



Effects of COVID-19-Related Telework Policies on the Transportation System

Requested by
California Transportation Commission

Contributing participants include
California Air Resources Board, California Department of General Services,
California Department of Transportation, California Energy Commission
and California Governor’s Office of Planning and Research

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The Caltrans Division of Research, Innovation and System Information (DRISI) receives and evaluates numerous research problem statements for funding every year. DRISI conducts Preliminary Investigations on these problem statements to better scope and prioritize the proposed research in light of existing credible work on the topics nationally and internationally. Online and print sources for Preliminary Investigations include the National Cooperative Highway Research Program (NCHRP) and other Transportation Research Board (TRB) programs, the American Association of State Highway and Transportation Officials (AASHTO), the research and practices of other transportation agencies, and related academic and industry research. The views and conclusions in cited works, while generally peer reviewed or published by authoritative sources, may not be accepted without qualification by all experts in the field. The contents of this document reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the California Department of Transportation, the State of California, or the Federal Highway Administration. This document does not constitute a standard, specification, or regulation. No part of this publication should be construed as an endorsement for a commercial product, manufacturer, contractor, or consultant. Any trade names or photos of commercial products appearing in this publication are for clarity only.

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Executive Summary

Background

On March 19, 2020, Gov. Gavin Newsom issued a statewide stay-at-home order to protect public health and slow the spread of COVID-19 in California. As a result, many California residents began working from home, leading to unprecedented changes to California's transportation system and traffic patterns.

To learn more about the COVID-19-related effects of telework on the transportation system, the California Transportation Commission requested further investigation to identify lessons learned about teleworking and transportation during the pandemic. Information gathered during this investigation will be used by multiple organizations, including California Transportation Commission and California Department of Transportation (Caltrans), to guide investment and policy decisions and to facilitate an effective teleworking environment in the post-COVID-19 era. Information about the outcomes of telework policies established in response to the COVID-19 pandemic was sought on a variety of topics, including vehicle miles traveled (VMT), traffic congestion, air quality, businesses and the workforce. Of particular interest are the potentially disproportionate effects of telework policies on disadvantaged and rural communities and communities of color.

To assist with this information-gathering effort, CTC & Associates conducted a literature search of domestic and international resources, including research in progress, that consider the extent and impacts of teleworking projected for the immediate future and for the long term.

Summary of Findings

Related Research and Resources

The literature search of recent publicly available domestic and international resources and in-progress research identified a representative sampling of publications that are organized into the following topic areas:

- Background information.
- Impacts of telework policies on transportation and climate.
- Impacts of telework policies on the workforce.
- Policies to incentivize teleworking.
- Obtaining data to assess the impacts of teleworking.

Below are highlights of resources identified for each of these topics. Following this discussion are tables summarizing all the publications, research in progress and other resources in this Preliminary Investigation by topic area (beginning on page 7). Each table provides the publication or project title, the year of publication if research is completed, and a brief description of the resource. Significantly more detail about the resource can be found in the **Detailed Findings** section of this report.

Background Information

A National Cooperative Highway Research Program (NCHRP) research project expected to begin in 2021 is based on the findings of a COVID-19 synthesis report in which transportation leaders identified problem statements to prioritize future research funding, including projects

related to changes in demand, transportation planning and data; social justice, access and mobility equity; the effects on economics, revenues and costs; and governance and roles during a pandemic. A separate COVID-19 mobility study is underway to evaluate both the short- and long-term impacts of the pandemic on mobility in the Southern California Association of Governments (SCAG) region. Led by the University of California, Davis and SCAG, the study is surveying respondents from the United States, Canada and other international locations at regular intervals to assess the shifting patterns in individual mobility and better understand modifications in travel behavior and the impacts on equity and the environment. Other resources highlight transportation-related COVID-19 issues and trends in home-based working using data from 1995 through 2017.

Impacts of Telework Policies on Transportation and Climate

Both domestic and international resources examine the impact of COVID-19 on VMT, traffic congestion (including peak period commute), air pollution and greenhouse gas (GHG) emissions, and air quality. In California, a METTRANS Transportation Center research project is currently underway to evaluate “emerging patterns and trends in telecommuting impacts in light of possible radical trends in work, workplaces, mobile work and telework.” A July 2020 California Energy Commission study that analyzed commuter and emissions data to determine the impact of increased telecommuting on GHG emissions indicates “that it offers opportunities for substantial reduction in GHG emissions at minimal cost.” A December 2020 journal article evaluates the impacts of COVID-19 on traffic-related air pollution, such as ultrafine particles, PM_{2.5}, black carbon, NO, NO₂, NO_x and carbon monoxide, in Seattle. An October 2020 journal article assesses air quality and pollutants in the continental United States.

Some resources note that results are preliminary and continued study is necessary to determine impacts. A July 2020 study of vehicle trends in New York City identifies practices that “foster the renewal and expansion of mobility,” including mitigating traffic congestion with dynamic vehicle management, maintaining a flexible transportation system, and using data to improve transportation planning and decision-making. A July 2020 journal article finds that “the extent of the emissions reductions that can be gained from remote work in any particular city depends on a number of factors, from whether most commuters drive cars or take public transit to what electricity sources the city uses.” A September 2020 journal article about travel activity in Australia notes the benefits of reduced vehicle use on air quality and traffic congestion but also encourages ongoing research into travel behavior post-pandemic.

Impacts related to teleworking and transportation extend to other issues, such as energy use and workers’ choices in where they live. A 2017 journal article suggests that teleworking is “a two-sided sword”—that while commuters may make fewer trips to their workplaces during peak periods, they may compensate by making other nonwork trips of longer distances. An October 2020 journal article notes that the impacts of teleworking versus commuting are complex, encouraging the additional considerations of “home office energy use, the [i]nternet and long-term consumer choices.” Minnesota Department of Transportation (DOT) recently funded a research project that will assess the long-term impacts of temporary shifts to telecommuting on workplace telecommuting policies and population migration. A 2015 Minnesota DOT study also explores the relationship between telecommuting and residential choice in one-worker households and multiple-worker households.

Traffic statistics and trends are presented, including reports from Oregon DOT and Washington State DOT. Other resources address modeling and analysis frameworks, including a 2015

journal article that aims to provide a framework for analyzing telecommuting behavior and the impacts of reduced VMT.

Impacts of Telework Policies on the Workforce

Additional resources describe the impacts of teleworking on workers, including the sectors of the economy that are most likely to offer or encourage telework; workers' capability to telework, including technology demands and other challenges; and differential impacts of teleworking to disadvantaged and rural communities and communities of color.

Business Sectors That Offer or Encourage Telework

Several national resources present trends and statistics related to working at home, telecommuting and flexible work schedules. Telework statistics from Global Workplace Analytics and the U.S. Bureau of Labor Statistics (BLS) are summarized by industry and by occupation. A June 2020 BLS article notes that "[w]orking at home is generally feasible in management, professional and administrative support jobs, but not in most service, construction, transportation and production jobs. Similarly, while telework feasibility is high in the information, financial activities, professional and business services, and public administration industries, it is low in the leisure and hospitality, agriculture and construction industries." A 2020 report to the U.S. Congress assesses the status of teleworking by federal agencies, noting that telework eligibility remains steady and that participation has stabilized. A January 2020 online article suggests promising teleworking career fields, including health care, computer/information technology (IT), education, sales and customer service, business, accounting and finance. Fast-growing remote career categories are art and creative, bookkeeping, internet and e-commerce, K-12 education, graphic design, translation, and math and economics. Some of the most popular remote job titles include accountant, customer service representative, nurse, project manager, recruiter, teacher, web developer and writer.

Technology Demands and Limitations

Managerial resistance and technology challenges are commonly cited as barriers to teleworking. A 2017 U.S. Government Accountability Office report presents the telework policies, procedures and other controls used by four federal agencies. A July 2020 journal article focuses on the impact of teleworking on researchers and their use of cloud services for data storage, analysis and presentation. A framework for IT managers to use that addresses teleworkers' technology barriers is presented in a 2012 journal article.

Differential Impacts of Teleworking

Inequity issues associated with telework are indicated in several resources, including a 2020 Oregon Employment Department report that notes more than 50% of Oregon workers "who could potentially telecommute are in the five occupation groups with the best access to telework: computer and mathematical; educational instruction and library; legal; business and financial operations; and management." According to the report, access to telework is divided by education and race: "A far greater number of Americans with at least a bachelor's degree or higher had the option to work from home than any other education category. White Americans had far more remote work flexibility than Black and Hispanic or Latino communities. A July 2020 International Monetary Fund (IMF) Blog post notes that the poor, the young and women face the most barriers to teleworking. A June 2020 IMF white paper encourages policy development that considers demographic and other considerations to make teleworking more equitable. An "equity approach" to teleworking is identified in a June 2020 study that ensures every worker has "access to opportunity, networks, resources and supports."

Policies to Incentivize Teleworking

Several resources present best practices for implementing or improving telework programs, including a 2017 guidebook and toolkit for use in national laboratories and a U.S. Office of Personnel Management paper that notes teleworking leads to improved employee performance, retention and morale, and improved organizational performance. Other state resources provide guidance for launching a telework program, including employee and manager strategies, policies and lessons learned.

Obtaining Data to Assess the Impacts of Teleworking

Transportation statistics are presented from national resources, including a 2020 U.S. DOT web page that provides daily vehicle travel trends (such as average trip distance, trip count, trip duration and VMT of vehicles, fleets and long-haul trucks) and other metrics during the pandemic. A Federal Highway Administration monthly report also analyzes traffic volume trends based on hourly state traffic count data. A May 2020 presentation by the Metropolitan Council in Minnesota presents teleworking statistics for various demographic characteristics, including race and worker residence. The agency's next step is to translate trip estimates into VMT and emissions to evaluate the impact of teleworking on VMT.

Additional Observations

Although outside the scope of this investigation, several recurring messages were noted during the review of these publications and resources. For example, some resources noted the preliminary basis of results and referred to other research that shows the benefits of teleworking may be offset by workers who compensate by making other nonwork trips or choosing to live in more remote areas instead of a reasonable distance from their workplaces, both of which tend to make workers more car-dependent. Additionally, some resources warned that once COVID-19 restrictions subside, personal car travel may return to earlier levels, potentially leading to increased traffic congestion.

Other resources noted that as travel behavior has changed during the pandemic, some companies and organizations are taking this opportunity to consider significant changes in working practices that will not only benefit employee and organizational performance and productivity, but will help agencies achieve sustainability goals.

Gaps in Findings

Many researchers acknowledge that research results are preliminary, offering a limited view of a unique time, and encourage additional or continued study before drawing conclusions. Also, agencies requesting this Preliminary Investigation had sought information about the structure of telework (such as selected days per week or the full workweek) and the associated impacts to workers and the transportation system. Neither domestic nor international resources were identified that specifically addressed this topic.

Next Steps

Moving forward, the California agencies requesting this investigation could consider:

- Reviewing the best practices and lessons learned described in these resources to potentially adapt them to meet specific agency needs.
- Examining the statistics illustrating the impact of COVID-19 on VMT, traffic congestion, air pollution and air quality.

- Reviewing the resources that address the impact of telework policies on the workforce, including:
 - Industries and occupations where teleworking is feasible.
 - Barriers that teleworkers face, including technology issues.
 - Inequities in teleworking.
- Evaluating the policies and practices suggested to incentivize teleworking.

Background Information

Publication or Project (Date)	Source	Excerpt From Abstract or Description of Resource
NCHRP Project 23-13: Transportation Research Related to COVID-19 (anticipated)	National Cooperative Highway Research Program	Considers transportation topics related to COVID-19—prioritized into immediate, intermediate and long-term needs—that may be considered for future TRB research. Estimated completion date: 2021.
Summary of Transportation Research Needs Related to COVID-19 (October 2020)	Transportation Research Board	Presents 38 problem statements as candidates for future research funding.
COVID-19 Transportation Resources (undated)	National Academies of Sciences, Engineering and Medicine	Links to numerous reports, webinars, blog posts and other resources about transportation-related COVID-19 issues, including changes to travel behavior and demand, and future system implications.
Trends in Home-Based Working (September 2018)	Federal Highway Administration	Explores changing trends in home-based working and select demographic characteristics of workers (such as gender, age, household income, occupation and home location) using data collected from 1995 through 2017.
COVID-19 Mobility Study (research in progress)	University of California, Davis	Presents the results of surveys that investigated the impacts of COVID-19 on individual mobility to determine “how a new ‘normality’ in terms of modified travel behavior is emerging, how activity and travel choices evolve during the recovery period, and the resulting impacts on equity and on the environment.” Completion date: not noted.

Impacts of Telework Policies on Transportation and Climate

Publication or Project (Date)	Domestic or International/State or Country	Excerpt From Abstract or Description of Resource
Changes in U.S. Air Pollution During the COVID-19 Pandemic (October 2020)	Domestic National	Assesses air quality during the COVID-19 pandemic, noting a decrease in nitrogen dioxide (NO ₂) and fine particulate matter (PM _{2.5}).
Does Telecommuting Save Energy? A Critical Review of Quantitative Studies and Their Research Methods (October 2020)	Domestic National	Attempts to quantify home, office, transportation and communications energy or GHG emissions implications of telecommuting. The issue is complex, and while most studies indicate some benefit, several suggest teleworking increases energy use.
VMT Could Drop By 10% in Post-COVID World (July 2020)	Domestic National	Suggests a 9.2% long-term reduction in annual VMT after COVID-19 because of a continued interest in teleworking by both employers and employees, and an increase in e-commerce.

