of time for tasks and breaks. They could also take advantage of tools to limit their distractions at home. Workers could also use webinars and books to train themselves to capture productivity gains and overcome possible remote work challenges. Childcare will be a less common challenge while schools are in session.

Discussion

Carbon emissions from transportation dropped while social distancing restrictions were in place, but they rose quickly after the restrictions were lifted (Tollefson, 2021). Our paper proposes two strategies to maintain the reduction in carbon emissions from ground transportation. First, create LTNs and pedestrianise some streets to discourage automobile use and encourage active travel. Second, encourage people to work from home when possible to reduce the number of vehicles on the road. We addressed stakeholders' roles and potential obstacles through three lenses based on the Installation Theory: governments, organisations, and individuals (Lahlou, 2018).

Many people started cycling during the first lockdowns to avoid contracting COVID and because they felt safer on streets with less traffic. The UK government stepped in to create LTNs by installing barriers during the pandemic. Further implementation of LTNs and pedestrianised roads can discourage driving and encourage cycling and walking (Aldred &

Goodman, 2020). Thus, the change can be "refrozen" when people commute to work by active travel modes after the restrictions are lifted.

The success of LTNs and pedestrianised roads in curbing transport emissions depends heavily on a long-term and decisive commitment from governments and the cooperation of the other two layers of stakeholders– the private sector and individuals. The Thames cycleway in London also faced opposition. The arguments against it closely mirror those used against LTNs such as a short consultation period and accusations of punishing motorists (Walker, 2012). The cycleway was installed, and now the conflict is all but forgotten. Once-controversial LTNs can become the new normal, much like protected cycle lanes.

Traffic on the roads was drastically reduced as many workers who usually commuted in automobiles started working from home during the pandemic. To maintain that change, we propose encouraging as many workers as possible to continue working from home. Organisations have the most direct power in this area. The government can encourage its employees to work from home to set an example and provide tax incentives for companies to keep their employees at home at least part-time or shorten their commutes. Individuals who have a choice can choose to work from home. Workers choosing to work from home, even part-time, would take some vehicles off the road.

Limitations and Future Research

The solutions presented in this paper do not come without limitations. Global warming is a problem without one single solution, and ultimately it will take strong interdisciplinary collaboration to reduce CO_2 levels permanently. Additionally, there is no guarantee that carbon emissions will fall significantly during and following the pandemic. Although carbon emissions fell by 17% during the early days of the pandemic, recent estimates suggest that CO_2 will continue to increase this year to between 0.08 to 0.23 ppm (McGrath, 2020).

Yet, it is essential to note that a change in an individual's daily surface transport decisions can substantially impact climate change. Not only will the avoidance of transport where possible, a shift towards remote work and active travel, and the improvement of sustainable alternatives reduce CO_2 emissions, but it can also aid in setting up new, sustainable norms. The establishment of sustainable norms can, in turn, have spill-over effects on everyday economic life and foster green consumption, distribution and production (Peattie, 2010). In this light, future research should be conducted to better understand how large of an impact reducing surface transport can have worldwide.

Another limitation concerns the uncertainty of the post-pandemic world. With a highly volatile pandemic, identifying all factors linked to the solutions is complex (e.g., pandemic spurring people to travel more in the future, increasing CO_2 emissions).

Additionally, there are shortcomings concerning remote work. For instance, many industries cannot allow their employees to work from home (Lund et al., 2020). According to an estimate by Dingel & Neiman (2020), only around 37% of jobs, mainly within finance, corporate management and professional services, could be done from home. At the same time, lower-paying jobs in industries such as agriculture and hospitality are restricted by the nature of their work.

The solutions presented have sought to model that humans' everyday decisions can benefit the reduction of CO_2, for instance, through changes in the setup of their neighbourhood or through the ways in which they work. This highlights humans' capacity to reconfigure parts of their lives and make changes within the system that enable a more sustainable future. Although climate change is the largest collective action problem that society has yet to face, reducing surface level transport emissions is a powerful and important piece of the puzzle towards a more sustainable future. Our research has attempted to show that it is feasible for communities to mitigate climate change by implementing low traffic neighbourhoods and finding ways to work remotely. Given this essay's scope, it focused only on two solutions, LTNs and remote work, and its implementation in the United Kingdom. Future research should seek to understand how to embrace solutions globally that go beyond those presented in this paper in order to mitigate CO_2 emissions in cities worldwide.

References

Adelmann, F., & Gaidosch, T. (2020). *Cybersecurity of remote work during the pandemic*. Washington, DC.

