Los Angeles Sustainability Executives Roundtable (LASER)
The White Paper Pandemic Series

Telecommuting’s Impact on Greenhouse Gas Emissions in Los Angeles
Executive Summary

This paper assesses the greenhouse gas emission impacts of the COVID-19 induced shift to telecommuting (i.e. working from home), the accompanying challenges, as well as the opportunities it presents to shape an environmentally sustainable future of work. We focus on the potential changes of greenhouse gas emissions in the transportation and buildings sector, and contrary to popular claims, we find that benefits from telecommuting are potentially insubstantial or even negative. As such we provide a number of recommendations for private enterprise leaders and public policymakers to consider as we move forward.

Acknowledgements

USGBC-LA Executive Director: Ben Stapleton
LASER Program Manager: Becky Feldman Edwards
LASER Leadership Committee:
Ben Stapleton - Executive Director, USGBC LA
Nurit Katz - Chief Sustainability Officer, UCLS
Lisa Day - Manager Environmental Sustainability, Disney
John Marler - VP Energy and Environment, AEG
Lisa Collichio - Director Sustainability, Metrolink
Maria Sison-Roces - Manager Corporate Sustainability Programs, LADWP
Gabe Olson - Clean Energy Strategy, SoCalGas
Natalie Teera - VP Sustainability & Social Impact, Hudson Pacific Properties
Rick Duarte - Sustainability, Metropolitan Water District
Tamara Wallace - Sustainability Manager, Cal States Office of the Chancellor

Authors: Carli Schoenleber, Alexander Sarno
Special thanks to: Southern California Gas Company, The Los Angeles Department of Water and Power, ADEC Innovations, StreetLight Data, FASTLinkDTLA, Hudson Pacific Properties, Kilroy Realty Corporation, California State University Northridge (CSUN), Arup, California Institute of Technology, Ali Karim Lee, and Erin Lopez
Introduction

With the onset of COVID-19, countries around the world mandated regional lockdowns to reduce the overall number of cases and avoid the worst negative health impacts of the virus. The County of Los Angeles was no exception and issued the Safer at Home order on March 19 which required all businesses considered non-essential to shut down, and banned gatherings of 10 or more people with some exceptions. The restrictions are set to ease in five stages, and as of June 12 the County has been in the third stage.

The pandemic has shaken nearly every aspect of economic and social activity in the County, however, the way that it has changed individuals’ lifestyles varies greatly depending on the type of work that they perform. Non-essential business shutdowns have had a disproportionate impact on employees whose work requires close contact with customers, such as food service, hospitality, and retail trade. Furthermore, as the most populous county in California, Los Angeles County has experienced the greatest employment impact in the state in cumulative terms, registering a 613,399 increase in unemployment claims change comparing November 2020 with November 2019. In percentage terms, LA County unemployment is currently at 12 percent compared with 4 percent in 2019.

To address social distancing concerns many companies have opted for telecommuting, otherwise known as working from home. It has been estimated that those who were telecommuting full-time reached its peak in April of approximately 51% of the U.S. working population, however a more recent Gallup poll conducted in September indicates that the proportion has decreased to 33% as more people are “sometimes” working from home. The new numbers still represent a dramatic shift from the
estimated 5% that worked from home according to the latest American Community Survey (ACS) in 2018.4,5,6

The purpose of this paper is to assess the greenhouse gas emission impacts of this shift in workforce location. In our investigation we found that telecommuting may not be as effective a tool in reducing greenhouse gas emissions once all shifts in building and transportation use are accounted for. This is an important consideration as the building and transportation sectors combined make up approximately 86% of all GHG emissions in Los Angeles County (see Figure 1).84 As such, we evaluate how each sector has been affected by COVID-19 and what private companies and public policymakers can do to ensure that the region continues to play a leadership role in environmental sustainability.

Figure 1. Los Angeles County GHG Emissions by Sector (2015)

Source: Los Angeles Countywide Sustainability Plan 84

Is Telecommuting Really Sustainable?

With the drastic reduction in vehicle miles traveled (VMT) and air pollution that occurred in the weeks following the COVID-19 stay-at-home orders, many began to see telecommuting as a viable tactic to reduce greenhouse gas emissions even after the pandemic subsided. In the months following the COVID-19 related shutdown, several news outlets, including the New York Times9 and Scientific American,10,11 framed telecommuting as an unexpected boon for the climate. California was no exception to this telecommuting optimism. In June 2020, Dean Florez, a member of the California Air Resources Board, suggested in a CalMatters article that California lawmakers may already be considering policies to incentivize telecommuting to combat climate change, citing ideas such as tax credits, penalizing businesses that don’t offer telecommuting options, and improving internet access in rural areas.12 Some cities in California are already moving forward with such policies. In San Francisco, the Metropolitan Transportation Commission adopted a mandate in November that will require employers to identify and fund incentives to limit the portion of their workforce that commutes to work by car on
an average workday to 40% by 2035, with the exception of businesses with less than 50 employees and agricultural employers.  