Publication or Project (Date)	Domestic or International/State or Country	Excerpt From Abstract or Description of Resource
Automotive's New Reality: Fewer Trips, Fewer Miles, Fewer Cars? (2020)	Domestic National	Estimates a 9% reduction in VMT based on changes in commuting and shopping. However, other factors could affect this change such as an increase in personal vehicles over public transit, reduced gas prices and commuters choosing to live in suburbs instead of cities.
COVID Pandemic-19 Shows Telecommuting Can Help Fight Climate Change (July 2020)	Domestic National	Examines the trade-offs in emissions reductions gained from remote work to other factors affecting emissions levels, such as the number of teleworkers, commuters driving personal vehicles instead of taking public transit, commuting distance, and electricity sources and levels used by offices.
Does Telecommuting Promote Sustainable Travel and Physical Activity (June 2018)	Domestic National	Explores the association between telecommuting and travel behavior, including walking/bicycling, transit use and driving, and time spent in daily physical activity.
Investigation of Commute Departure Time to Understand the Impacts of Part-Day Telecommuting on the Temporal Displacement of Commute Travel (July 2016)	Domestic National	Investigates commute departure time and the impacts of part-day telecommute arrangements in New York City in which workers telecommute and also travel to their workplaces but adjust their departure times to avoid peak hour traffic congestion.
Toward a Comprehensive Telecommuting Analysis Framework: Setting the Conceptual Outline (2015)	Domestic National	Presents a framework for modeling telecommuting behavior with impacts on travel to enhance telecommuting analysis.
Revisiting the Impact of Teleworking on Activity-Travel Behavior Using Recent Data and Sequence-Based Analytical Technique (research in progress)	Domestic California	Reexamines telecommuting and its relationship with travel behavior to assess its beneficial impacts on transportation and its efficacy as a transportation policy tool. Emerging patterns and trends will be presented in light of possible radical trends in work, workplaces, mobile work and telework. Completion date: December 2020.
Snapshot of COVID-19 Transportation Impacts in the SCAG Region (2020)	Domestic California	Presents a brief analysis of COVID-19's impact on the transportation system, including passenger, freight/cargo and vehicle movement on the region's highways, roads, rail and transit systems.
How Much Can Working at Home Reduce GHG Emissions? (2020)	Domestic California	Attempts to quantify the reduction in GHG emissions as a result of increased teleworking.
Special Report 3: Impact of COVID-19 Mitigation on Traffic, Fuel Use and Climate Change (April 2020)	Domestic California	Investigates several continuing impacts of a government shelter-in-place order on transportation, including VMT, GHG emissions, fuel use and tax revenue, and the correlation between COVID-19 and travel rates.
Reports on COVID-19 Mitigation and Traffic Impacts (undated)	Domestic California	Provides access to reports and other resources about COVID-19 mitigation and the impacts on traffic.

Publication or Project (Date)	Domestic or International/State or Country	Excerpt From Abstract or Description of Resource
The “GO-Virtual Initiative”: Using Flexible Workplace Practices to Reduce Traffic Congestion, Increase Economic Development, and Provide More Access to Affordable Housing Choices in the South Bay Region of Los Angeles County (August 2019)	Domestic California	Examines the potential of flexible workplace practices such as telework, flexible scheduling and co-working spaces to address traffic congestion, pollution and lack of housing affordability in the South Bay region of Los Angeles County.
MnDOT Announces COVID-19 Research Funding (August 2020)	Domestic Minnesota	Describes two recently funded COVID-19 research proposals: Telecommuting During COVID-19: How Does It Shape the Future Workplace and Workforce?, and COVID-19 Impacts on Speed and Safety for Rural Roads and Work Zones.
Telecommuting and Its Relationships With Travel and Residential Choices: An Exploration of the 2000 and 2010 Regional Travel Surveys in the Twin Cities (June 2015)	Domestic Minnesota	Examines telecommuting and its connections with travel behavior and residential choice in one-worker and multiple-worker households.
Transportation During Coronavirus in New York City (July 2020)	Domestic New York	Describes the effects of COVID-19 on multiple modes of transportation in New York City, including vehicle trends. Provides recommendations for traffic congestion mitigation and transportation planning.
Weekly COVID-19 Traffic Reports (2020)	Domestic Oregon	Reports weekly observed traffic volume patterns using data from 38 state highway locations. Events that may impact traffic are noted, such as COVID-19 or wildfires.
COVID-19 Multimodal Transportation System Performance Dashboard (2020)	Domestic Washington	Provides traffic data collected from 32 locations from March through December 14, 2020. Compared to 2019, traffic volume is down 16%.
Impacts of the COVID-19 Responses on Traffic-Related Air Pollution in a Northwestern U.S. City (December 2020)	Domestic Washington	Evaluates the effects of COVID-19 on traffic-related air pollution in Seattle using data collected from February 17 through May 31, 2020 (five weeks before and 10 weeks after the Washington “stay home” order was enacted).
Insights Into the Impact of COVID-19 on Household Travel and Activities in Australia—The Early Days Under Restrictions (September 2020)	International Australia	Reports the changing travel patterns of Australian residents after COVID-19 restrictions were imposed (a 35% to 60% decrease in vehicle use).
Working From Home: Modeling the Impact of Telework on Transportation and Land Use (2017)	International Germany	Models the decision to telework, the resulting travel demand for work and nonwork trips, and household relocation.

Publication or Project (Date)	Domestic or International/State or Country	Excerpt From Abstract or Description of Resource
How COVID-19 and the Dutch “Intelligent Lockdown” Change Activities, Work and Travel Behaviour: Evidence From Longitudinal Data in the Netherlands (July 2020)	International Netherlands	Presents the preliminary results of travel behavior following stay-at-home orders. In addition to a decrease in commuting, the number of vehicle trips and the distance traveled dropped by 55% and 68%, respectively, when compared to the fall of 2019.

Impacts of Telework Policies on the Workforce: Business Sectors That Offer or Encourage Telework

National Research and Resources

Publication or Project (Date)	Excerpt From Abstract or Description of Resource
Telework.gov (undated)	Provides varied information about teleworking, including related legislation, materials for developing telework programs, employee and manager training, and guidance for performance measurement.
Status of Telework in the Federal Government: Report to Congress Fiscal Year 2018 (March 2020)	Presents trends in teleworking using data from 2012 through 2018, indicating that telework eligibility remains steady and participation has stabilized.
Latest Work-At-Home/Telecommuting/Mobile Work/Remote Work Statistics (undated)	Provides statistics on the work-at-home/telework population using 2005-2018 American Community Survey data. Includes a March 2020 update about the impact of COVID-19.
Ability to Work From Home: Evidence From Two Surveys and Implications for the Labor Market in the COVID-19 Pandemic (June 2020)	Summarizes the feasibility of teleworking for business sectors and occupations.
COVID-19 and Remote Work: An Early Look at U.S. Data (June 2020)	Reports on the preliminary effects of COVID-19 on people working from home (U.S. population surveyed April 1-5, 2020, and again May 2-8, 2020). Approximately 35.2% of commuters were working from home, and 10.1% had been laid off or furloughed. States with a larger portion of employment in information work (such as management, professional and related occupations) were more likely to work from home and had fewer people laid off or furloughed.
How Many Jobs Can be Done at Home? (June 2020)	Classifies the teleworking feasibility of all occupations and reports that 37% of U.S. jobs can be “performed entirely at home, with significant variation across cities and industries.”
Top 100 Companies With Remote Jobs in 2020 (January 2020)	Examines the most promising industries and occupations for teleworking, including a list of the top 100 companies that currently offer remote jobs.

Publication or Project (Date)	Excerpt From Abstract or Description of Resource
The “GO-Virtual Initiative”: Using Flexible Workplace Practices to Reduce Traffic Congestion, Increase Economic Development, and Provide More Access to Affordable Housing Choices in the South Bay Region of Los Angeles County (August 2019)	Focuses on industries where teleworking is most feasible. Also examines the barriers to flexible workplace practices in the South Bay region of Los Angeles County and compares the projected impacts of government interventions.

Impacts of Telework Policies on the Workforce: Technology Demands and Limitations

National Research and Resources

Publication or Project (Date)	Excerpt From Abstract or Description of Resource
Federal Telework: Additional Controls Could Strengthen Telework Program Compliance and Data Reporting (February 2017)	Addresses barriers to participating in teleworking observed in four government agencies, including managerial resistance and technology challenges.
NIH’s Cloud Enabled Shifts to How Researchers Work During Pandemic (July 2020)	Considers digital services and cloud-computing capabilities to address technology limitations of teleworking. Researchers in particular are looking to the cloud “to get the benefits of scale, collaboration [and] the ability to store and analyze data,” and to share and present information in a remote environment.
IT Support Services for Telecommuting Workforce (August 2012)	Provides a framework that IT managers can use to address the technology challenges of teleworkers.

Impacts of Telework Policies on the Workforce: Differential Impacts of Teleworking

Publication or Project (Date)	Domestic or International/State	Excerpt From Abstract or Description of Resource
Before the Coronavirus, Telework Was an Optional Benefit, Mostly for the Affluent Few (March 2020)	Domestic National	Discusses the pandemic’s potential to make teleworking available to a broader range of workers.
Not Everybody Can Work From Home: Black and Hispanic Workers are Much Less Likely to be Able to Telework (March 2020)	Domestic National	Highlights the racial inequity of teleworking.
Work–Life Flexibility for Whom? Occupational Status and Work–Life	Domestic	Reviews how occupational status and employment flexibility experiences vary and shape work–life inequality, which is a form of job inequality.

Publication or Project (Date)	Domestic or International/State	Excerpt From Abstract or Description of Resource
Inequality in Upper, Middle and Lower Level Jobs (May 2017)	National	
New Frames for Remote Work in Government Agencies: Report to the California State Controller's Office (June 2020)	Domestic California	Identifies equity frameworks and develops equity analyses that evaluate and implement the most effective telework policies for government employees "to ensure that critical government functions continue during a variety of disasters and emergencies."
How Working From Home Works Out (June 2020)	Domestic California	Examines inequity issues associated with teleworking.
Who Can't Work From Home During a Global Pandemic? (July 2020)	Domestic Oregon	Highlights the gaps in occupations that are eligible for remote working, including factors of education and race.
Teleworking is Not Working for the Poor, the Young and the Women (July 2020)	International	Investigates the pandemic's impact on global labor markets and those workers least likely to be able to work remotely: the poor, the young and women. Offers solutions such as broadening social insurance and safety nets, including wage subsidies and public works programs, and reducing inequality by strengthening education and training programs.
Who Will Bear the Brunt of Lockdown Policies? Evidence from Tele-workability Measures Across Countries (June 2020)	International	Indicates that COVID-19 could exacerbate inequality among remote workers. Researchers encourage policy development that accounts for demographic and distributional considerations now and in the future.

Policies to Incentivize Teleworking

Publication or Project (Date)	Domestic or International/State	Excerpt From Abstract or Description of Resource
Enabling a Mobile Workforce—How to Implement Effective Teleworking at U.S. Department of Energy National Laboratories: A Guidebook and Toolkit (May 2017)	Domestic National	Presents best practices for implementing or improving telework programs at national laboratories.
Telework Insights: A Current Look at Telework in the Federal Government and Promising Practices to Support a 21st Century Workforce (undated)	Domestic National	Highlights the benefits of teleworking, including improved employee performance, retention and morale, and improved organizational performance.

Publication or Project (Date)	Domestic or International/State	Excerpt From Abstract or Description of Resource
TELEWORK 360°: A Best Practices Digest and Guide to Getting Telework Right in the Public Sector (2006)	Domestic National	Provides guidance for state and local governments interested in launching a telework program.
Telework (undated)	Domestic Arizona	Provides resources for teleworking, including program requirements, training and employee management.
Telework Policy (May 2013)	Domestic California	Provides resources for California Department of Human Resources' model telework plan.
Statewide Telework (undated)	Domestic California	Provides guidance about the state's telework program.
Telework and Flex-Schedules Toolkit (undated)	Domestic California	Presents information, guidance and lessons learned related to teleworking and alternate work schedules.
State Employee Telework Program (undated)	Domestic Florida	Presents resources for employees and employers about the state's telework program.
Teleworking Information Center (undated)	Domestic Maryland	Provides access to the state's telework policy and manual, frequently asked questions about the telework program and agreement, and schedule and work plan templates.
Reflections of Remote Work During COVID-19 (June 2020) (webinar)	Domestic Maryland	Offers best practices and transportation implications for a post-COVID-19.
Telework for Commonwealth Employees (undated)	Domestic Massachusetts	Presents telework policies and training and cybersecurity resources for the state's telework program.
Telework Policy (September 2020)	Domestic Minnesota	Includes business-related benefits of teleworking to agencies, including attracting and retaining skilled employees, reducing the risk of infectious disease transmission and minimizing the impact on the environment.
Smart Business Strategy: Minnesota's eWorkPlace is Back! (undated)	Domestic Minnesota	Introduces employees and employers to teleworking strategies and benefits, including tools to launch a program and sample telework policies.
Teleworking Program Policy (undated)	Domestic North Carolina	Provides access to teleworking and alternative work schedule program policies, legislation and sample agreements.
Telecommuting and Teleworking Toolkit (undated)	Domestic Oregon	Provides guidance and best practices for telecommuting and teleworking along with sample agreements.

Publication or Project (Date)	Domestic or International/State	Excerpt From Abstract or Description of Resource
A New Workplace: Modernizing Where, How and When Utah Works (undated)	Domestic Utah	Introduces A New Workplace—a state initiative that promotes teleworking. Environmental benefits are discussed along with access to program guidance.
Telework!VA (undated)	Domestic Virginia	Provides teleworking resources for employers and employees.
Telework Resources During the COVID-19 Pandemic (October 2020)	Domestic Washington	Presents resources and lessons learned by other states that have adopted teleworking programs.
Teleworking During the COVID-19 Pandemic and Beyond: A Practical Guide (2020)	International	Presents effective policies and practices for implementing a teleworking program in the public and private sectors.
Telework in the 21st Century: An Evolutionary Perspective (November 2019)	International	Offers a framework explaining the evolution of telework in the last 40 years, and discusses telework and its effects on working time, work–life balance, occupational health and well-being, and individual and organizational performance.

Obtaining Data to Assess the Impacts of Teleworking

Publication or Project (Date)	Domestic	Excerpt From Abstract or Description of Resource
COVID-19 Related Transportation Statistics, Bureau of Transportation Statistics (2020)	Domestic National	Compares pre-COVID-19 and current statistics for passenger travel and freight shipments, including daily vehicle travel trends.
Travel Monitoring: Traffic Volume Trends (September 2020)	Domestic National	Summarizes hourly traffic count data reported by states in a monthly travel trends report. Data is “used to estimate the percent change in traffic for the current month compared with the same month in the previous year. Estimates are readjusted annually to match the vehicle miles of travel from the Highway Performance Monitoring System.”
COVID-19 (Coronavirus) Outbreak Transportation Survey (May 2020)	Domestic Minnesota	Examines the pandemic’s impact on travel behavior, including potentially permanent changes to travel behavior such as teleworking.

Detailed Findings

Background

The COVID-19 pandemic has brought unprecedented changes to California's transportation system and traffic patterns, the full effects of which are unclear. In June 2020, after a presentation by Ellen Greenberg, deputy director for Sustainability, California Department of Transportation (Caltrans), about telework and its impact on transportation, the California Transportation Commission requested further investigation to identify lessons learned from the pandemic.

Several California agencies, including the California Transportation Commission and Caltrans, sought information about the outcomes of telework policies established in response to the COVID-19 pandemic, including vehicle miles traveled (VMT), traffic congestion, air quality, businesses and the workforce. Of particular interest are the potentially disproportionate effects of telework policies on disadvantaged communities, rural communities and communities of color. Information from this investigation is expected to guide future investments and policy decisions, and will also help facilitate an effective teleworking environment in the post-COVID-19 era. While COVID-19 has prompted this inquiry, the California agencies driving this investigation determined that research on the impacts of telework that has been conducted in the last five years would be beneficial to the examination of this issue.