Aldred, R., & Goodman, A. (2020). Low Traffic Neighbourhoods, Car Use, and Active Travel: Evidence from the People and Places Survey of Outer London Active Travel Interventions. *Findings*. https://doi.org/10.32866/001c.17128

Alexander, A., De Smet, A., & Mysore, M. (2020). Reimagining the post-pandemic organisation. *McKinsey Insights*, (July), 1–9. Retrieved from https://www.mckinsey.com/business-functions/organization/our-insights/reimagining-the-post-pandemic-organization#

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioural change. *Psychological Review*. US: American Psychological Association. https://doi.org/10.1037/0033-295X.84.2.191

Bartik, A., Cullen, Z., Glaeser, E. L., Luca, M., & Stanton, C. (2020). What Jobs are Being Done at Home During the COVID-19 Crisis? Evidence from Firm-Level Surveys. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3634983

Bednar-Friedl, B., Wolkinger, B., König, M., Bachner, G., Formayer, H., Offenthaler, I., & Leitner, M. (2015). Transport. *Springer Climate*, 279–300. https://doi.org/10.1007/978-3-319-12457-5_15

Burnes, B. (2004). *Kurt Lewin and the Planned Approach to Change: A Re-appraisal*.

Capgemini Research Institute. (2020). The Future of Work: From remote to hybrid. Retrieved from https://www.capgemini.com/wp-content/uploads/2020/12/Report-The-Future-of-Work.pdf

Carmona, M., Gabrieli, T., Hickman, R., Laopoulou, T., & Livingstone, N. (2018). *Street Appeal*. UCL for Transport for London.

Choudhury, P., Foroughi, C., & Larson, B. (2021). Work-from-anywhere: The productivity effects of geographic flexibility. *Strategic Management Journal*, *42*(4), 655–683. https://doi.org/https://doi.org/10.1002/smj.3251

Dingel, J. I., & Neiman, B. (2020). How many jobs can be done at home? *Journal of Public Economics*. https://doi.org/10.1016/j.jpubeco.2020.104235

Erez, M., Earley, P., & Hulin, C. (1985). The Impact of Participation on Goal Acceptance and Performance: A Two-Step Model. *Academy of Management Journal*, *28*, 50–66.

European Environment Agency. (2018). *National emissions reported to the UNFCC and to the EU Greenhouse Gas Monitoring Mechanism*.

Fransen, S., Jolivet, D., & Fernandes, B. C. (2020). Is COVID-19 Shifting Attitudes Towards Sustainability? A Case Study from Amsterdam. *Development & Society: Sustainability, Environment, Health, Migration, Social Development*. Retrieved from https://ourworld.unu.edu/en/is-covid-19-shifting-attitudes-towards-sustainability-a-case-study-from-amsterdam

Furness. (2020). Low Traffic Neighbourhoods: Good idea badly implemented?

Gajendran, R. S., & Harrison, D. A. (2007). The Good, the Bad, and the Unknown About Telecommuting: Meta-Analysis of Psychological Mediators and Individual Consequences. *Journal of Applied Psychology*, *92*(6), 1524–1541. https://doi.org/10.1037/0021-9010.92.6.1524

Gemzøe, L., & Gehl, J. (2013). Cities for People – Copenhagen studies in urban life. *Cyclists & Cycling Around the World – Creating Liveable and Bikeable Cities*, 1–10. Retrieved from http://cyclists-world.com/onewebmedia/UK_CYKELBOG_LARS_GEMZØE.pdf

GIZ. (2014). *Sustainable Urban Transport: Avoid-Shift-Improve (A-S-I)*. *Sustainability behind Sustainability*. Eschborn, Germany.

Hedley, A. J., Wong, C. M., Thach, T. Q., Ma, S., Lam, T. H., & Anderson, H. R. (2002). Cardiorespiratory and all-cause mortality after restrictions on sulphur content of fuel in Hong Kong: An intervention study. *The Lancet*, *360*, 1646–1652. https://doi.org/10.1016/S0140-6736(02)11612-6

Hudda, N., Simon, M. C., Patton, A. P., & Durant, J. L. (2020). Reductions in traffic-related black carbon and ultrafine particle number concentrations in an urban neighborhood during the COVID-19 pandemic. *Science of the Total Environment*, *742*. https://doi.org/10.1016/j.scitotenv.2020.140931

Hunter, P. (2019). Remote working in research. *EMBO Reports*, *20*(1). https://doi.org/https://doi.org/10.15252/embr.201847435

IEA. (2020). *Global Energy Review: CO2 Emissions in 2020*. Paris. Retrieved from https://www.iea.org/articles/global-energy-review-co2-emissions-in-2020

Intergovernmental Panel on Climate. (2014). *Climate Change 2014 Synthesis Report*. Retrieved from https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf

Jarrett, J., Woodcock, J., Griffiths, U. K., Chalabi, Z., Edwards, P., Roberts, I., & Haines, A. (2012). Effect of increasing active travel in urban England and Wales on costs to the National Health Service. *The Lancet*, *379*(9832), 2198–2205. https://doi.org/10.1016/S0140-6736(12)60766-1

Kanfer, F. (1991). Helping people change: A textbook of methods, 4th ed. (F. H. Kanfer & A. P. Goldstein, Eds.), *Helping People Change: A Textbook of Methods, 4th Ed.* New York, NY: Pergamon Press.