On first examination, the argument to mitigate climate change with telecommuting seems to make perfect sense—more telecommuting means fewer vehicles on the road which should lead to reduced greenhouse gas emissions. Drumming up scientific support for this argument isn’t difficult. In fact, there is a nearly 30-year body of research which largely shows that telecommuting is a practical way to reduce carbon emissions. As the public became more aware of climate change in the 1990’s, studies began to accumulate which drew similar conclusions that telecommuting results in reduced air pollution, greenhouse gas emissions, and energy consumption in office buildings.  

However, before enacting telecommuting policies for environmental reasons, it behooves policymakers to reserve haste and ensure that a complete picture of telecommuting impacts is gathered.

In the summer of 2020, systematic literature reviews published in *Environmental Research Letters* and *Energy and Buildings* each concluded the environmental benefits of telecommuting may be vastly overestimated due to the tendency for telecommuting studies to have a limited scope in terms of study length and variables evaluated. The primary issue identified by Hook et al. is that the majority of telecommuting studies don’t take into account the full range of potential impacts of telecommuting and instead focus primarily on work-related travel, a variable relatively straightforward to measure. In this paper, 50% of the 39 studies reviewed only looked at work-related travel to estimate greenhouse gas savings from telecommuting. Disconcertingly, when studies take into account other variables that may be impacted by telecommuting, such as non-work related travel, home energy use, and office energy use, an environmental benefit is less likely to be uncovered, and sometimes energy use increases are found instead. Moreover, it was determined that studies that included more impacts from telecommuting were considered to be the most methodologically rigorous from a scientific perspective and thus should be the studies most trusted to evaluate if telecommuting should be promoted as sustainable. Based on this analysis, Hook et al. concluded that “the available evidence suggests that economy-wide energy savings [from telecommuting] are typically modest, and in many circumstances could be negative or non-existent.”

In what cases could telecommuting result in energy use increases? To understand this, one must closely examine studies that have considered a range of “rebound effects”—the short or long-term ramifications of telecommuting that could chip away at energy savings from reducing one’s commute. One prominent theme that bears out of this research is that telecommuting may eventually encourage workers to move away from urban areas to suburban or rural areas where the cost of living is reduced but average carbon footprints are higher. Indeed, two studies found that teleworkers tend to live in larger homes and several studies show that commuters tend to travel a longer distance on the days they do drive to the office. Two studies also found that commuters tend to live further away from employment centers than their non-telecommuting peers. Possibly because they live too far from an urban center to access it, research has also shown that telecommuters are more likely to use a personal vehicle to get to work rather than taking public transportation. Overall, this research suggests that long-term telecommuting studies should be conducted to better understand how telecommuting impacts workers’ lifestyle choices.

Beyond the potential for telecommuting to exacerbate urban sprawl, another major rebound effect many studies fail to consider is how telecommuting impacts non-work-related travel. While some
studies found no increase in non-work travel, three studies found telecommuters took more frequent and longer non-work trips. This could be explained by the fact that teleworkers may need to take extra trips to compensate for errands they otherwise would’ve done on their way to and from the office or that reducing one’s commute time frees up time and energy to increase travel for leisure or social activities. Thus, if non-work travel isn’t evaluated in a telecommuting study, it’s likely energy savings from telecommuting are overestimated.

One may raise the point that at the onset of the pandemic, telecommuting’s environmental benefits were physically apparent just by looking at the clear blue sky. There is no denying that the air quality of Los Angeles County was measurably better, nonetheless other factors such as seasonal atmospheric conditions and the economic shutdown likely played a large role in clearing the air. Thus, it is unclear to what extent telecommuting contributed to cleaner air in Los Angeles in the spring months of 2020. Until we can observe increased telecommuting along with a fully operating economy across all seasons of the year, it will be difficult to fully understand how telecommuting and air quality relate to each other. Despite this uncertainty, as a part of this study, we collaborated with StreetLight Data, Adec Innovations, and FirstCarbon Solutions to create maps which show the changes in VMT from April to June compared to 2019 levels. Although the findings do show dramatic decreases in VMT in May compared to the year prior, we also observe that VMT began to rise substantially as pandemic restrictions eased in June (see Appendix Items 3-5). The main takeaway from these observations is that, while it appears telecommuting played a role in reduced VMT and improved air quality, we should not infer how telecommuting would impact the environment solely based on data obtained during the pandemic due to a number of confounding factors that would distort any future predictions.