Related Research and Resources

To assist with this information-gathering effort, CTC & Associates conducted a literature search of domestic and international in-progress and published research that considers the extent and impacts of teleworking in both the near and long term. Findings from this literature search are presented below in the following topic areas:

- Background information.
- Impacts of telework policies on transportation and climate.
- Impacts of telework policies on the workforce.
 - Business sectors that offer or encourage telework.
 - Technology demands and limitations.
 - Differential impacts of teleworking.
- Policies to incentivize teleworking.
- Obtaining data to assess the impacts of teleworking.

Background Information

Below are resources that describe anticipated domestic research priorities and projects based on preliminary findings about the impacts of the COVID-19 pandemic on transportation. Additional resources provide background information about demographics and general trends in teleworking.

National Research and Resources

Anticipated Research: NCHRP Project 23-13: Transportation Research Related to COVID-19, estimated start date: 2021.

Project description at <http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4998>

From the project description: A recent COVID-19 report provides a cross-sectional collection of research needs derived from several sources including notes from a brainstorming session which convened a group of transportation leaders. The topics—prioritized into immediate, intermediate and long-term transportation needs related to COVID-19—may be considered for future research to be pursued by TRB [Transportation Research Board], USDOT [U.S. Department of Transportation] and others.

Once research needs are prioritized, selected studies may identify any transferrable lessons learned that will be relevant to other transportation system disruptions.

Related Resources:

“Summary of Transportation Research Needs Related to COVID-19,” Michael Grant and Beverly Bowen, *Transportation Research E-Circular*, No. E-C267, October 2020.

<http://onlinepubs.trb.org/onlinepubs/circulars/ec267.pdf>

The COVID-19 synthesis report mentioned in the previous citation presents “a research agenda that can assist research funding agencies in prioritizing research activities and funding.” Thirty-eight problem statements are presented as candidates for future research funding in the following categories:

- Operations, resilience and disaster recovery.
- Supply chain and goods movement.
- Changes in demand, transportation planning and data.
- Social justice, access and mobility equity.
- Effects on economics, revenues and costs (including stimulus).
- Governance and roles during a pandemic.
- Public health.

COVID-19 Transportation Resources, National Academies of Sciences, Engineering and Medicine, undated.

<https://www.nationalacademies.org/topics/transportation-covid-19-resources>

Additional information about a range of transportation-related COVID-19 issues is available at this web page, including changes to travel behavior and demand since the COVID-19 crisis and future system implications.

Trends in Home-Based Working, 2017 National Household Travel Survey, FHWA NHTS Brief, Federal Highway Administration, September 2018.

<https://nhts.ornl.gov/assets/NHTSBriefTelecommuting041719.pdf>

Home-based working, as noted in this brief, is of interest to transportation planners because it helps mitigate high-traffic volumes and congestion during peak travel periods. The following demographic characteristics of workers are examined using data collected from 1995 through 2017:

- Gender.
- Age (18 to 34 years, 35 to 54 years, 55+ years).

- Household income (less than \$50,000; \$50,000 to \$74,999; \$75,000 to \$99,999; and \$100,000+).
- Occupation (sales/service, clerical/administrative support, manufacturing/construction, professional/managerial/technical, other).
- Home location (second city, rural, suburban, town, urban).

From the conclusion:

[C]haracteristics of home-based workers have evolved over time. In particular, there is a more equal balance of males and females working from home, with baby boomer respondents (i.e., ages 55+) reporting a higher proportion of home-based work in the 2017 NHTS [National Household Travel Survey]. As the proportion of older home-based workers has increased, so has the proportion of workers reporting a household income of less than \$50,000, although more research is needed to confirm that these two characteristics are related and whether the older home-based workers are fully engaged in the workforce or semi-/fully retired. The actual composition of the home-based workforce has remained largely the same in terms of occupation and geographic location, reflecting the reality that certain types of jobs and industries are better-suited for home-based work as compared to others. As working from home continues to become more commonplace, further research is needed to identify a more precise method for capturing home-based work in the NHTS with respect to the question wording and categories of workers.

Related Research and Resources

Research in Progress: COVID-19 Mobility Study, University of California, Davis, start date: in progress; expected completion date: not noted.

<https://postcovid19mobility.ucdavis.edu/>

University of California, Davis and Southern California Association of Governments (SCAG) have partnered to examine the temporary and longer-term impacts of the COVID-19 pandemic on mobility in the SCAG region. *From the web site:*

Our research team at UC Davis is leading a **large data collection** effort that includes a combination of **quantitative** (online surveys checking how behaviors and attitudes have changed and how people are adjusting to the COVID-19 outbreak) and **qualitative** (in-depth phone interviews to discuss more details on household organization, work activities, use of e-shopping and delivery services, changes in habits, preferences about land use, future plans to adjust travel choices and vehicle ownership, etc.) approaches.

In spring 2020, researchers administered three versions of an online survey to more than 10,000 respondents in the United States, Canada and other international locations:

- *Longitudinal survey* resampled thousands of respondents from a 2018 California mobility survey and a 2019 eight-city travel survey (Los Angeles, San Francisco, Sacramento, Boston, Seattle, Salt Lake City, Kansas City and Washington, D.C.) that provided “a unique opportunity to build a longitudinal study to investigate the impacts of the pandemic.” Comparing current responses to the large data set of mobility information collected in 2018-2019, researchers were able to “analyze the changes in individuals’ attitudes and behaviors now as well as when people go back to the ‘new’ normality.”
- *Opinion panel* surveyed new respondents from 15 regions in the United States and two regions in Canada. (Note: The 17 study regions comprised all regions that were sampled in the longitudinal survey (above), seven new U.S. regions and two new Canadian regions.

- *Convenience sample* collected responses from participants in other regions of the United States and Canada and other international locations through several different channels, including professional listservs and social media.

In fall 2020, a new set of online surveys was distributed to all respondents from the spring 2020 surveys that investigated the “evolution of the impacts on individual mobility as the pandemic has entered a new stage in the U.S. and abroad. This new data collection will help us understand how a new ‘normality’ in terms of modified travel behavior is emerging, how activity and travel choices evolve during the recovery period, and the resulting impacts on equity and on the environment.”

Summary results from this project will be presented at the 2021 TRB Annual Meeting. Researchers are also preparing three scientific papers for publication in transportation journals.

Impacts of Telework Policies on Transportation and Climate

The domestic and international resources below provide insight into the impact of COVID-19 on transportation. Topics explored include VMT, traffic congestion, air pollution emissions and air quality.

Domestic Research and Resources

California

Research in Progress: Revisiting the Impact of Teleworking on Activity-Travel Behavior Using Recent Data and Sequence-Based Analytical Technique, METRANS Transportation Center, start date: January 2020; expected completion date: December 2020.

Project description at <https://rip.trb.org/view/1689996>

From the project description: Telecommuting and telework is the use of information and telecommunication technology to replace the more traditional working at workplaces and traveling to work. In the 1970s telecommuting was envisioned as a policy tool in a Travel Demand Management (TDM) toolkit with hopes it [would] help us decrease congestion, air pollution and waste of resources. Legislation and planning at many levels of government support telecommuting as a measure to benefit the public, employers and employees. The beneficial impacts of telecommuting on transportation are questioned today as new evidence and analysis emerge. We also face a rapid transformation of work, workplaces and[,] as a consequence[,] telework. In this project we revisit telecommuting and its relationship with travel behavior to assess its efficacy as a policy tool in a multipronged way. First, we develop a new analytical tool based on sequence analysis of activity and travel patterns at fine temporal and spatial resolutions. This replaces daily summary indicators that mask person variation in travel patterns. Second, we apply this new tool to two recent travel behavior databases in California that are the California Household Travel Survey with data collected in 2012-13 and the National Household Travel Survey with data collected in 2017. Third, we perform analysis at different geographical and social contexts in California to assess if and how telework opportunities are correlated with daily activity and travel patterns. The project concludes with a synthesis of findings about emerging patterns and trends in telecommuting impacts in light of possible radical trends in work, workplaces, mobile work and telework.

Snapshot of COVID-19 Transportation Impacts in the SCAG Region, Southern California Association of Governments, August 2020.

https://scag.ca.gov/sites/main/files/file-attachments/scag-covid-19-transportation_impacts_0.pdf?1605037459

From the introduction:

The public response to the novel coronavirus (COVID-19) pandemic and the subsequent national, state, county and local mandatory stay-at-home orders has significantly impacted transportation demand globally, nationally, regionally and locally. As the largest metropolitan planning organization in the nation, the Southern California Association of Governments (SCAG) is at the forefront of transportation planning and analysis. In order to facilitate regional planning and public awareness, SCAG prepared this document to highlight impacts of the COVID-19 pandemic on transportation activities to date. The analysis includes passenger, freight/cargo and vehicle movement on the region's highways, roads, rail and transit systems.

Among the short-term impacts of COVID-19 in the region:

- VMT on the arterial and highway network declined by nearly 80% in early April (using January 2020 as benchmark).
- VMT on the freeway network alone dropped by nearly 50% in early April over the prior year.
- VMT began increasing by mid-April.
- As of the report publication date, total VMT is nearing pre-pandemic levels.

How Much Can Working at Home Reduce GHG Emissions?, Ysbrand van der Werf, California Energy Commission, July 2020.

https://www.energy.ca.gov/sites/default/files/2020-07/How%20Much%20Can%20Working%20at%20Home%20Reduce%20GHG%20Emissions_a_da.pptx

Workforce, commuter and emissions data were analyzed to determine the impact of increased telecommuting on greenhouse gas (GHG) emissions, indicating “that it offers opportunities for substantial reduction in GHG emissions at minimal cost.” The analysis examined single-occupant vehicles from 30 counties and two business sectors (information/finance/insurance and real estate/rental/leasing), which accounts for 22% of California's workforce and 41% of its work-from-home force. Researchers suggested possible improvements to the analysis:

- Explore better alignment between EMFAC (EMission FACTors, California's federally approved on-road mobile source emission inventory model) and census data.
- Improve upon sector data.
- Expand analysis to include carpools and mass transit for examining scenarios with many working at home.
- Include other fuels and counties.

Special Report 3: Impact of COVID19 Mitigation on Traffic, Fuel Use and Climate Change, Fraser Shilling, Road Ecology Center, University of California, Davis, April 2020.

https://roadecology.ucdavis.edu/files/content/projects/COVID_CHIPs_Impacts_updated_430.pdf

From the introduction:

We investigated several continuing impacts of government shelter-in-place order on rates of traffic, crashes, injuries/deaths and costs on California highways and certain major roadways patrolled by the California Highway Patrol. Using estimated traffic data from

Streetlightdata.com, we analyzed traffic conditions before and after stay-at-home guidance. Using federal standards/averages for vehicle fuel-mileage and emissions of greenhouse gases (GHG), we compared GHG emissions at the state and U.S. scale before and after COVID-19 mitigation (a new “green lining”). For California, we also estimated the decrease in fuel-tax revenue as a result of the Governor’s stay-at-home order.

Key findings from this investigation:

- **Reduction in nationwide travel.** Total VMT at the county and state level had declined by 61% to 90% following the various government stay-at-home orders, which “could be accompanied by nationwide declines in crash impacts.”
- **Change in GHG emissions.** VMT data suggest that “GHG emissions that cause climate change were reduced by 4% in total and by 13% from transportation in the almost [eight] weeks since many stay-at-home orders went into effect.” Researchers noted that “[i]f traffic remained reduced for one year, the reduction in VMT would allow California to meet half of its 2050 climate change target.”
- **Reduction in traffic and COVID-19 cases.** Researchers noted “a positive correlation between [the] number of [COVID-19] cases and deaths and the reduction in county-level travel. This could mean that less traffic resulted in fewer cases (e.g., via community transmission)” and that people “traveled less when there was more COVID-19 impact.”
- **Reduction in fuel use and tax revenue.** Reduced travel “has resulted in an estimated \$46 million [per] week reduction in SB1 [Senate Bill 1] fuel tax funds and [approximately] \$161 million [per] week in total fuel tax revenues for California state and local transportation projects.”

Related Resource:

Reports on COVID-19 Mitigation and Traffic Impacts, Road Ecology Center, University of California, Davis, undated.

<https://roadecology.ucdavis.edu/>

Reports and other resources about the impact of COVID-19 mitigation on traffic and the consequences of reduced traffic are available at this web site, including the report mentioned above.

The “GO-Virtual Initiative”: Using Flexible Workplace Practices to Reduce Traffic Congestion, Increase Economic Development and Provide More Access to Affordable Housing Choices in the South Bay Region of Los Angeles County, Fynnwin Prager, Mohja Rhoads, Jose N. Martinez, Chris Cagle, Aaron Baum and Jacki Bacharach, Mineta Transportation Institute, August 2019.

https://transweb.sjsu.edu/sites/default/files/1860-Prager-Flexible-Workplaces-South-Bay_0.pdf

From the abstract:

Flexible workplace practices (FWPs) such as telework, flexible scheduling and the use of co-working spaces have the potential to address problems of congestion, pollution and lack of housing affordability in the South Bay region of Los Angeles County. However, trends in the adoption of FWPs—especially of working from home—across the region do not appear to be increasing as much as expected, despite advances in technology, changing worker demands, and evolving workplace cultures. In the South Bay and Los Angeles, commute times and the proportion of residents driving alone to work have increased as the economy has grown. As alternatives to driving alone to work, employees appear to face the choices of using public transit if more accessible, or carpooling if the journey is longer; however, both of these modes of transportation have declined in usage in recent years. Instead, the only

alternative to driving alone that has increased in frequency in the South Bay and Los Angeles County in recent years is working from home, which is most likely concentrated among residents in locations with higher education levels or occupations that are more appropriate. Prior literature has provided numerous insights here, finding that conditions are region-specific, and that occupational and industry constraints combine with manager resistance and employee concerns over work-life balance to limit the expansion of FWP. The authors of this study contribute to the literature by focusing on the obstacles to expansion of FWP among South Bay organizations, as well as by comparing the projected impacts of potential government interventions in this space. The authors explore these issues with methods innovative to the field, including a combination of surveys and expert elicitation focus groups that includes numerous types of FWP, especially the inclusion of co-working spaces as a strategy. Participants in the survey and focus groups perceived the major obstacles to expansion to be a combination of managerial and executive resistance, alongside occupational constraints. Participants perceived government subsidies and incentives as both having a good combination of costs and impacts, possibly to be used to encourage the use of private co-working spaces, which offer a market solution that balances the benefits of traditional at-home telework and collaborative workplaces. That said, telework remains a cost-effective approach to reducing commute-related emissions, and hence more aggressive programs, such as telework facilities exchanges, expansion of South Coast Air Quality Management District mandates, and incentives for workforce training and program implementation may be needed to achieve broader climate action and local pollution targets.