Lahlou, S. (2018). *Installation theory: The societal construction and regulation of behaviour*. https://doi.org/10.1017/9781316480922

Lawlor, E. (2013). The pedestrian pound. *Just Economics for Living Streets*.

Le Quéré, C., Jackson, R. B., Jones, M. W., Smith, A. J. P., Abernethy, S., Andrew, R. M., … Peters, G. P. (2020). Temporary reduction in daily global CO2 emissions during the COVID-19 forced confinement. *Nature Climate Change*, *10*(7), 647–653. https://doi.org/10.1038/s41558-020-0797-x

Lewin, K. (1947). Frontiers in Group Dynamics. *Human Relations*. https://doi.org/10.1177/001872674700100103

Liu, Z., Ciais, P., Deng, Z., Lei, R., Davis, S. J., Feng, S., … Schellnhuber, H. J. (2020). Near-real-time monitoring of global CO2 emissions reveals the effects of the COVID-19 pandemic. *Nature Communications*, *11*(5172), 1–12. https://doi.org/10.1038/s41467-020-18922-7

Living Streets. (2020). *Low Traffic Neighbourhoods*. London.

Lojeski, K. S., & Reilly, R. R. (2020). *The Power of Virtual Distance* (2nd ed.). Wiley.

Lowndes, V., & Sullivan, H. (2008). How low can you go? Rationales and challenges for neighbourhood governance. *Public Administration*, *86*(1), 53–74. https://doi.org/10.1111/j.1467-9299.2007.00696.x

Lund, S., Madgavkar, A., Manyika, J., & Smit, S. (2020). *What's next for remote work: An analysis of 2,000 tasks, 800 jobs, and nine countries*. Retrieved from https://www.mckinsey.com/~/media/McKinsey/Featured Insights/Future of Organisations/Whats next for remote work An analysis of 2000 tasks 800 jobs and nine countries/Whats_next_for_remote_work_F.pdf?shouldIndex=false

Mahase, E. (2020). Covid-19: WHO declares pandemic because of 'alarming levels' of spread, severity, and inaction. *BMJ (Clinical Research Ed.)*. https://doi.org/10.1136/bmj.m1036

McCubbin, D. R., & Delucchi, M. A. (1999). The health costs of motor-vehicle-related air pollution. *Journal of Transport Economics and Policy*, *33*, 253–286. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-0033453278&partn erID=40&md5=e5a6b3277da328c8f5c065b5f83e003b

McGrath, M. (2020). Climate change: Covid pandemic has little impact on rise in CO2.

Naimark, J. S., Madar, Z., & Shahar, D. R. (2015). The impact of a Web-based app (eBalance) in promoting healthy lifestyles: Randomized controlled trial. *Journal of Medical Internet Research*. https://doi.org/10.2196/jmir.3682

Peattie, K. (2010). Green consumption: Behavior and norms. *Annual Review of Environment and Resources*, *35*, 195–228. https://doi.org/10.1146/annurev-environ-032609-094328

Samuelson, W., & Zeckhauser, R. (1988). Status quo bias in decision making. *Journal of Risk and Uncertainty*, *1*, 7–59. https://doi.org/10.1007/BF00055564

Saunders, L. E., Green, J. M., Petticrew, M. P., Steinbach, R., & Roberts, H. (2013). What Are the Health Benefits of Active Travel? A Systematic Review of Trials and Cohort Studies. *PLoS ONE*, *8*(8), e69912–e69912. https://doi.org/10.1371/journal.pone.0069912

Sparkman, G., & Walton, G. M. (2017). Dynamic Norms Promote Sustainable Behavior, Even if It Is Counternormative. *Psychological Science*, *28*(11), 1663–1674. https://doi.org/10.1177/0956797617719950

Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. *Nudge: Improving Decisions about Health, Wealth, and Happiness*. https://doi.org/10.1016/s1477-3880(15)30073-6

Tollefson, J. (2021). COVID curbed carbon emissions in 2020 - but not by much. *Nature*. https://doi.org/10.1038/d41586-021-00090-3

Transport for London. (2020). Travel in London Report 13. Retrieved 13 April 2021, from https://content.tfl.gov.uk/travel-in-london-report-13.pdf

United Nations. (2016). *Mobilising Sustainable Transport for Development*. *United Nations*.

Walker, P. (2012). The opposition to London's segregated cycle lanes is living in the past.

Walsh, J. C., Corbett, T., Hogan, M., Duggan, J., & McNamara, A. (2016). An mHealth Intervention Using a Smartphone App to Increase Walking Behavior in Young Adults: A Pilot Study. *JMIR MHealth and UHealth*, *4*(3), e109. https://doi.org/10.2196/mhealth.5227