Apart from workers’ travel behavior, how company offices adapt to telecommuting can have a significant impact on telecommuting’s overall energy impact. Though it might be assumed energy consumption at the office would decrease in proportion to the number of workers telecommuting on any given day, a range of studies have indicated that in order for telecommuting to result in energy savings, offices would need to downsize their building footprint, move to a shared workspace office model (e.g., hoteling), and operate at full capacity every day. This is partly because any energy savings from workers’ absence in the office would be offset by energy usage in workers’ home offices; further, it’s likely many worker’s home offices are less energy efficient due to the need to heat or cool an entire house for just one person during the workday. Additionally, some building operations, such as lighting and HVAC, are usually not operated to adjust energy usage based on building occupancy. One study found that even if an office was completely vacant, as they largely were in the early months of the COVID-19 pandemic, energy use in the office would only decrease by 50%; another study found 75% of plug load energy use occurred during hours when offices were unoccupied.

On the basis of this literature review, it’s clear that more research is needed to elucidate the full range of impacts telecommuting might have on office energy use and workers’ lifestyle choices, driving behaviors, and home office energy usage. Thus, we believe planners and policymakers should exercise caution before rushing to implement a telecommuting policy and instead carefully consider if the current body of telecommuting research makes the case for a sustainable telecommuting scenario for their specific city or region.
Moving Forward

As illustrated by the literature reviewed above, it’s clear that telecommuting is not always synonymous with sustainability. However, regardless of the environmental implications of telecommuting, evidence suggests that COVID-19-related telecommuting is likely to permanently embed itself into American work culture. Instead of full-time telecommuting, several estimates suggest that after the pandemic subsides, telecommuting will likely continue on a part-time basis of 1-3 days per week, mirroring most pre-pandemic telecommuting policies, yet occurring at a higher rate. According to Stanford economist, Nicolas Bloom, post COVID-19 telecommuting will likely result in about 20% days worked from home in the U.S., compared to around 40% amidst the pandemic and 5% pre-pandemic.

Given this trend towards increased telecommuting, it is worth exploring how to make this shift as sustainable as possible in the Los Angeles region. Throughout the remainder of this paper, we will explore a number of opportunities, namely in the transportation and building sectors, that Los Angeles policymakers and private entities could leverage to make telecommuting a more environmentally sustainable practice. Challenges specific to COVID-19 and Los Angeles will also be discussed.

Transportation

In 2017 transportation became the largest source of greenhouse gas (GHG) emissions in the United States, with passenger vehicles composing the largest proportion of those emissions (see Figure 2). Transportation is also the largest emitter of GHGs in California, and is a close second to the building sector in Los Angeles County. Substantial changes to the way we get around, such as greater telecommuting frequency, must then be assessed for whether or not they will improve upon these trends. As stated earlier, it may appear at first glance that telecommuting would help ameliorate this issue by removing passenger vehicles off the road, thereby reducing greenhouse gas emissions; however, researchers raise two concerns that may yield commute reduction insubstantial. First it is possible that workers will compensate for less work-related driving with more driving for leisure and/or errands, and the second is that workers may be incentivized to move to more rural areas where driving further distances becomes more frequent. COVID-19 will likely remain a prominent concern until Q4 2021, and telecommuting on a part-time basis will become a part of the status quo; so in order to successfully adapt to the challenges these changes present, we outline what Los Angeles has done in response thus
far and what regional policymakers may consider going forward. Areas of consideration that we cover in
this analysis include transportation pricing, public transportation, active transportation, and vehicle
electrification.

**Transportation Pricing**

Ask any transportation specialist and they will tell you that creating better pricing structures in
our transportation system is integral to environmental sustainability. Prior to the arrival of COVID-19,
policymakers were giving great effort to try to mitigate a trend of increasing VMT in the state, and if
telecommuting results in more passenger vehicles on the road, it has considerable potential to
exacerbate greenhouse gas emissions (see Figure 3).  

**Figure 3. Statewide CO2 and Vehicle Miles Traveled (VMT) Per Capita Trend with
Respect to Anticipated Performance of Current SB 375 SCSs**

Transportation pricing in its various forms (i.e. VMT fees, congestion pricing, and smart parking
pricing, etc.) is one of our most effective tools to rectify accountability for emissions, and ultimately to
create a sustainable society. In short, pricing has two main functions. First, it adjusts travel prices to
account for environmental damage, among other negative societal costs. Current prices do not reflect
these costs, which is why single occupancy travel is so popular! Theoretically, an additional benefit to
the first function of pricing is that when solo driving begins to reflect the true cost that it poses on
society, traffic congestion should decrease as people are less inclined to spend what it costs to drive
alone, which may lead to greater use of sustainable modes of travel such as public and/or active
transportation. Second, pricing equips transportation authorities with greater funds to improve the built
environment which helps them make sustainable transportation competitive with single-occupancy
travel.