The potential for emissions reductions as a result of FWP, including estimates of annual emissions reductions, is briefly discussed beginning on page 37 of the report (page 47 of the PDF).

Minnesota

“MnDOT Announces COVID-19 Research Funding,” Micaela Resh, *Crossroads*, Minnesota Department of Transportation, August 13, 2020.

<https://mntransportationresearch.org/2020/08/13/mndot-announces-covid-19-research-funding/>

In June 2020, the MnDOT Office of Research & Innovation solicited COVID-19-specific research proposals from academic researchers and consultants. Proposals were required to have a MnDOT or Minnesota city or county champion; research projects are expected to be completed within one year. Four proposals were selected for funding in July, including:

- **Telecommuting During COVID-19: How Does It Shape the Future Workplace and Workforce?**

Researcher: University of Minnesota

From the project description: This project will assess the long-term impacts of temporarily shifting the workforce to telecommuting on Minnesota workplace telecommuting policies and population migration. The study will compare differences among geographic areas and industries. The desired outcome is data-driven, evidence-based insights for transportation planning and congestion mitigation on both state and local levels.

- **COVID-19 Impacts on Speed and Safety for Rural Roads and Work Zones**

Researcher: Iowa State University

From the project description: According to the Minnesota Department of Public Safety, after Minnesota's stay-at-home order was issued, traffic fatalities increased about 50%. This was at the same time traffic fell roughly 50%. This research project will:

- Evaluate the impact of the pandemic on the frequency and severity of crashes across urban, small urban and rural areas.
- Us[e] crash records [for] high-risk areas and develop solutions to prevent severe crashes from happening.

“Telecommuting and Its Relationships With Travel and Residential Choices: An Exploration of the 2000 and 2010 Regional Travel Surveys in the Twin Cities,” David Levinson, Greg Lindsey, Yingling Fan, Jason Cao, Michael Iacono, Martin Brosnan, Andrew Guthrie and Jessica Schoner, Chapter 2, *Travel Behavior Over Time*, Minnesota Department of Transportation, June 2015.

<http://cts-d8resmod-prd.oit.umn.edu:8080/pdf/mndot-2015-23.pdf>

Using 2000 and 2010 travel behavior inventories, researchers examined telecommuting and its connections with travel behavior and residential choice. One-worker and multiple-worker households were “differentiated to study the interactions among employed household members.” Travel behavior was measured as workers’ average vehicle kilometer traveled (VKT) and vehicle hour traveled (VHT) and household average VKT and VHT. Residential choice was measured as average commute distance. Key findings from the study:

- The share of telecommuters and workers’ and household average VHT has increased from 2000 to 2010. Workers’ and household average VKT has decreased for one-worker households but remained unchanged for multiple-worker households.
- Telecommuters in:
 - *One-worker households* tend to be more affluent, more highly educated, older and more likely to have multiple jobs than nontelecommuters.
 - *Multiple-worker households* tend to be more affluent, have more household members and live in job-rich areas (within a 10-mile buffer from their residence) than nontelecommuting households.
- In general, telecommuting has limited impacts on travel behavior of multiple-worker households and is positively associated with most travel behavior variables of one-worker households. Telecommuting “tends to complement travel and the increase is mainly due to nonwork travel.”
- Telecommuting does not affect commute distance for one-worker households but is negatively associated with average commute distances for multiple-worker households, suggesting that “the ability of one worker to telecommute may motivate the household to seek a location closer to the workplace of other household members and hence leads to a decrease in average commute distance.”

New York

Transportation During Coronavirus in New York City, Sarah Kaufman, Mitchell Moss, Kelsey McGuinness, Nicholas Cowan, Samuel Schwartz, Meera Joshi, Daniel Schack, Josh Rogers, Charles Rudner, Olivia Limone, Jenee Malloy, Josh Koh, Katherine Rivard, Rachel Wise, Yana Chudnaya, William Farrell and Haotian Lucy Wu, Rudin Center for Transportation Policy and Management, July 2020.

<https://wagner.nyu.edu/files/faculty/publications/Full%20Report.pdf>

From the introduction:

This report describes and analyzes the effects of the pandemic on New York's transportation systems during the spring of 2020. We examine a multiplicity of transportation modes—from subways and buses to bicycles and taxis and for-hire vehicles—as well as commuter rail and vehicular use of bridges and tunnels. New York City and the surrounding region face tough challenges to rebuild ridership and restore faith in public transit—critical factors in any economic recovery. We identify and recommend potential policies to foster the renewal and expansion of mobility in the coming months and years.

Below are highlights of vehicle trends in New York City (beginning on page 11 of the report, page 15 of the PDF):

- Traffic speeds rose 27% as vehicular trips decreased by 84%.
- Manhattan saw the most significant drop in VMT: Drivers traveled 93% less in April than they had in January.
- Citywide average daily VMT increased slightly in May, but were down 71.1% of the January daily average.
- In May, Manhattan saw the least recovery of any of the other boroughs.

Among the report's recommendations:

- **Mitigate traffic congestion with dynamic vehicle management.** To reduce vehicle traffic and increase funding for the Metropolitan Transportation Authority, adopt a feasible congestion mitigation strategy that implements congestion pricing, synchronizes e-hail regulations and staggers work hours.
- **Continue the flexible adaptation of the transportation system.** Adapt to a rapidly changing environment by prioritizing public transit in underserved communities, bus rapid transit, and communication and coordination among key transportation agencies.
- **Improve planning with coordinated data.** Require relevant and consistent transportation data be provided for analysis and agile planning.
- **Accommodate and encourage micromobility.** Expand the protected bike lane network, expand Open Streets for commuters (beyond recreational use), extend micromobility to essential workers' neighborhoods and lower vehicular speeds in areas with high-density micromobility.
- **Inform decision-making with data.** Require relevant, anonymized data in as real-time format as possible and in a universal format; use information technologies for collaborative and strategic planning; and provide schedules, real-time and operations data to the public.

Oregon

Weekly COVID-19 Traffic Reports, Traffic Counting, Oregon Department of Transportation, 2020.

<https://www.oregon.gov/odot/Data/Pages/Traffic-Counting.aspx>

Weekly observed traffic volume patterns are reported on this web page. Data is collected from 38 locations on the state highway system. Weekly and year-over-year comparisons are made, noting that events other than COVID-19 may impact traffic patterns (for example, the wildfires that occurred in late September and early October).

Washington

COVID-19 Multimodal Transportation System Performance Dashboard, Washington State Department of Transportation, 2020.

<https://www.wsdot.wa.gov/about/covid-19-transportation-report/default.htm>

Highway traffic data collected at 32 locations from March through December 14, 2020, indicates that traffic volume is down 16% when compared to 2019 baseline data. *From the web page:*

Washington state has seen a significant decline in travel across all modes of transportation since mid-March. Washingtonians have responded positively to Gov. Inslee's various COVID-19 related initiatives such as closing schools (March 12), restricting gatherings to fewer than 50 people (March 16) and the Stay Home — Stay Healthy Executive Order (March 25).

Multimodal travel changes in [h]ighway [t]raffic, [t]oll [s]ystems, and [f]erries, [t]ransit and [p]assenger [r]ail ridership are reflected in the executive summary. [Scroll down the web page to see this information.]

....

WSDOT [Washington State DOT] is monitoring these systemwide transportation changes based on data from WSDOT Traffic Information, the Washington State Transit Association and the Port of Seattle (Seattle-Tacoma International Airport).

“Impacts of the COVID-19 Responses on Traffic-Related Air Pollution in a Northwestern U.S. City,” Jianbang Xiang, Elena Austin, Timothy Gould, Timothy Larson, Jeffry Shirai, Yisi Liu, Julian Marshall and Edmund Seto, *Science of the Total Environment*, Vol. 747, December 2020.

<https://www.sciencedirect.com/science/article/pii/S0048969720348543?via%3Dihub>

From the abstract: This study evaluates the COVID-19 impacts on traffic-related air pollution, including ultrafine particles (UFPs), PM_{2.5}, black carbon (BC), NO, NO₂, NO_x and CO in a [n]orthwestern U.S. city. Hourly traffic, air pollutants and meteorological data on/near a major freeway in the downtown of Seattle, Washington, were collected for five weeks before and [10] weeks after the Washington [s]tay [h]ome [o]rder (SHO) was enacted, respectively (February 17–May 31, 2020). The pollutants between pre- and post-SHO periods were compared, and their differences were statistically tested. ... [F]irst-order multivariate autoregressive (MAR(1)) models were developed to reveal the impacts specific to the change of traffic due to the COVID-19 responses while controlling for meteorological conditions. Results indicate that compared with those in the post-SHO period, the median traffic volume and road occupancy decreased by 37% and 52%, respectively. As for pollutants, the median BC and PM_{2.5} levels significantly decreased by 25% and 33%, [respectively], while NO, NO₂, NO and CO decreased by 33%, 29%, 30% and 17%, respectively. In contrast, neither size-resolved UFPs nor total UFPs showed significant changes between the two periods, although larger particles (≥115.5 nm) decreased by 4[%]–29%. Additionally, significant differences were found in meteorological conditions between the two periods. Based on the MAR(1) models, controlling for meteorological conditions, the COVID-19 responses were associated with significant decreases in median levels of traffic-related pollutants including 11.5–154.0 nm particles (ranging from -3% [95% confidence interval (CI): -1%, -4%] to -12% [95% CI: -10%, -14%]), total UFPs (-7% [95% CI: -5%, -8%]), BC (-6% [95% CI: -5%, -7%]), PM_{2.5} (-2% [95% CI: -1%, -3%]), NO, NO₂, NO_x (ranging from -3% [95% CI: -2%, -4%] to -10% [95% CI: -18%, -12%]), and CO (-4% [95% CI: -3%, -5%]). These findings illustrate that the conclusion of the COVID-19 impacts on urban traffic-related air pollutant levels could be completely different in scenarios whether meteorology was adjusted for or not. Fully adjusting for meteorology, this study shows that the COVID-19 responses were associated with much more reductions in traffic-related

UFPs than PM_{2.5} in the Seattle region, in contrast to the reverse trend from the direct empirical data comparison.

International Research

Australia

“Insights Into the Impact of COVID-19 on Household Travel and Activities in Australia—The Early Days Under Restrictions,” Matthew J. Beck and David A. Hensher, *Transport Policy*, Vol. 96, pages 76-93, September 2020.

<https://www.sciencedirect.com/science/article/pii/S0967070X20304200?via%3DiHub>

From the abstract:

The paper reports the findings from the first phase of an ongoing survey designed to identify the changing patterns in travel activity of Australian residents as a result of the stage 2 restrictions imposed by the Australian government. ... With some employers encouraging working from home and others requiring it, in addition to job losses, and many children attending school online from home, the implications on travel activity [are] extreme. The authors identify the initial impacts associated with the first month of stricter social distancing measures introduced in Australia.

Section 4.5 of the article addresses motor vehicle and road use (from page 91 of the article, page 16 of the PDF):

Overall, car use is down by over a third (35%) and for the majority of respondents who were able to decrease car use, that reduction is even larger at 60% less than before COVID-19. The benefits of that reduction include improved air quality and visibility in our capital cities, and in less congestion on the roads for those essential workers who need to travel. However, our analysis indicates that it is likely that as COVID-19 restrictions ease, the car will return in a dominant way and could cause congestion at levels not seen prior to the outbreak should sensible measures not be introduced. ... Maintaining flexibility with respect to working from home and work starting and finishing times will be as important for road congestion as [f]or public transport crowding, so transport authorities should be encouraged to lobby government and business to ensure that support for these working arrangements are in place for at least as long as restrictions stand. Innovative thinking may also need to occur[;] perhaps bus lanes might be given over to mixed traffic for the duration of the pandemic to facilitate traffic flow.

The study authors conclude that future research could consider an ongoing reduction in car use to continue improved traffic congestion, air pollution and health (from page 92 of the article, page 17 of the PDF):

Should demand for private car travel return in a significant way, it may also be worthwhile to accelerate the adoption of electric vehicles as a means of reducing tail-pipe pollution. It will be interesting to see if the COVID-19 disruption has any impact on potential growth of alternatively fuelled vehicles.

Germany

“Working From Home: Modeling the Impact of Telework on Transportation and Land Use,” Rolf Moeckel, *Transportation Research Procedia*, Vol. 26, pages 207-214, 2017.

<https://www.sciencedirect.com/science/article/pii/S2352146517308803>

Researchers suggest that teleworking is “a two-sided sword,” as work trips may be eliminated, particularly during peak hours, but some teleworkers may compensate by making additional

other trips, such as to a grocery store that is farther away or by finding housing in more remote areas, which makes teleworkers “more car-dependent.” *From the abstract:*

The research presented in this paper proposes a modelling concept to microscopically simulate the decision to telework, the resulting travel demand for work and non-work trips, and household relocation. By explicitly representing a travel time budget for every household, the tendency to add non-work trips is modelled endogenously for teleworkers. A model for household relocation explicitly accounts for the travel time to work, and this constraint is loosened proportionally to the number days of telework per week.

Netherlands

“How COVID-19 and the Dutch ‘Intelligent Lockdown’ Change Activities, Work and Travel Behaviour: Evidence From Longitudinal Data in the Netherlands,” Mathijs de Haas, Roel Faber and Marije Hamersma, *Transportation Research Interdisciplinary Perspectives*, Vol. 6, July 2020.

<https://doi.org/10.1016/j.trip.2020.100150>

From the abstract: This paper presents first insights in current and potential future effects of the virus and the Dutch government’s ‘intelligent lockdown’ on people’s activities and travel behaviour. Findings are based on a representative sample of about 2,500 respondents from the Netherlands Mobility Panel (MPN). The authors show that approximately 80% of people reduced their activities outdoors, with a stronger decrease for older people. 44% of workers started or increased the amount of hours working from home and 30% have more remote meetings. Most of these workers report positive experiences. Students and school pupils, however, are mostly not happy with following education from home. Furthermore, the amount of trips and distance travelled dropped by 55% and 68%[,] respectively[,] when compared to the fall of 2019. So-called “roundtrips” (e.g.[,] a walking or cycling tour) gained in popularity. People are currently more positive towards the car and far more negative towards public transport. Changes in outdoor activities seem to be temporal, with over 90% of people who currently reduced their outdoor activities not expecting to continue this behaviour in the future after [the coronavirus]. However, 27% of home-workers expect to work from home more often in the future. In addition, 20% of people expect to cycle and walk more and 20% expect to fly less in the future. These findings show that the coronavirus crisis might result in structural behavioural changes, although future longitudinal analyses are needed to observe these possible structural effects.

Related Research and Resources

“Changes in U.S. Air Pollution During the COVID-19 Pandemic,” Jesse D. Berman and Keita Ebisu, *Science of the Total Environment*, Vol. 739, October 2020.