Restructuring transportation pricing and finance has long been demanded by transportation
experts to address environmental concerns related to single-occupancy vehicle travel; however, its
application may now be all the more imperative as increased telecommuting threatens to exacerbate environmentally detrimental travel behavior.\textsuperscript{22}

Public Transportation

No matter which way you slice it, replacing passenger vehicle trips with public transportation trips will help lead us to a more sustainable world; however, even before COVID-19, ridership rates in Los Angeles County had been decreasing on average since 1985. In recent years the decreases were largely due to increases in car ownership rates among low-income and immigrant populations who were most likely to use public transit.\textsuperscript{23} COVID-19 has only exacerbated this trend as ridership rates on buses and trains have fallen by 50% since the beginning of the year which has driven LA Metro to incur a $1-billion-plus deficit.\textsuperscript{24}

Given that public transportation has been linked with an increased risk of contracting COVID-19,\textsuperscript{25} challenges remain in the short-term utilizing public transportation as means to reduce travel related greenhouse gas emissions. Hesitancy to ride public transit is also reflected in a non-representative sample of Los Angeles residents who responded to the DTLA Mobility Ecosystem and COVID-19 survey from Fast Link DTLA. In this survey, 85\% of respondents (n=90) said they wouldn’t consider traveling by bus to DTLA, despite new bus-only lanes. Only 2\% of respondents (n=255) said they would feel comfortable riding transit without protections such as a covid-19 vaccine, mask requirements, social distancing, strict cleaning procedures, and proper ventilation.

Transportation authorities have an immense task given the evidenced decline in public transit use and COVID-19 related transit-riding reluctances. To meet the challenge, LA Metro launched a COVID-19 Response Task Force in April 2020. Their purpose is to respond to the immediate concerns regarding health and safety measures, to develop post-pandemic recovery solutions, and to ensure that economic recovery is equitable for the County. In their third and most recent progress report of four, they have created 17 recommendations separated into three phases: respond, relaunch, and recover. The bus specific recommendations of the report include creating safer environments through new cleaning methods, increasing public and private mask distribution, introducing a contactless payment option, making off-peak service free or discounted for a limited period, improving air flow and filtering, restoring more frequent transit service, retaining rear-door boarding as an option, launching a promotional campaign to encourage safe use of services, and reimagining major capital projects to enhancing mobility and ridership, among others.

LA Metro also has a number of long-term policies in the works that will aid them in retaining and gaining riders. The policies worth noting are the NextGen Bus Plan, the MetroMicro Pilot Project, the Fareless System Initiative (FSI), and the LA County Commuter Tax Benefit. The NextGen Bus Plan restructures LA Metro’s Bus Service to increase frequency of buses, improve service on most routes and put more buses in areas with the greatest demand, resulting in buses arriving every five to 10 minutes for 83\% of current riders compared to around 48 percent today.\textsuperscript{26}

Developed in tandem with the NextGen Bus Plan, MetroMicro is a three-year pilot project, beginning this December, providing on-demand shared ride service for short trips within designated service zones in Los Angeles County in vehicles that hold up to 10 passengers (see Figure 4). This service - accessible via mobile app, internet browser or Metro’s call center - will provide a public transportation

LA

8
alternative, competitive with private ridesharing services like Uber and Lyft, for riders that are concerned with coming in contact with groups of people via traditional public transit options.  

Figure 4. LA Metro - Metro Micro Service Zones

Source: LA Metro 2020

In September, LA Metro began a formal feasibility investigation into the possibility of implementing a free-fare public transportation policy and is set to deliver an action plan by the end of the year.  

If approved, LA Metro would be the first large transportation in the world to implement such a policy, leading the charge to make public transportation more accessible for its predominantly low-income riding demographic.

Lastly, LA Metro is slated to launch its LA County Commuter Tax Benefit program in January 2021. The ordinance will require employers in LA County with 50 to 249 employees at their worksite, to offer their employees the option to use pre-tax dollars for vanpooling, transit, and parking at Park and Ride lots and transit lots. Employees will have the opportunity to use up to $270 per month in pre-tax dollars (as of 2020) to pay for vanpooling, transit, and parking at Park and Ride lots and transit lots, which rings in at $3,240 savings per year if the benefits are applied to to their full extent.  

If well implemented, this will also further increase incentives to use public transportation.