Citation at

<https://www.sciencedirect.com/science/article/pii/S0048969720333842?via%3Dihub#!>

From the abstract:

We assessed air quality during the COVID-19 pandemic for fine particulate matter (PM_{2.5}) and nitrogen dioxide (NO₂) in the continental United States from January 8th–April 21st in 2017–2020. We considered pollution during the COVID-19 period (March 13[th]–April 21st) and the pre-COVID-19 period (January 8th–March 12th) with 2020 representing current data and 2017–2019 representing historical data. County-level pollution concentrations were compared between historical versus current periods, and counties were stratified by institution of early or late non-essential business closures.

Highlights from this article follow:

- NO₂ declined 25.5% (with absolute decrease of 4.8 ppb) during the current COVID-19 period compared to historical data.
- PM_{2.5} also decreased in urban counties and counties from states instituting early nonessential business closures during the COVID-19 period.
- Regulatory networks confirm air pollution declines from COVID-19.

“Does Telecommuting Save Energy? A Critical Review of Quantitative Studies and Their Research Methods,” William O’Brien and Fereshteh Yazdani Aliabadi, *Energy and Buildings*, Vol. 225, October 2020.

<https://www.sciencedirect.com/science/article/pii/S0378778820317710?via%3Dihub>

Assessing the impacts of teleworking versus commuting is complex, according to researchers, especially when rebound effects such as home office energy use, the internet and long-term consumer choices are considered. *From the abstract:*

Few studies have quantified home, office, transportation, and communications energy or GHG emissions implications of telecommuting simultaneously. To make progress in answering the question of whether telecommuting results in less energy use and [GHG] emissions than conventional centralized office working, this paper reviews results and research methods of primarily quantitative studies of any and all four domains that consider operating energy and/or [GHG] emissions. The results ultimately show that this problem is complex, and that current datasets and methods are generally inadequate for fully answering the research question. While most studies indicate some benefit, several suggest teleworking increases energy use—even for the domain that is thought to benefit most: transportation.

Section 2.1 (beginning on page 4 of the article) assesses the environmental impacts of teleworking on transportation, noting that despite “reduced travel from teleworking, numerous rebound effects with varying degrees of impact have been established.”

“VMT Could Drop By 10% in Post-COVID World,” Saumya Jain, State Smart Transportation Initiative, July 30, 2020.

<https://ssti.us/2020/07/30/vmt-could-drop-by-10-percent-in-post-covid-world/>

From the blog post: Since the COVID-19 lockdown began, we’ve witnessed a substantial decline in vehicle-miles traveled (VMT). A similar dip during the 2008-[20]09 recession persisted for several years, and this one may do the same. A new report from the KPMG group suggests that we can expect up to a 9.2[%] long-term reduction in annual VMT. The report bases these estimates on the continued interest in teleworking, by both employers and employees, and an increased overall reliance on e-commerce.

The paper looked at two of the main household VMT generators—commuting and shopping. Using data from StreetLight and estimates from various employee and employer preference surveys, the KPMG paper estimates that 10[%] to 20[%] of the U.S. workforce could permanently switch to remote working. Looking at historic e-commerce trends and recent changes due to the pandemic, the paper estimates that shopping trips could decline by 10[%] to 30[%]. In addition to cutting VMT, this combined reduction could translate into a 2.5[%] to 5[%] drop in car ownership, KPMG estimated.

These estimates paint a promising picture, but it is crucial to have strategic policies that support and promote this positive change. A shift from public transportation to private vehicles, lower gas prices and an increase in home deliveries are all factors that might offset the impact of

reduced commuting and shopping trips. VMT reduction strategies could help ensure we witness this change and that it stays long term.

Related Resource:

Automotive's New Reality: Fewer Trips, Fewer Miles, Fewer Cars?, Gary Siberg, Bala Lakshman, Tom Mayor, Yoshi Suganuma, Jono Anderson, Todd Dubner and Nehal Doishi, KPMG LLP, 2020.

<https://advisory.kpmg.us/content/dam/advisory/en/pdfs/2020/automotives-new-reality.pdf>

Findings in this report (mentioned in the previous citation) suggest a long-term reduction in annual VMT. *From the introduction:*

In the following analysis, we show how we estimated that VMT could fall by more than 9[%], or about 270 billion miles per year, based on changes in commuting and shopping. That's about 100 million trips from New York to California. To be sure, a number of variables could mitigate this outcome: commuters shifting from public transportation to private cars; lower gas prices encouraging long trips; population migration from cities to suburbs where driving is more of a necessity.

"COVID Pandemic-19 Shows Telecommuting Can Help Fight Climate Change," Ainslie Cruickshank, *Scientific American*, July 22, 2020.

<https://www.scientificamerican.com/article/covid-19-pandemic-shows-telecommuting-can-help-fight-climate-change/>

From the article: A May survey of 2,500 Americans found that 42[%] were teleworking full-time—one of many dramatic changes wrought by the novel coronavirus. Though experts studying the pandemic's economic and environmental consequences are clear that there is no silver lining to a disease that has killed more than half a million people and upended the lives of millions of others around the world, some believe the resulting lockdowns may offer lessons to apply to another, slower-moving crisis.

If remote work, for example, remains a permanent fixture for more people in a post-COVID-19 world, it could help put a dent in one of the U.S.'s largest sources of planet-warming emissions. "Transportation is a huge contributor to greenhouse gas emissions, as well as other [regulated air] pollutants, so anything we can do to reduce such emissions is good for all of us," says Patricia Mokhtarian, an engineer at the Georgia Institute of Technology, who studies travel behavior and telecommuting. [Note: "Transportation" includes "automobiles and other on-road vehicles, trains, seagoing vessels and aircraft."]

But the extent of the emissions reductions that can be gained from remote work in any particular city depends on a number of factors, from whether most commuters drive cars or take public transit to what electricity sources the city uses. The inadvertent teleworking experiment in response to COVID-19 has offered a unique look at these trade-offs, which can otherwise be hard to separate from other things that affect emissions.

....

It could take months of digging through detailed data from this forced experiment in remote work to get a clearer picture of its potential to reduce transportation-generated greenhouse gas emissions. Researchers would also have to collect information on how far people commute, how many jobs can reasonably be done from home full-time, whether downtown office towers will still draw pre-COVID-19 levels of electricity, and how energy demand and sources change by season and time of day. Broadly speaking, though, Samaras says, telework could "play a big role, because transportation is now the largest source of U.S. greenhouse gas emissions—and it's growing" at the same time the electricity sector is "getting cleaner."

“Does Telecommuting Promote Sustainable Travel and Physical Activity?” Sandip Chakrabarti, *Journal of Transport and Health*, Vol. 9, pages 19-33, June 2018.

Citation at <https://trid.trb.org/view/1515967>

From the abstract: Researchers have explored the efficacy of telecommuting as a travel demand management strategy in the U.S. Conditions under which telecommuting can reduce VMT (vehicle miles traveled) and ease peak-period traffic congestion have been extensively investigated; empirical findings are well documented in the literature. Analysis of the impact of telecommuting on non-motorized travel, public transit use and physical activity, however, has received relatively less attention in the past. In this paper, the author uses the 2009 U.S. National Household Travel Survey to explore how telecommuting is associated with usual travel behavior, i.e.[,] walking/bicycling, transit use and driving, as well as with average time spent in daily physical activity. The author also compares telecommuters' travel behavior and physical activity on a typical workday in telecommuting vs. non-telecommuting scenarios. The study showed that frequent telecommuting (4+ times/month) is associated with 15% more walk trips per week, 56% higher odds of 1+ transit trip per month, 44% higher odds of 30+ minutes of physical activity per day, and 27% higher odds of driving 20,000+ miles per year compared to no-telecommuting scenario. On a typical workday, telecommuting is associated with 41% higher odds of walking/bicycling > 1 mile, 71% higher odds of 30+ minutes of physical activity, 71% lower odds of riding transit, and 3.58 times greater odds of driving < 10 miles. Findings suggest that telecommuting can increase non-motorized travel and physical activity in the presence of latent demand for active living. Increase in transit ridership and reduction in VMT are not automatic. Planning and policy implications are discussed.

“Investigation of Commute Departure Time to Understand the Impacts of Part-Day Telecommuting on the Temporal Displacement of Commute Travel,” Hamidreza Asgari and Xia Jin, *World Conference on Transport Research*, July 2016.

Citation at

https://www.researchgate.net/publication/294581960_Investigation_of_Commute_Departure_Time_to_Understand_the_Impacts_of_Part-Day_Telecommuting_on_the_Temporal_Displacement_of_Commute_Travel

From the abstract: The primary objective of this research is to investigate the impacts of part-day telecommute arrangements on commute departure time. Part-day telecommuting occurs when the worker telecommutes while also travel[ing] to the workplace. In this case, telecommuting does not replace commut[ing], but the workers may alter their commute departure times in order to avoid peak hour congestions. This paper intends to add empirical evidence on whether and to what extent telecommuting may lead to the temporal displacement of commute [travel] and the actual outcomes on the network. With an interest on the departure time for commute trips, three different hazard models are developed, respectively for full-day commuters (no telecommuting episode), regular telecommuters (who telecommute on a regular basis) and non-regular telecommuters (who telecommute occasionally). Different socio-economic, demographic and job-related attributes are used as independent variables in the model. Data were obtained from the 2010-2011 Regional Household [T]ravel Survey (RHTS) conducted in the New York [m]etropolitan region. This study adds to the literature by shedding light on the impacts of telecommuting on peak hour congestion relief and the underlying factors.

“Toward a Comprehensive Telecommuting Analysis Framework: Setting the Conceptual Outline,” Hamidreza Asgari and Xia Jin, *Transportation Research Record 2496*, pages 1-9, 2015.

Citation at <https://trid.trb.org/view/1336580>

From the abstract: The interest in telecommuting has been continuous and growing because of its promising potential for reducing travel and improving air quality. Several research efforts

have been accomplished in telecommuting estimation and impact analysis of reductions in vehicle miles traveled as a result of telecommuting. Although there is an extensive body of literature, most previous studies concentrated on the estimation of telecommuting in terms of choice (whether to telecommute) and frequency (how often on a weekly or monthly basis). These studies failed to recognize that there were various forms of daily telecommuting that would have had different impacts on daily activity patterns. This study aims to provide a comprehensive framework for telecommuting behavior and impact analysis. There are several important features of the framework that are intended to fill the knowledge gaps in the field. First, the study provides an algorithm to identify major forms of telecommuting activities (e.g., full time, part time). Second, the study incorporates choice and frequency as lifestyle choice and extends the effort to a daily framework. These study features enable the estimation of the interactions between telecommuting engagement and other daily activities and facilitate an impact analysis on vehicle miles traveled, congestion reduction and so forth. Third, the study proposes appropriate modeling structures capable of dealing with various engagement forms and the interactions with other activities. This study represents a major enhancement in telecommuting analysis in quantifying the effects of telecommuting on traffic outcomes.

Impacts of Telework Policies on the Workforce

The domestic and international resources below illustrate the effects of teleworking on employees. Topics explored include sectors of the economy that are most likely to offer or encourage teleworking; workers' capability to telework, such as technology demands and other limitations; and the differential impacts of teleworking to disadvantaged communities, rural communities and communities of color.

Business Sectors That Offer or Encourage Telework

National Research and Resources

Telework.gov, undated.

<https://www.telework.gov/about/>

As the official web site of the federal government's telework program, this online resource provides access to a range of information about telework, "an important tool for achieving a resilient and results-oriented workforce." Links to telework legislation are available at the site along with guidance for telework program development, fundamentals training for employees and managers, and performance measurement.

Related Resource:

Status of Telework in the Federal Government: Report to Congress Fiscal Year 2018, U.S. Office of Personnel Management, March 2020.

<https://www.telework.gov/reports-studies/reports-to-congress/2019-report-to-congress.pdf>

From the executive summary:

Since Congress passed the Telework Enhancement Act in 2010, Federal agencies have made remarkable progress in developing and utilizing telework programs to help achieve mission objectives. The Telework Enhancement Act mandated that OPM [Office of Personnel Management] provide an annual report to Congress addressing the telework programs of each [e]xecutive agency (5 U.S.C. § 6506). The current report fulfills OPM's reporting requirements for fiscal year 2018 and provides information on telework trends over a multi-year period, including 2012-2018.

Below are some of the key findings from the report:

- Telework eligibility remains steady. Approximately 42% of federal employees were eligible to telework in 2018 (one percentage point lower than in 2017).
- Telework participation has stabilized. Telework participation increased from 21% to 22% of all employees and from 49% to 51% of eligible employees during fiscal years 2017 to 2018, which was similar to fiscal year 2016 percentages.
- Agencies maintain progress in setting and achieving telework goals. Overall, 76% of agencies met at least one of their participation goals (total, frequent, infrequent or situational participation).
- Assessment of cost savings achieved through telework continues to improve. Among federal agencies, 36% tracked some form of cost savings related to telework—a seven-point increase from fiscal year 2017.
- Agency management continues to leverage telework in support of mission goals. Promoting telework continues at the leadership level as a strategic management tool.

Related Research and Resources

Latest Work-At-Home/Telecommuting/Mobile Work/Remote Work Statistics, Global Workplace Analytics, undated.

<https://globalworkplaceanalytics.com/telecommuting-statistics>

This web page provides statistics on the work-at-home/telework population using data from the 2005-2018 American Community Survey (ACS). A pie chart illustrates the percentage of teleworkers by industry sector based on 2016 ACS data; information is reproduced in Table 1 below. A March 2020 update provides access to information about the impact of COVID-19 on teleworking.

Table 1. Percentage of Teleworkers by Industry

Industry Sector	Percentage of Teleworkers
Accommodation and Food Services	2%
Administrative and Support, Waste Management and Remediation Services	6%
Agriculture, Forestry, Fishing and Hunting	6%
Arts, Entertainment and Recreation	3%
Construction	3%
Educational Services	3%
Finance and Insurance	9%
Health Care and Social Assistance	4%

Industry Sector	Percentage of Teleworkers
Information	10%
Management of Companies and Enterprises	5%
Manufacturing	3%
Mining, Quarrying, and Oil and Gas Extraction	2%
Other Services (Except Public Administration)	5%
Professional, Scientific and Technical Services	12%
Public Administration	4%
Real Estate, Rental and Leasing	8%
Retail Trade	3%
Transportation and Warehousing	3%
Utilities	3%
Wholesale Trade	7%

Source: 2016 ACS data, Global Workplace Analytics.

“Ability to Work From Home: Evidence From Two Surveys and Implications for the Labor Market in the COVID-19 Pandemic,” Matthew Dey, Harley Frazis, Mark Lowenstein and Hugette Sun, *Monthly Labor Review*, U.S. Bureau of Labor Statistics, June 2020.