The LA Metro public transit system is definitely in a bit of a fix, nonetheless the short-term and long-term action plans outlined here are combatting the worst effects of COVID-19 and may see LA public transit through to a decent position post-pandemic.
Active Transportation

Unlike public transportation trends, it appears that active transportation modes have garnered greater interest as a result of the new work paradigm. In the COVID-19 Response Task Force report mentioned earlier, LA Metro found that during COVID-19, Metro Bike Share saw a lower reduction in use than Metro bus, rail and parking, suggesting that there is interest in bike share as a physically-distanced transportation option. In light of this trend, the Task Force has developed goals around increasing accessibility to bicycling by enhancing its BikeShare program and considering a new program called “Adopt-a-Bike” which would allow unclaimed bicycles found on LA Metro property to be offered free of charge to LA County residents and the unhoused community who are in need of a bicycle. The validity of these efforts are supported by academic literature which suggests that telecommuters are prone to increasing interest in active transportation where activity latency exists.³⁹

This is a moment to capitalize on peaked interest in active transportation as bicycling and walking cumulatively only make up around 2-5% of all commute trips.⁵ Although LA Metro was able to swiftly implement the new DTLA 7th Street protected bicycle lane over the Summer, more bicycle friendly and convenient active transportation infrastructure is needed. The City of Los Angeles is only able to claim 19 miles of protected bicycle lanes; San Francisco, which is about a tenth of the area of L.A., has nineteen lane-miles and is expecting to install about twenty new miles over the next two years.³⁰ Research has shown that if individuals rely more on automobiles for transportation, which may be a result of individuals enabled to move further away from urban centers due to increased telecommuting, the likelihood that they will use bicycles to commute generally decreases.³¹ In order to attract more active transportation users, LA must curate an active transportation network - scattered lanes will not suffice. Expanding public and active transportation infrastructure in suburban and rural areas may not be a cost-effective tool due to increased costs associated with greater sprawl; however the more increased conglomeration can occur in such settings, the more public and active transportation may be seen as a justifiable investment.

Vehicle Electrification

For telecommuters who are insistent on moving further away from city centers, public and active transportation options will become less convenient for travel. Sure, the transportation pricing policies outlined earlier will help in mitigating environmental degradation, however if the vehicles are still fossil-fuel dependent, they will continue to inhibit the achievement of a sustainable transportation system. To address this, it will be essential to increase electric vehicle (EV) infrastructure and accessibility, particularly in remote areas. It has been shown that choosing an electric vehicle over a conventional sedan in rural counties carries approximately twice the average emissions reduction from an EV compared to most urban counties.⁹⁰ In the short-term COVID-19 may have delayed the sales of EVs as gas prices have declined, which may shift the interest of potential EV buyers back internal combustion engine (ICE) vehicles.⁹² Because cost has been shown to be an important factor for the spread of new vehicle technologies, California ought to continue leading the nation in ensuring that EV adoption is affordable (see Figure 5).³¹
Fortunately, there is significant political will to facilitate the adoption of electrical vehicles in the long-run as California Governor, Gavin Newsom, recently mandated by executive order to only allow the production and sale of electric vehicles by 2035, and both the County as well as the City of Los Angeles have created sustainability plans which prioritize electric vehicles. While it appears that zero-emission vehicles will be prominent in all parts of the region in the coming decades, we encourage policymakers to conduct further research regarding effective placement of charging infrastructure that may accommodate for changes in transportation patterns induced by greater telecommuting.

**Buildings**

**Office Buildings**

Making telecommuting more environmentally sustainable in the buildings sector also comes with a number of opportunities and challenges. Given that the building sector is the greatest source of emissions in Los Angeles County, smart solutions are dire. Starting with office buildings, recall from earlier that an office building’s energy use is more strongly tied to its size and associated operations (i.e., lighting, HVAC) than the number of building occupants (i.e., employees). To get a better sense of how local office buildings were affected by COVID-19, we asked a handful of universities and companies to provide energy-use data from April-June of this year compared to their 2019 levels (see Figure 6; see also Appendix - Item I & 2). Despite nearly 100% of employees working from home throughout April-June 2020 due to COVID-19, electricity use only decreased by 6-45% compared to April-June 2019, a time when the offices were fully staffed.
Thus, if operating purely from a sustainability perspective, the most environmentally sustainable telecommuting scenario would involve moving to a shared workspace office model and reducing the office building footprint in proportion to the number of employees telecommuting on any given day.

How likely does this seem taking COVID-19 into consideration? While it is too soon to tell how office buildings will permanently adapt to increased telecommuting, a few different outcomes are being