<https://www.bls.gov/opub/mlr/2020/article/ability-to-work-from-home.htm>

From the article:

Teleworking is also less feasible in part-time jobs and in jobs found in nonmetropolitan areas. Working at home is generally feasible in management, professional and administrative support jobs, but not in most service, construction, transportation and production jobs. Similarly, while telework feasibility is high in the information, financial activities, professional and business services, and public administration industries, it is low in the leisure and hospitality, agriculture and construction industries.

Telework statistics are presented for a range of characteristics collected from the American Time Use Survey (ATUS) and the National Longitudinal Survey of Youth 1979 (NLSY79), including occupations and industries, which are excerpted in Tables 2 and 3 below.

Table 2. Telework Statistics by Industry

Industry	ATUS Ability to Telework Rate	NLSY79 Ability to Telework Rate
Agriculture, Forestry, Fishing and Hunting	8.3%	16.0%
Construction	17.3%	21.8%
Education and Health Services	48.9%	49.7%
Financial Activities	77.9%	75.3%
Information	71.2%	77.3%
Leisure and Hospitality	13.0%	20.5%

Industry	ATUS Ability to Telework Rate	NLSY79 Ability to Telework Rate
Manufacturing	36.4%	36.6%
Mining, Quarrying, and Oil and Gas Extraction	55.9%	15.0%
Other Services	31.0%	55.5%
Professional and Business Services	69.9%	68.5%
Public Administration	65.2%	54.9%
Industry Missing	—	50.2%

Source: *Monthly Labor Review*, June 2020.

Table 3. Telework Statistics by Occupation

Occupation	ATUS Ability to Telework Rate	NLSY79 Ability to Telework Rate
Construction and Extraction Occupations	0.0%	0.0%
Farming, Fishing and Forestry Occupations	0.0%	0.0%
Installation, Maintenance and Repair Occupations	1.0%	3.9%
Management, Business and Financial Occupations	86.6%	86.5%
Office and Administrative Support Occupations	59.2%	61.5%
Production Occupations	0.4%	3.9%
Professional and Related Occupations	64.4%	64.3%
Sales and Related Occupations	31.9%	30.1%
Service Occupations	7.9%	13.4%
Transportation and Material Moving Occupations	0.3%	1.3%

Source: *Monthly Labor Review*, June 2020.

Related Resources:

COVID-19 and Remote Work: An Early Look at U.S. Data, Erik Brynjolfsson, John J. Horton, Adam Ozimek, Daniel Rock, Garima Sharma and Hong-Yi TuYe, National Bureau of Economic Research, June 2020.

<https://www.nber.org/papers/w27344>

From the abstract: We report the results of a nationally-representative sample of the U.S. population during the COVID-19 pandemic. The survey ran in two waves from April 1-5, 2020[,] and May 2-8, 2020. Of those employed pre-COVID-19, we find that about half are now working from home, including 35.2% who report they were commuting and recently switched to working from home. In addition, 10.1% report being laid-off or furloughed since the start of COVID-19. There is a strong negative relationship between the fraction in a state still commuting to work and the fraction working from home. We find that the share of people switching to remote work can be predicted by the incidence of COVID-19 and that younger people were more likely to switch to remote work. Furthermore, states with a higher share of employment in information work including management, professional and related occupations were more likely to shift toward working from home and had fewer people laid

off or furloughed. We find no substantial change in results between the two waves, suggesting that most changes to remote work manifested by early April.

How Many Jobs Can be Done at Home?, Jonathan Dingel and Brent Neiman, Becker Friedman Institute, University of Chicago, June 2020.

https://bfi.uchicago.edu/wp-content/uploads/BFI_White-Paper_Dingel_Neiman_3.2020.pdf

From the abstract:

Evaluating the economic impact of “social distancing” measures taken to arrest the spread of COVID-19 raises a fundamental question about the modern economy: [H]ow many jobs can be performed at home? We classify the feasibility of working at home for all occupations and merge this classification with occupational employment counts. We find that 37[%] of jobs in the United States can be performed entirely at home, with significant variation across cities and industries. These jobs typically pay more than jobs that cannot be done at home and account for 46[%] of all U.S. wages.

The share of jobs that can be done at home are presented by industry and by occupation using surveys from the Occupational Information Network (O*NET) and employment counts from the Bureau of Labor Statistics’ 2018 Occupational Employment Statistics. Information is excerpted in Tables 4 and 5 below.

Table 4. Share of Jobs That Can Be Done at Home by Industry

Industry	Share of Jobs
Accommodation and Food Services	0.04
Administrative and Support, Waste Management and Remediation Services	0.31
Agriculture, Forestry, Fishing and Hunting	0.08
Arts, Entertainment and Recreation	0.30
Construction	0.19
Educational Services	0.83
Finance and Insurance	0.76
Government: Federal, State and Local	0.41
Health Care and Social Assistance	0.25
Information	0.72
Management of Companies and Enterprises	0.79
Manufacturing	0.22
Mining, Quarrying, and Oil and Gas Extraction	0.25
Other Services (Except Public Administration)	0.31
Professional, Scientific and Technical Services	0.80
Real Estate, Rental and Leasing	0.42
Retail Trade	0.14
Transportation and Warehousing	0.19
Utilities	0.37
Wholesale Trade	0.52

Source: Friedman Institute, University of Chicago, June 2020.

Table 5. Share of Jobs That Can Be Done at Home by Occupation

Occupation	O*NET Derived Baseline
Architecture and Engineering Occupations	0.61
Arts, Design, Entertainment, Sports and Media Occupations	0.76
Building and Grounds Cleaning and Maintenance Occupations	0.00
Business and Financial Operations Occupations	0.88
Community and Social Service Occupations	0.37
Computer and Mathematical Occupations	1.00
Construction and Extraction Occupations	0.00
Education, Training and Library Occupations	0.98
Farming, Fishing and Forestry Occupations	0.01
Food Preparation and Serving Related Occupations	0.00
Healthcare Practitioners and Technical Occupations	0.05
Healthcare Support Occupations	0.02
Installation, Maintenance and Repair Occupations	0.01
Legal Occupations	0.97
Life, Physical and Social Science Occupations	0.54
Management Occupations	0.87
Office and Administrative Support Occupations	0.65
Personal Care and Service Occupations	0.26
Production Occupations	0.01
Protective Service Occupations	0.06
Sales and Related Occupations	0.28
Transportation and Material Moving Occupations	0.03

Source: Friedman Institute, University of Chicago, June 2020.

“Top 100 Companies With Remote Jobs in 2020,” Rachel Jay, FlexJobs, January 12, 2020.

<https://www.flexjobs.com/blog/post/100-top-companies-with-remote-jobs-2020/>

FlexJobs annually publishes a list of the top 100 companies that list remote jobs with their firm.

The 2020 list is included in the article. *From the article:*

Healthcare and computer/IT [information technology] continue to be the most promising career fields for remote-friendly jobs, while the education industry has also enjoyed sustained growth in its remote job opportunities. Sales and customer service remain strong prospects for remote jobs, with virtual assistants, in particular, seeing higher demand. Remote work is also being more widely adopted across the fields of business, accounting and finance.

Seven fast-growing remote career categories are art and creative, bookkeeping, internet and ecommerce, K-12, graphic design, translation, and math and economics. While a wide

variety of jobs can be done from home, some of the most popular remote job titles include accountant, customer service representative, nurse, project manager, recruiter, teacher, web developer and writer.

The “GO-Virtual Initiative”: Using Flexible Workplace Practices to Reduce Traffic Congestion, Increase Economic Development and Provide More Access to Affordable Housing Choices in the South Bay Region of Los Angeles County, Fynnwin Prager, Mohja Rhoads, Jose N. Martinez, Chris Cagle, Aaron Baum and Jacki Bacharach, Mineta Transportation Institute, August 2019.

https://transweb.sjsu.edu/sites/default/files/1860-Prager-Flexible-Workplaces-South-Bay_0.pdf

From the abstract: Flexible workplace practices (FWPs) such as telework, flexible scheduling, and the use of co-working spaces have the potential to address problems of congestion, pollution and lack of housing affordability in the South Bay region of Los Angeles County. However, trends in the adoption of FWPs—especially of working from home—across the region do not appear to be increasing as much as expected, despite advances in technology, changing worker demands, and evolving workplace cultures. In the South Bay and Los Angeles, commute times and the proportion of residents driving alone to work have increased as the economy has grown. As alternatives to driving alone to work, employees appear to face the choices of using public transit if more accessible, or carpooling if the journey is longer; however, both of these modes of transportation have declined in usage in recent years. Instead, the only alternative to driving alone that has increased in frequency in the South Bay and Los Angeles County in recent years is working from home, which is most likely concentrated among residents in locations with higher education levels or occupations that are more appropriate. Prior literature has provided numerous insights here, finding that conditions are region-specific, and that occupational and industry constraints combine with manager resistance and employee concerns over work-life balance to limit the expansion of FWP. The authors of this study contribute to the literature by focusing on the obstacles to expansion of FWP among South Bay organizations, as well as by comparing the projected impacts of potential government interventions in this space. The authors explore these issues with methods innovative to the field, including a combination of surveys and expert elicitation focus groups that includes numerous types of FWP, especially the inclusion of co-working spaces as a strategy. Participants in the survey and focus groups perceived the major obstacles to expansion to be a combination of managerial and executive resistance, alongside occupational constraints. Participants perceived government subsidies and incentives as both having a good combination of costs and impacts, possibly to be used to encourage the use of private co-working spaces, which offer a market solution that balances the benefits of traditional at-home telework and collaborative workplaces. That said, telework remains a cost-effective approach to reducing commute-related emissions, and hence more aggressive programs, such as telework facilities exchanges, expansion of South Coast Air Quality Management District mandates, and incentives for workforce training and program implementation may be needed to achieve broader climate action and local pollution targets.

Technology Demands and Limitations

National Research and Resources

Federal Telework: Additional Controls Could Strengthen Telework Program Compliance and Data Reporting, U.S. Government Accountability Office, February 2017.

<https://www.gao.gov/assets/690/682916.pdf>

From the conclusions:

Telework is an important tool agencies can use to realize benefits for both themselves and their employees. As technology and the nature of work in the federal government evolve, incorporating telework into agency operations and expanding telework participation could help agencies continue normal operations during adverse weather or other [continuity of operations] events, as well as attract and retain employees. But to have a telework program that can achieve these benefits and comply with the [Telework Enhancement Act of 2010's] requirements, the four case study agencies we reviewed must ensure that their telework policies, procedures and other controls are implemented appropriately, and that the technology needed for employees to telework functions as it should. Documenting that those responsible for implementing agency telework policy are trained before doing so and reviewing telework agreements regularly can help these agencies ensure that they are applying their telework policies consistently, and improve telework data accuracy. Identifying pain points for teleworkers can also help agencies prioritize ways to improve and [invest] in their programs.

Because telework data are used across the government, such as by Congress for oversight, and by agencies for decision-making purposes, the four agencies [Department of Education, General Services Administration (GSA), Department of Labor, and the Securities and Exchange Commission (SEC)] and [the Office of Personnel Management (OPM)] need to ensure that the data they report accurately reflect the status of telework at federal agencies. Reporting and using data that either do not comply with the act or are known to be of questionable quality compromises these agencies' abilities to effectively manage their telework programs, and limits the usefulness of OPM's annual reports to Congress. OPM's plans to use data in [Employee Human Resources Integration (EHRI)] and a shorter data call instrument could improve telework data accuracy. However, OPM and agencies must also take steps to help ensure that these annual reports include only accurate data or clearly explain why this is not possible.

Managerial resistance and technology challenges are barriers to telework participation, according to the report (beginning on page 19 of the report, page 23 of the PDF):

All four of our case study agencies described agencywide activities demonstrating the senior leadership's efforts to design and implement a successful telework program. However, in our focus groups with teleworkers and supervisors we heard a range of examples of how supervisors or managers discourage or support agency telework programs. ... Officials at three of our four case study agencies and two focus groups with teleworkers and supervisors reported that some managers do not support telework because they believe it contributes to poorer performance, as compared to the performance of in-office employees.

....

We heard at [10] of our [11] focus groups with supervisors and teleworkers that teleworkers have experienced challenges accessing needed equipment and applications. Sometimes this limits the type of work that could be done while teleworking. Seven of these focus groups discussed how network connectivity or access was a challenge, including having to repeatedly log on to the agency network after being disconnected and spending time getting

assistance from their respective agencies' IT help desks. One focus group with supervisors reported that when IT challenges arose, supervisors may have to cover teleworking employees' daily tasks while the employee resolved the IT issues. We also heard at some of the focus groups that teleworkers and supervisors discussed what resources and tools the teleworker would need to perform work activities while teleworking, and how to address any telework technology-related problems.

Case study agency officials described a number of actions to address telework technology challenges. For example, these agencies provide dedicated help desk support to teleworkers; provide equipment, including webcams, to teleworkers; and have upgraded IT systems to support telework. GSA officials said they focus IT investments on mobile strategies that allow employees to work from anywhere. Labor officials said they have upgraded IT to expand the number of programs supported remotely. SEC officials said they provide employees who telework [three] days a week or more with laptops, monitors and printers to use in their telework location. SEC officials also said that in 2015, they introduced new tools, including phones with integrated cameras and upgraded videoconference equipment, which have helped enable more collaboration, among both teleworkers and employees across their 11 field offices. We heard at all seven focus groups with teleworkers that teleworkers do not always have access to, or were not aware of, the IT tools available to teleworkers.

Related Research and Resources

“NIH’s Cloud Enabled Shifts to How Researchers Work During Pandemic,” Faith Ryan, *GovernmentCIO Magazine*, July 20, 2020.

<https://governmentciomedia.com/nihs-cloud-enabled-shifts-how-researchers-work-during-pandemic>

From the article: The National Institutes of Health [NIH] has an important role in the coronavirus pandemic as it leads vaccine efforts and continues to be the world’s largest funder of biomedical research. As the agency transitioned to a near-100% teleworking environment and postponed non-mission-critical laboratory operations, it has had to overcome challenges in equipping researchers with secure access to data and tools to continue agency missions.

“The NIH has a fantastic backbone. We’ve got great networking. But [researchers] want to access terabytes at a time, and you can’t do that from home very easily,” said Eric Gallagher, CIO [chief information officer] of NIH’s National Center for Complementary and Integrative [Health].

....

Researchers have turned to digital services and are considering cloud-computing capabilities to facilitate sharing large amounts of data. “Many of those are looking to make the move to cloud for their research purposes—to get the benefits of scale, collaboration, the ability to store and analyze data in ways that they couldn’t with the tools cloud service providers have to offer,” [NIH’s Cloud Services for Research Program Manager Nick] Weber said.

....

“Many of those are looking to make the move to cloud for their research purposes—to get the benefits of scale, collaboration, the ability to store and analyze data in ways that they couldn’t with the tools cloud service providers have to offer,” Weber said. Not only are researchers looking to cloud for interoperable systems and advanced data analytics, but they’re also looking at it to share and present in a remote environment. ... Supporting employee participation and collaboration with video services has also meant rethinking equipment and infrastructure security, removing barriers to successful remote work.

....

“From an information security perspective, I think it’s really been helpful because we’ve been able to take a closer look at [w]hat risks are we taking on by using these collaboration tools or these infrastructure components to support our research? And I think that’s really opened the door to have that be the path of the future,” Weber said.

....

“You want to plan for the robustness of your infrastructure. Every element of it ... it is about the people. They have to feel that their IT is dependable,” Gallagher said, emphasizing the need to ensure the agency’s resiliency and success to such quick pivots through enhanced technology preparedness.

“IT Support Services for Telecommuting Workforce,” Tuncay Bayrak, *Telematics and Informatics*, Vol. 29, Issue 3, pages 286-293, August 2012.

Citation at <https://www.sciencedirect.com/science/article/abs/pii/S0736585311000682>

From the abstract: The purpose of this study is to describe how telecommuting and a telecommuter differ from in situ working and the desk-bound worker and how this difference dictates different approaches to providing various services such as IT support services for telecommuters. Our goal is to provide a framework to assist IT managers in addressing issues of how to support telecommuting employees to maximize their potential benefits.

Differential Impacts of Teleworking

Domestic Research and Resources

California

New Frames for Remote Work in Government Agencies: Report to the California State Controller’s Office, Diane T. Chin, Katya Abelsky, Aryn Frazier, A.D. Lewis, Axel Hufford, Leah Kennedy, Richard Sun, Tian Xie and Jerry Yan, Stanford Law School, June 2020.

[https://law.stanford.edu/wp-content/uploads/2020/07/Remote Work in Government Agencies - FINAL S20.pdf](https://law.stanford.edu/wp-content/uploads/2020/07/Remote-Work-in-Government-Agencies-FINAL-S20.pdf)

From the project summary:

Working with the California State Controller’s Office [SCO’s], Stanford Law students developed research goals and a plan to identify best practices for remote work by government employees to ensure that critical government functions continue during a variety of disasters and emergencies. Students were also asked to identify equity frameworks and develop equity analyses that would allow the SCO to evaluate and implement the most effective telework policies.

In this study, researchers defined “an equity approach” as “one that ensures each person gets what they need to survive or succeed—access to opportunity, networks, resources and supports—based on their current position and their desired outcome. We distinguish equity from equality, diversity and inclusion.” Discussion of the equity framework and analysis, which begins on page 32 of the report (page 34 of the PDF) examines racial, gender, disability and LGBTQ+ justice.

How Working From Home Works Out, Nicholas Bloom, Policy Brief, Stanford Institute for Economic Policy Research, June 2020.

<https://siepr.stanford.edu/research/publications/how-working-home-works-out>

This article discusses inequity issues associated with telework. Key takeaways:

- Currently 42% of U.S. workers are working from home full time, accounting for more than two-thirds of economic activity.
- Policymakers should ensure that broadband service is expanded so more workers can do their jobs away from a traditional office.
- As companies consider relocating from densely populated urban centers in the wake of the COVID-19 crisis, cities may suffer while suburbs and rural areas benefit.
- Working from home is here to stay, but post-pandemic will be optimal at about two days a week.

Only 51% of workers surveyed were able to work efficiently from home; these workers tended to be managers, professionals and financial workers. The remaining respondents—those in retail, health care, transportation and business services—must work in a traditional workplace. Many respondents lacked the facilities to effectively work from home, including internet connectivity. Finally, teleworking is more suited to employees who are more educated and earn higher incomes.

The author recommended that working from home:

- Should be a part-time arrangement (work from home about one to three days per week).
- Should be optional.
- Is a privilege, not an entitlement, and requires effective performance management.

Oregon

Who Can't Work From Home During a Global Pandemic?, Brandon Schrader, Oregon Employment Department, July 16, 2020.

<https://www.qualityinfo.org/-/who-can-t-work-from-home-during-a-global-pandemic->

From the conclusion:

As COVID-19 cases continue to climb in Oregon and around the United States, people face an uncertain economic future. If Oregon follows the path of California, New York or several other states, more aggressive social distancing efforts may be reinstated. Of course, public health policy is designed to save lives and has been incredibly successful in other countries. Nevertheless, opportunity costs exist and those costs are distributed disproportionately. It's likely that industries like accommodation and food services or retail trade will be hit hard if those safety measures are necessary. We know that individuals who are Black or Hispanic, earn less and have the least education have the worst access to remote work. For these sectors and workers, social distancing and telecommuting aren't an option. As leaders design policy in response to COVID-19, it's crucial that the 63[%] of workers who can't work from home are protected.

Highlights from the report:

- **Vast gaps exist in remote work between occupations.** More than 50% of Oregon workers “who could potentially telecommute are in the five occupation groups with the best access to telework: computer and mathematical; educational instruction and library; legal; business and financial operations; and management. The presence of these

occupations in different places and industries begins to tell a story of who can and can't work from home.”

- **Industries with the least telework access faced steep job losses.** Before COVID-19, industries that were less likely to offer telework made up 60% of the workforce; this same group “made up 83% of job losses between March and April 2020. Conversely, industries with above average telecommuting access were vastly underrepresented in initial job losses.”
- **Access to telework options is divided by education and race.** “A far greater number of Americans with at least a bachelor’s degree or higher had the option to work from home than any other education category. White Americans had far more remote work flexibility than Black and Hispanic or Latino communities. For education, 52[%] of employees with a bachelor’s degree or higher were able to work from home whereas only 4[%] of those with no high school diploma could telecommute. Even those who had an associate’s degree or some college [education] had poor access to remote work—less than a quarter of workers could telework.”
 - Asian workers had the best telecommuting options (37%) followed by white workers (30%), Black workers (19%), and Hispanic and Latino workers (slightly more than 16%).
 - Although approximately 30% of the workforce comprises Black and Hispanic workers, they are underrepresented in industries with the best access to telecommuting.
 - Less than 30% of the finance, education and information sector workforce is made up of Black and Hispanic workers.
 - Black and Hispanic workers are “overrepresented in some of the hardest hit industries,” such as accommodation and food services or health care and social assistance.

Related Research and Resources

“Before the Coronavirus, Telework Was an Optional Benefit, Mostly for the Affluent Few,”

Drew DeSilver, Fact Tank: New in the Numbers, Pew Research Center, March 20, 2020.

<https://www.pewresearch.org/fact-tank/2020/03/20/before-the-coronavirus-telework-was-an-optional-benefit-mostly-for-the-affluent-few/>

From the article: COVID-19 may yet do what years of [teleworking] advocacy have failed to: Make telework a benefit available to more than a relative handful of U.S. workers. Only 7% of civilian workers in the United States, or roughly 9.8 million of the nation’s approximately 140 million civilian workers, have access to a “flexible workplace” benefit, or telework, according to the 2019 National Compensation Survey (NCS) from the federal Bureau of Labor Statistics. And those workers who have access to it are largely managers, other white-collar professionals and the highly paid. (“Civilian workers” refers to private industry workers and state and local government workers combined.)

“Not Everybody Can Work From Home: Black and Hispanic Workers are Much Less Likely to be Able to Telework,”

Elise Gould and Heidi Shierholz, Working Economics Blog, Economic Policy Institute, March 19, 2020.

<https://www.epi.org/blog/black-and-hispanic-workers-are-much-less-likely-to-be-able-to-work-from-home/>

From the article:

The commonly paired statements that “everyone is working from home” and “everyone is having their goods delivered” amid the coronavirus outbreak ignores a whole segment of the

workforce—the ones prepping and delivering their purchases. In fact, less than 30% of workers can work from home, and the ability to work from home differs enormously by race and ethnicity.

Highlights from the blog post:

- Less than one in five Black workers (19.7%) and roughly one in six Hispanic workers (16.2%) are able to work from home. Asian workers are the most likely to be able to work from home, followed by non-Hispanic and white workers.
- Higher-wage workers are six times as likely to be able to work from home as lower-wage workers.
- Only 8.8% of leisure and hospitality workers are able to telework versus more than 50% of workers in financial activities, professional and businesses services, and information.

“Work–Life Flexibility for Whom? Occupational Status and Work–Life Inequality in Upper, Middle and Lower Level Jobs,” Ellen Ernst Kossek and Brenda Lautsch, *Academy of Management Annals*, Vol. 12, Issue 1, May 2017.

Citation at <https://journals.aom.org/doi/10.5465/annals.2016.0059>

From the abstract: We define work–life flexibility as employment-scheduling practices that are designed to give employees greater control over when, where, how much or how continuously work is done. Research has underexamined how work–life flexibility is stratified across occupations. We review how occupational status and flexibility experiences vary and shape work–life inequality, which we identify as a form of job inequality. We investigate the range of definitions, measurement approaches and theorizing regarding work–life flexibility. We find that employees across occupational groups experience different work–life flexibility outcomes from different flexibility types. Providing employee control over scheduling variation (flextime) may benefit lower level workers the most, yet many are unable to access this flexibility form. Part-time work permitting control over work volume/workload hurts lower level employees the most (because of involuntary income and benefits loss). Yet, these same part-time practices enhance recruitment and retention for upper level jobs but harm promotion and pay. Work continuity control (leaves) benefits upper and middle level employees but is largely unavailable to lower level workers. Flexibility to control work location is rarely available for lower level jobs; but benefits middle and upper level employees, provided that individuals are able to control separation from work when desired and self-regulate complexity. We offer implications for research and practice.

International Research and Resources

“Teleworking is Not Working for the Poor, the Young and the Women,” Mariya Brussevich, Era Dabla-Norris and Salma Khalid, *IMF Blog*, International Monetary Fund, July 7, 2020.

<https://blogs.imf.org/2020/07/07/teleworking-is-not-working-for-the-poor-the-young-and-the-women/>

From the article:

The COVID-19 pandemic is devastating labor markets across the world. Tens of millions of workers lost their jobs, millions more [are] out of the labor force altogether, and many occupations face an uncertain future. Social distancing measures threaten jobs requiring physical presence at the workplace or face-to-face interactions. Those unable to work remotely, unless deemed essential, face a significantly higher risk of reductions in hours or pay, temporary furloughs or permanent layoffs. What types of jobs and workers are most at risk? Not surprisingly, the costs have fallen most heavily on those who are least able to bear them: the poor and the young in the lowest-paid jobs.

In a new paper, we investigate the feasibility to work from home in a large sample of advanced and emerging market economies. We estimate that nearly 100 million workers in 35 advanced and emerging countries (out of 189 IMF members) could be at high risk because they are unable to do their jobs remotely. This is equivalent to 15[%] of their workforce, on average. But there are important differences across countries and workers.

Highlights from the blog post:

- Significant differences arose across countries, even for the same occupations. For example, teleworking is much easier in Norway and Singapore than it is in Turkey, Chile, Mexico, Ecuador and Peru “because more than half the households in most emerging and developing countries don’t even have a computer at home.”
- Teleworking is least likely in the food and accommodation, and wholesale and retail trade sectors, which impacts the young, women and part-time workers and employees of small- and medium-sized companies.
- To protect the most vulnerable:
 - Cushion the impact of affected workers and their families by broadening social insurance and safety nets, including wage subsidies and public works programs.
 - Reduce inequality by strengthening education and training programs to better prepare workers for the jobs of the future.

Related Resource:

Who Will Bear the Brunt of Lockdown Policies? Evidence from Tele-Workability Measures Across Countries, Mariya Brussevich, Era Dabla-Norris and Salma Khalid, IMF Working Paper, International Monetary Fund, June 2020.

Publication available at <https://www.imf.org/en/Publications/WP/Issues/2020/06/12/Who-will-Bear-the-Brunt-of-Lockdown-Policies-Evidence-from-Tele-workability-Measures-Across-49479>

From the abstract: Lockdowns imposed around the world to contain the spread of the COVID-19 pandemic are having a differential impact on economic activity and jobs. This paper presents a new index of the feasibility to work from home to investigate what types of jobs are most at risk. We estimate that over 97.3 million workers, equivalent to about 15[%] of the workforce, are at high risk of layoffs and furlough across the 35 advanced and emerging countries in our sample. Workers least likely to work remotely tend to be young, without a college education, working for non-standard contracts, employed in smaller firms, and those at the bottom of the earnings distribution, suggesting that the pandemic could exacerbate inequality. Cross-country heterogeneity in the ability to work remotely reflects differential access to and use of technology, sectoral mix and labor market selection. Policies should account for demographic and distributional considerations both during the crisis and in its aftermath.

Policies to Incentivize Teleworking

Domestic Research and Resources

National

Enabling a Mobile Workforce—How to Implement Effective Teleworking at U.S. Department of Energy National Laboratories: A Guidebook and Toolkit, U.S. Department of Energy and Oak Ridge National Laboratory, May 2017.

<https://info.ornl.gov/sites/publications/Files/Pub74811.pdf>

From the overview:

Teleworking is deemed a viable option for National Laboratories when work can be performed away from the lab with at least the same level of efficiency and quality as when it is performed at the lab and continues to meet the needs of stakeholders, both internal and external. To help labs achieve this level of viability, best practices for implementing or improving telework programs at National Laboratories that will maximize the above benefits to both employees and employers are presented in this report.

Guidance for developing a telework implementation plan begins on page 3 of the guide (page 13 of the PDF) followed by an employee communication strategy that creates awareness, builds interest and maintains engagement in teleworking (beginning on page 11 of the guide, page 21 of the PDF). Brief summaries of implementation progress at partnering national laboratories are also provided along with a telework toolkit (beginning on page 21 of the guide, page 31 of the PDF).

Telework Insights: A Current Look at Telework in the Federal Government and Promising Practices to Support a 21st Century Workforce, U.S. Office of Personnel Management, undated.

<https://www.opm.gov/policy-data-oversight/worklife/federal-work-life-survey/telework-insights.pdf>

This paper “serves as a current review of telework in the [f]ederal [g]overnment, presenting current issues, insights and implications for practice.” Insights from this paper noted that teleworking:

- Improved employee performance (72%).
- Increased employee retention (76%).
- Improved morale (83%).
- Provided other beneficial outcomes.

Additional research indicates telework as a work-life intervention improves engagement by supporting employees’ ability to manage their professional and personal responsibilities, and high engagement improves organizational performance.

Arizona

Telework, Capitol Rideshare, State of Arizona, undated.

<https://capitolrideshare.az.gov/telework>

From the web page:

Telework is a management option that allows qualified state employees to work from home, or a state office location closer to home, one or more days a week. Properly trained employees and supervisors are equipped to implement a successful telework agreement,

which can increase productivity, improve morale and help recruit and retain high value employees.