<table>
<thead>
<tr>
<th>University 1</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Apr-19/20 Electricity</strong></td>
<td>May-19/20 Electricity</td>
<td>Jun-19/20 Electricity</td>
</tr>
<tr>
<td>-23%</td>
<td>-20%</td>
<td>-18%</td>
</tr>
<tr>
<td><strong>Apr-19/20 Natural Gas</strong></td>
<td>May-19/20 Natural Gas</td>
<td>Jun-19/20 Natural Gas</td>
</tr>
<tr>
<td>-17%</td>
<td>-61%</td>
<td>-47%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>University 2</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Apr-19/20 Electricity</strong></td>
<td>May-19/20 Electricity</td>
<td>Jun-19/20 Electricity</td>
</tr>
<tr>
<td>-13%</td>
<td>-9%</td>
<td>-9%</td>
</tr>
<tr>
<td><strong>Apr-19/20 Natural Gas</strong></td>
<td>May-19/20 Natural Gas</td>
<td>Jun-19/20 Natural Gas</td>
</tr>
<tr>
<td>3%</td>
<td>-4%</td>
<td>N/A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Company 1</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Apr-19/20 Electricity</strong></td>
<td>May-19/20 Electricity</td>
<td>Jun-19/20 Electricity</td>
</tr>
<tr>
<td>-45%</td>
<td>-21%</td>
<td>-45%</td>
</tr>
<tr>
<td><strong>Apr-19/20 Natural Gas</strong></td>
<td>May-19/20 Natural Gas</td>
<td>Jun-19/20 Natural Gas</td>
</tr>
<tr>
<td>-79%</td>
<td>-66%</td>
<td>-37%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Company 2</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Apr-19/20 Electricity</strong></td>
<td>May-19/20 Electricity</td>
<td>Jun-19/20 Electricity</td>
</tr>
<tr>
<td>-6%</td>
<td>-8%</td>
<td>-10%</td>
</tr>
<tr>
<td><strong>Apr-19/20 Natural Gas</strong></td>
<td>May-19/20 Natural Gas</td>
<td>Jun-19/20 Natural Gas</td>
</tr>
<tr>
<td>-16%</td>
<td>-42%</td>
<td>-33%</td>
</tr>
</tbody>
</table>
debated. On one hand, there is some evidence to suggest that offices of the future will be downsized, which would help make telecommuting more sustainable. According to an October, 2020 Bisnow survey of 550 real estate experts, over half of respondents (53%) thought businesses would decrease their office spaces in response to COVID-19 related telecommuting. Similarly, 75% of CoreNet Global members surveyed in September, 2020 predicted real estate footprints would decrease. More time is needed to know for sure, but it appears that Los Angeles might be undergoing this transition. According to the LA Times, 2020 third-quarter leasing of office space was significantly below pre-COVID-19 levels, mirroring occupancy drops observed during the worst period of the Great Recession for office real estate. Yet, it is unclear if this demand decrease will ultimately mean permanently downsized footprints after a COVID-19 is successfully distributed in 2021. Rental prices remain high, there has been an uptick in demand for subleases, and leasing activity is a lagging indicator.

A similar option that has been proposed to accommodate increased telecommuting is the hub and spoke office model. In this scenario, there is a centrally located office building (i.e., hub) and many smaller offices (i.e., spokes) surrounding the hub that are located closer to employees’ homes in residential areas. If the hub and spoke model resulted in the same or reduced office building square footage, it is likely telecommuting would be more sustainable due to reduced commute-related VMT for workers. In both of these scenarios, it’s thought that corporate offices will still be necessary to attract talent and prevent the erosion of corporate culture, yet they would primarily be used for collaboration and client facing events and meetings, leaving a significant amount of working hours to take place via telecommuting.

Yet, other experts predict we could see an opposite scenario where telecommuting increases but building footprints stay the same or even increase to allow for social distancing, resulting in a less energy efficient, but pandemic-resilient office environment. In a June 2020 policy brief, Stanford economist, Nicolas Bloom, reported that because of COVID-19, demand for office space will likely increase as office densities are significantly reduced. In Los Angeles, JLL, a commercial real estate company, is reportedly enforcing a 50% capacity rule until the CDC or local health officials determine social distancing is no longer needed. Bloom also speculated that even after the pandemic ends, companies may want to maintain a lower office density to increase resiliency to a future disease outbreak. Moreover, Brookfield, an asset management company, reported in August 2020 that commercial office leases had not been significantly impacted by the pandemic, predicting office building footprints wouldn’t be going down anytime soon. Additionally, it’s possible that some of the retrofits proposed to make buildings more COVID-19 resilient (e.g., ventilation, UV lighting, increased cleaning, automated doors) could end up increasing energy used in office buildings.

While downsizing office space is the most sound option to minimize GHG emissions from telecommuting, it is currently unclear if office buildings are headed in this direction. Yet, there are still ample opportunities to make telecommuting more sustainable by leveraging green building solutions. Second to transportation, buildings are the largest source of GHG emissions in the United States, accounting for approximately one third of our total energy consumption. In California, buildings similarly contribute to 25% of total greenhouse gas emissions, and the largest source of these emissions come from commercial buildings, of which 25% are offices. These percentages reflect building emissions from fossil fuels emitted for heating and cooking as well as electricity used for lighting, appliances, and cooling. Yet, these percentages would be even larger if they accounted for
emissions associated with the entire life cycle of a building, including building materials, construction, demolition, landfills, and land use changes.\textsuperscript{45}

Given the role of buildings in California’s greenhouse gas emissions, under 2018 Assembly Bill 32, the California Energy Commission (CEC) was required to assess the feasibility of reducing GHG emissions in buildings by 40% under 1990 levels by 2030.\textsuperscript{83} This bill laid the foundation for the CEC’s 2018 Integrated Energy Policy Report (IEPR), which put a priority on decarbonizing buildings via an increasingly clean energy supply, energy efficiency and electrification system updates, and demand response technologies.\textsuperscript{83}

**Clean energy supply**

Given California’s goal of having a 100% net-zero electricity system by 2045, first and foremost, it is key to increase the availability of renewable energy sources through solar photovoltaics (PV) and wind energy. In 2018, renewable energy sources supplied about 34% of California’s electricity,\textsuperscript{83} and according to the CPUC, California is on track to increase that percentage to the state-mandated 60% by 2030.\textsuperscript{82} Yet, to meet California’s GHG goals, a clean energy supply must be accompanied with a focus on minimizing energy demand in buildings. With this focus in mind, the CEC adopted the 2019 California Energy Efficiency Action Plan, which outlined energy efficiency strategies that could potentially double the state’s energy efficiency savings in end uses, such as buildings, by 2030.\textsuperscript{44}

**Electrification**

The process of replacing fossil fueled powered appliances with those powered by electricity is known as electrification. According to Langevin et al., end uses associated with fossil fuels present the greatest opportunity to reduce GHG emissions from buildings.\textsuperscript{46} In California, 50% of direct emissions from commercial buildings originate from burning natural gas for space and water heating.\textsuperscript{47} Apart from reducing GHGs, replacing natural gas powered appliances also improves indoor air quality, benefiting the health of building occupants.\textsuperscript{48} As noted in the 2019 IEPR, electric heat pumps are one of the easiest and most cost effective replacements for natural gas powered appliances in commercial buildings; electric storage water heaters and electric ovens are also great options.\textsuperscript{49} Yet, given the state’s historic reliance on natural gas, a quick transition to electrification may not be readily compatible with California's electricity distribution infrastructure. Moreover, due to the complexity of commercial building designs, sometimes equipment or expertise needed to replace a gas appliance with an electric one is not available.\textsuperscript{47}

**Energy Efficiency Technologies**

In addition to electrification, decarbonizing buildings will require greater use of energy efficient technologies. For commercial buildings, HVAC and commercial refrigeration systems have the most potential to reduce building electricity consumption.\textsuperscript{44} According to a 2017 report from the U.S. Department of Energy, advanced HVAC sensors were ranked as the top technology enhancement to update current HVAC systems. This technology, which is in late state development, will allow for easier control of the HVAC system by using features such as wireless communication, low-energy computing, and energy harvesting technologies.\textsuperscript{50} “Ventilation reduction through advanced filtration” was also...
ranked as a high priority and late stage development technology; this involves installing filters that capture CO2 and other pollutants from the return airstream, which not only improves indoor air quality but reduces the amount of outside air required for the HVAC system to operate. While some of these technologies are easy to install, maximizing building efficiency would require a more complex process of improving building envelope efficiency via walls, windows, the roof, and foundations. Improving the building envelope may include insulating roofs, ceilings, and walls, installing cool roofs to reflect solar heat, or installing high performance window film.

Yet, despite the potential for electrification and energy efficiency to reduce California’s GHGs, there is still a lack of awareness from building owners and operators on how to take advantage of energy efficiency improvements. Reflecting this challenge, the CEC’s 2019 CA Energy Efficiency Action Plan predicts the doubling of energy savings goal by 2030 will likely be missed by approximately 20%, underscoring the need to increase demand flexibility/response technologies that optimize use of clean energy in the electricity grid.

**Demand response/flexibility**

Demand response technologies help address the fact that peak energy demand is misaligned with peak availability of renewable energy in the electricity grid; solar energy generation reaches its peak during mid-day, but peak electricity demand usually occurs in the late afternoon and evening hours. Demand response/flexibility technologies allow appliances to shift energy consumption from this peak demand time to mid-day when the electricity grid has the highest proportion of renewable energy. With automation of demand response devices at a large scale via advanced metering infrastructure, utilities would have the ability to communicate with demand response devices in buildings such that the grid is efficiently optimized to minimize fossil fuels and maximize renewable energy, all without compromising the needs and comfort of building occupants. This flexibility in the timing of energy use afforded by demand response technologies would eventually allow for a 100% renewable energy grid. Moreover, there is evidence that energy flexibility technologies would be significantly cheaper than upgrading operations to allow for peak energy loads or using natural gas powered appliances when renewable energy isn’t available. According to the Rocky Mountain Institute, some of the most promising demand flexibility technologies in commercial buildings are: electric water heaters, electric vehicle charging, electric space heaters, and air conditioning systems that utilize ice storage units.