The State of Arizona Telework program was first launched as a pilot program in 1990, with a goal of improving air quality by reducing commute-related pollution as required under ARS 49-588 [Arizona Revised Statutes 49-588, Requirements for Major Employers].

Links on this web page provide information about telework requirements, training and employee management.

California

Telework Policy, California Department of Human Resources, updated May 2013.

<https://www.calhr.ca.gov/employees/Pages/telework-policy.aspx>

Information about California Department of Human Resources' model telework plan is provided at this site. *From the web page:*

The California Department of Human Resources (CalHR) encourages the use of teleworking and telecommuting where it's a viable option and clearly defines the benefits to the employee and management. The department recognizes the benefits of such work options for employees when both program and employee personal needs can be addressed. Managers and employees must understand that adherence to the policy and procedures are an essential requirement of the telework program. This page shows CalHR's model telework plan.

Related Resource:

Statewide Telework (Telecommuting), California Department of General Services, undated.

<https://www.dgs.ca.gov/Resources/Telework>

Available at this site are policy, guidelines and other information about the state's telework program.

Telework and Flex-Schedules Toolkit, Office of Sustainability, San Mateo County, undated.

https://www.commute.org/files/programs/SMC_Telework_Toolkit.pdf

From the introduction:

The San Mateo County Transit District (SamTrans) received a Metropolitan Transportation Commission (MTC) Climate Initiatives Grant to pilot implementation of a suite of transportation demand management strategies through the Connect, Redwood City! program. As a partner agency, the [c]ounty received grant funding in 2012 to re-launch its telework and flex-schedules and to develop trainings and a telework toolkit as a resource for other local governments and businesses in the region interested in exploring [a]lternate [w]ork [s]chedules. With 71[%] of commuters in San Mateo County driving alone to work and growing traffic congestion, these resources can help agencies and businesses consider how they might implement [a]lternate [w]ork [s]chedules.

This detailed toolkit includes information and guidance related to teleworking and alternate work schedules. Among the lessons learned was the impact of managerial support. *From page 8 of the guide (page 14 of the PDF):*

Telework programs are often described as low-hanging fruit because they have low financial costs for implementation; however, they can require a high degree of organizational culture change, which can make them hard to implement. Overall, implementing flex-schedules may

be an easier way to decrease employee vehicle miles travelled and associated greenhouse gas emissions due to a greater level of acceptance by managers. Where there is managerial or executive resistance to telework, there may still be an opportunity to maximize the use of flex-schedules. Where there is strong managerial or executive support of telework, telework can flourish.

Topics discussed include:

- Benefits of teleworking (beginning on page 13 of the guide, page 19 of the PDF).
- Launching a telework pilot program (beginning on page 29 of the guide, page 35 of the PDF).
- Technology, equipment and infrastructure considerations (beginning on page 45 of the guide, page 51 of the PDF).
- Case studies (beginning on page 21 of the guide, page 27 of the PDF).
- Training materials (beginning on page 55 of the guide, page 61 of the PDF).
- Sample materials (beginning on page 59 of the guide, page 65 of the PDF).

Other topics briefly addressed include environmental benefits, such as traffic congestion mitigation (page 17 of the guide, page 23 of the PDF), and equity and incentives for nonteleworking staff (page 23 of the guide, page 29 of the PDF).

Florida

State Employee Telework Program, Florida Department of Management Services, undated. https://www.dms.myflorida.com/workforce_operations/human_resource_management/for_state_personnel_system_hr_practitioners/employment_policies_and_programs/state_employee_telework_program

This web page provides information on the state's telework program, including employee eligibility and human resource management policy communications, state statutes and resources for employees and employers.

Maryland

Teleworking Information Center, Maryland Department of Budget and Management, undated. <https://dbm.maryland.gov/employees/Pages/telework/teleworkHome.aspx>

This web page provides documents related to the state's telework program, including the telework policy and manual, frequently asked questions about the program and agreement, schedule and work plan templates.

Reflections of Remote Work During COVID-19, Maryland Department of Transportation, June 5, 2020.

https://mdot.maryland.gov/OPCP/Webinar_LunchLearn_Session5_Final.pdf

This webinar is a bonus session that reflects on a previous webinar series and offers best practices and transportation implications for post-COVID-19.

Massachusetts

Telework for Commonwealth Employees, Commonwealth of Massachusetts, undated. <https://www.mass.gov/telework-for-commonwealth-employees>

This web page provides approved telework employees with information needed to remotely perform their work responsibilities. The web page also provides links to manager and supervisor training resources, employee training resources, telework policies and cybersecurity resources.

Minnesota

Telework Policy, Minnesota Management and Budget, September 2020.

<https://mn.gov/mmb-stat/policies/1422-telework.pdf>

This web page provides the state's telework policy. *From the objective:*

Use telework where possible as a means to prevent and mitigate the potential spread of COVID-19 in the workplace, and provide flexible work environment arrangements consistent with business needs as part of agencies' strategy to attract and retain a highly qualified and skilled workforce. Telework provides business-related benefits to agencies including:

- Attracting and retaining skilled workers from throughout the state and region.
- Allowing employees flexibility to perform work from an approved alternative worksite while delivering quality services to Minnesotans.
- Reducing risk of infectious disease transmission in the workplace.
- Supporting continuity of operations, including during health and safety situations impacting agencies' workforces.
- Reducing the need for office space and parking.
- Minimizing impact to the environment.

Smart Business Strategy: Minnesota's eWorkPlace is Back!, eWorkPlace, undated.

<https://www.eworkplace-mn.com/>

From the web page:

eWorkPlace is a program to help Twin Cities metro area employers introduce telework and enjoy its benefits. In the past five years, eWorkPlace has proven itself as a smart business strategy that enables employees to work from home, full- or part-time, and connect to the office and clients via internet, phone and mobile devices.

More than 40 Twin Cities employers and 4,000 employees have enrolled in eWorkPlace in the past five years. eWork[P]lace has realized more than a 9 to 1 return on investment, as well as crucial benefits to employers, employees and their communities.

Links to telework tools are available on this page to help companies launch a telework program, including a step-by-step telework implementation guide, a manager's guide, sample telework policies and case studies.

North Carolina

Teleworking Program Policy, North Carolina Office of State Human Resources, undated.

<https://oshr.nc.gov/policies-forms/employment-records/teleworking-program-policy>

This web page provides links to the following state telework documents:

- Current and outdated teleworking and alternative work schedule program policies.
- Policy history.
- Statutory authority and administrative rule.
- Sample telework agreement and alternative work schedule agreement.

Oregon

Telecommuting and Teleworking Toolkit, Oregon Department of Administrative Services, undated.

<https://www.oregon.gov/das/HR/Pages/Tele.aspx>

This web page provides links to the following state telework documents:

- Telecommuting and Teleworking Guidelines and Best Practices.
- Telecommuting agreement (fixed, regular basis) (Word document and PDF).
- Teleworking agreement (occasional, irregular basis) (Word document and PDF).

Utah

A New Workplace: Modernizing Where, How and When Utah Works, Governor's Office of Management and Budget, undated.

<https://gomb.utah.gov/a-new-workplace-modernizing-where-how-and-when-utah-works/>

From the web page:

A vast portion of work today is no longer bound to a specific location or schedule. In short, a majority of work can be conducted anywhere and anytime. With this in mind, the state tested a telework pilot and found it to be very successful. Due to the pilot's success, the state plans to implement telework across all state agencies through an initiative entitled The New Workplace: Modernizing Where, How and When Utah Works.

A one-page fact sheet—Managing Performance Over Presence—is accessible at this page (<https://gomb.utah.gov/wp-content/uploads/2019/07/A-New-Workplace-PDF.pdf>). Goals and statistics from the pilot are highlighted along with the program rollout plan. According to the results of the pilot program, more than 273 pounds of emissions were saved. Targeted benefits are also listed, including a monthly savings of 1,300 pounds of emissions.

Additional resources related to the Utah Works/New Workplace initiative are available on this page:

- Deployment guide.
- Pilot report.
- Business case.
- Frequently asked questions.
- Policy for teleworking on bad air quality days.

Virginia

Telework!VA, Virginia Department of Rail and Public Transportation, undated.

<http://www.teleworkva.org/>

Teleworking resources for employers and employees are available at this web site, including guidance for implementing a program and employee training.

Washington

Telework Resources During the COVID-19 Pandemic, Washington Office of Financial Management, October 2020.

<https://www.ofm.wa.gov/state-human-resources/coronavirus-covid-19-hr-guidance-state-agencies/telework-resources-during-covid-19-pandemic>

This page provides a range of resources to support managers and employees who telework, including steps to get started with remote working, sample policies and agreements, and lessons learned by other states that have adopted teleworking (described in Route Fifty, a digital news publication that “connects the people and ideas advancing state, county and municipal government across the United States”).

International Research and Resources

Teleworking During the COVID-19 Pandemic and Beyond: A Practical Guide, Jon Messenger, Zoltan Vadkerti and Agnes Uherezky, International Labour Organization, 2020.

https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---travail/documents/instructionalmaterial/wcms_751232.pdf

From the introduction: The purpose of the [g]uide is to provide practical and actionable recommendations for effective teleworking that are applicable to a broad range of actors; to support policymakers in updating existing policies; and to provide a flexible framework through which both private enterprises and public sector organizations can develop or update their own teleworking policies and practices. The [g]uide also includes a number of examples regarding how employers and policymakers have been handling teleworking during the COVID-19 pandemic; lessons learned from the recent months that are relevant for the future of teleworking arrangements post-pandemic; and a list of available tools and resources.

Telework in the 21st Century: An Evolutionary Perspective, Jon Messenger, International Labour Organization, November 2019.

Citation at https://www.ilo.org/global/publications/books/WCMS_723395/lang--en/index.htm

From the description: New information and communications technologies have revolutionized daily life and work in the 21st century. This insightful book offers a new conceptual framework explaining the evolution of telework over four decades. It reviews national experiences from Argentina, Brazil, India, Japan, the United States and 10 EU [European Union] countries, and analyses large-scale surveys and company case studies regarding the incidence of telework and its effects on working time, work–life balance, occupational health and well-being, and individual and organizational performance.

Related Research and Resources

TELEWORK 360°: A Best Practices Digest and Guide to Getting Telework Right in the Public Sector, Center for Digital Government, 2006.

<http://dls.virginia.gov/commission/pdf/Telework%20360%20-%20Best%20Practices%20and%20Guide.pdf>

From page 4 of the document: Telework 360° is written primarily for state and local government officials interested in implementing or expanding organizational telework capabilities. The concept of telework or telecommuting is not new for government. Most states, counties and cities have some experience with telework and some programmatic elements are already in place.

....

The guide begins with definitions and a brief history of telework. It is important to understand these concepts because a comprehensive telework program offers and requires more than

simply putting a plan in place to have a few employees work from home a few days a week. There are both compelling drivers pushing the public sector toward telework, and the promise of transformational benefits that can be harvested as reward for having the courage to fundamentally change the way public service is delivered. But the organization must be prepared to manage such change. To that end, the guide explores some of the policy issues that must be addressed in order to support change in making telework work.

Obtaining Data to Assess the Impacts of Teleworking

Domestic Research and Resources

National

COVID-19 Related Transportation Statistics, Bureau of Transportation Statistics, U.S. Department of Transportation, 2020.

<https://www.bts.gov/covid-19>

From the web page:

Responding to interest in the most recent coronavirus-related data, BTS [Bureau of Transportation Statistics] has created web pages of transportation statistics allowing comparison of pre-COVID-19 and current numbers for passenger travel and freight shipments.

These pages present a wide range of data on all transportation modes from various sources, and BTS will add more measures as they become available.

Among the metrics provided is daily vehicle travel trends during the pandemic (<https://www.bts.gov/covid-19/daily-vehicle-travel>), which is “an index for vehicle travel trends including average trip distance, trip count, trip duration and vehicle miles traveled (VMT) for passenger vehicles, local fleets and long-haul trucks.”

Travel Monitoring: Traffic Volume Trends, Office of Highway Policy Information, Federal Highway Administration, September 2020.

https://www.fhwa.dot.gov/policyinformation/travel_monitoring/tvt.cfm

From the web page: Traffic Volume Trends is a monthly report based on hourly traffic count data reported by the [s]tates. These data are collected at approximately 5,000 continuous traffic counting locations nationwide and are used to estimate the percent change in traffic for the current month compared with the same month in the previous year. Estimates are readjusted annually to match the vehicle miles of travel from the Highway Performance Monitoring System and are continually updated with additional data.

Minnesota

COVID-19 (Coronavirus) Outbreak Transportation Survey, Metropolitan Council, May 2020.

<https://metro council.org/Council-Meetings/Committees/Transportation-Committee/2020/July-27,-2020/Info-1-COVID.aspx>

A survey of metro area adults who participated in the 2019 Travel Behavior Inventory (TBI) examined the impact of COVID-19 on travel behavior, including potentially permanent changes to travel behavior such as teleworking.

Slides 12 through 16 present teleworking statistics; highlights are presented below:

- Before COVID-19, 5% of respondents teleworked; in May 2020, 24% of workers earning less than \$50,000 teleworked and 54% of those earning more than \$50,000 teleworked (slide 12).
- Frequency of teleworking by race (using pre-outbreak and May 2020 data) (slide 15):

One or more days per week:

- o Black 31% (pre-outbreak: 26%).
- o Hispanic/Latino 58% (pre-outbreak: 26%).
- o Asian 70% (pre-outbreak: 37%).
- o White 62% (pre-outbreak: 25%).

Less than weekly/never:

- o Black 51% (pre-outbreak: 62%).
- o Hispanic/Latino 29% (pre-outbreak: 74%).
- o Asian 16% (pre-outbreak: 58%).
- o White 23% (pre-outbreak: 71%).

Slides 24 through 29 provide supplemental survey results related to teleworking, including teleworking rates by geography (urban, suburban and rural) and in the Twin Cities, and employer attitudes. Other highlights:

- (Slide 25) Across all incomes, workers who used to:
 - o **Use public transit** primarily telework (58%), drive (12%) or are unemployed (16%). Only 11% continue to use transit to commute.
 - o **Drive to work** are teleworking (48%) or still driving to work (39%), with a smaller share unemployed or furloughed (13%).
 - o **Telework** continue to do so (91%), with some now driving to work (7%) and very few unemployed (2%).
 - o **Bike or walk** to work are most likely teleworking (62% and 31%, respectively).
- (Slide 29) Impact of new telework culture on VMT:
 - o Employees who are currently teleworking some amount said that they preferred to work from home two days more per week (unweighted average) than they did before the pandemic.
 - o Counting only those who also said their employer was “very likely” to support continued telework, this represents a reduction of approximately 650,000 round-trip commutes per week across the region.
 - o Next step: Translate these rough trip estimates into VMT and emissions numbers by leveraging 2019 TBI data on personal vehicles, mode type and commute distance/route.