**Homes Offices**

To maximize the sustainability of telecommuting, it is also important to acknowledge the opportunities in the residential housing sector given most office workers will likely continue telecommuting at least on a part time basis. This is especially a concern in Los Angeles given evidence that telecommuting and economic hardship related to the pandemic may be motivating people to move away from the urban center in favor of suburban or rural areas where cost of living is reduced but building footprints (and by extension energy usage) are higher.
It’s no secret that Los Angeles is in an affordable housing crisis; according to a Housing Wire report that compared median incomes to housing prices, Los Angeles was rated in February, 2020 as having the least affordable housing market in the U.S.\textsuperscript{53,54} Additionally, the 2019 USC LA Barometer survey of 1200 randomly selected Angelinos found that despite respondents being satisfied with their neighborhoods, 20% reported they planned on leaving LA, citing high cost of living as the number one reason.\textsuperscript{55} Currently, it seems like COVID-19 may be exacerbating this problem. In September, 2020, the Los Angeles Times reported that the pandemic is fueling a desire to purchase larger homes outside of central LA, resulting in record high housing prices.\textsuperscript{56} Beyond LA, there is evidence pointing to a national trend. According to an Upwork survey of 20,000 people, 11.5% of respondents said they were considering moving because of telecommuting opportunities and cost of living.\textsuperscript{57} This is strikingly high compared to the 3.6% of households that moved to another county or state between 2018 and 2019, according to the U.S. Census.\textsuperscript{57}

Given this trend, it’s more important than ever to consider green building opportunities in the context of the residential housing sector. Strategies like weatherization, demand response, and energy efficiency could help compensate for the increased energy usage associated with telecommuters’ moving to larger, suburban, homes. However, should these additional costs fall on the shoulders of the employees? Already, some employers are reimbursing costs related to telecommuting, such as for utilities and home office equipment.\textsuperscript{58} It would stand to reason that since companies take responsibility for energy and other resource consumption across their portfolio of operations, as they shift those operations into employee homes, those should still be part of their portfolio for any employee that spends a significant amount of their time telecommuting. This may open new avenues for home energy efficiency, bundled retrofits, and financing in ways previously unseen in the market.

**Sustainable Telecommuting Outlook**

It would be untrue to deny that telecommuting presents a number of potential opportunities for positive change, including expanding work opportunity accessibility, reducing traffic congestion, enabling more flexible work schedules, among many others. It is for these reasons and others unlisted that telecommuting will become a part of the normal work routine for many. The issue with telecommuting does not lie in the pursuit of these opportunities, as they are merited. As evidenced by this investigation, increased telecommuting only becomes an issue when a complete picture of the shifts in behavior that accompany telecommuting are not considered. In order to successfully adapt to the forthcoming challenges, we present seven recommendations for policymakers and private enterprise leaders to consider to ensure that Los Angeles remains a global environmental leader.

**Recommendations**

**Transportation**

1. Embed progressive pricing into our transportation system
2. Bolster public transportation with the LA Metro Recovery Task Force recommendations
3. Implement a connected network of active transportation infrastructure
4. Consider the benefits of placing electric vehicle infrastructure in suburban and rural areas
Buildings

5. Reduce office building footprints in proportion to the number of employees telecommuting on any given day
6. Decarbonize office buildings and home offices: replace natural gas appliances with electric, seal building envelopes, install energy efficient HVAC and lighting systems, and implement demand response/flexibility devices as they become available.
7. Employers take responsibility for building decarbonization in home offices of telecommuters to maximize building efficiency across employers’ portfolio of operations.

References


8: Andrew Hook et al 2020 Environ. Res. Lett. 15 093003


Appendix

Item 1 - Electricity Consumption, May 2019 to June 2019 versus May 2020 to June 2020

These graphs show reduction in electricity consumption for the period of 3 months (April – June) for 2019 and 2020.
Item 2 - Natural Gas Consumption - May 2019 to June 2019 versus May 2020 to June 2020

These graphs show reduction in natural gas consumption for the period of 3 months (April – June) for 2019 and 2020.
Item 3 - Change in Vehicle Miles Traveled from April 2019-April 2020 in LA County
Item 4 - Change in Vehicle Miles Traveled from May 2019-May 2020 in LA County

Legend
Change in VMT May 2019 - 2020
-90% to -99%
-80% to -89%
-70% to -79%
-60% to -69%
-50% to -59%
-40% to -49%
-30% to -39%
-20% to -29%
-10% to -19%
0%
1% to 9%
10% to 19%
20% to 29%
30% to 39%
50% to 59%
60% to 69%

Source: Census 2000 Data. The California Spatial Information Library (CSIL).
Item 5 - Change in Vehicle Miles Traveled from June 2019-June 2020 in LA County