

## Supplementary Material 1: Detailed explanation of search terms

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The search term used contained three separate strands: a term for telework; a term for the energy/environment impact of interest; and a term describing the nature of impact/relationship.

("at-home work\*" OR "connected work\*" OR "smart work\*" OR "collocated work\*" OR "multi-sited work\*" OR "smart-work\*" OR "e-work\*" OR "virtual work\*" OR "digital work\*" OR "web-work\*" OR telework\* OR "remote work\*" OR "working remote\*" OR "work\* from home" OR "anywhere work\*" OR telecommut\* OR "e-commut\*" OR "home-work\*" OR "homework\*" OR "home-based work\*" OR "flexible-location\*" OR "flexi-work\*" OR "flexible work\*" OR "digital nomad\*")

AND

(energ\* OR electric\* OR environment\* OR ecolog\* OR climat\* OR "climate change" OR carbon OR "greenhouse gas\*" OR GHG\* OR emission\* OR sustainab\* OR green\* OR footprint\* OR mile\* OR traffic OR congest\* OR kilomet\* OR distance OR fuel OR gas OR petrol OR "fossil fuel\*" OR travel\* OR transport\* OR commut\* OR pollut\* OR mobility OR consumption OR consum\* OR efficien\* OR utilisation OR expenditure OR demand\*)

AND

(relation\* OR effect\* OR affect\* OR saving\* OR save\* OR impact\* OR benefit\* OR advantage\* OR improv\* OR frequen\* OR reduc\* OR increas\* OR low\* OR offset\* OR substitut\* OR complement\* OR benefic\* OR cost\* OR "cost-benefit" OR importan\* OR magnitude OR differen\* OR improve\* OR worse\* OR implication\*)

In *Scopus*, the search string was as follows, and yielded 7,041 results:

TITLE-ABS-KEY ( "at-home work\*" OR "connected work\*" OR "smart work\*" OR "collocated work\*" OR "multi-sited work\*" OR "smart-work\*" OR "e-work\*" OR "virtual work\*" OR "digital work\*" OR "web-work\*" OR telework\* OR "remote work\*" OR "working remote\*" OR "work\* from home" OR "anywhere work\*" OR telecommut\* OR "e-commut\*" OR "home-work\*" OR "homework\*" OR "home-based work\*" OR "flexible-location\*" OR "flexi-work\*" OR "flexible work\*" OR "digital nomad\*" ) AND ( energ\* OR electric\* OR environment\* OR ecolog\* OR climat\* OR "climate change" OR carbon OR "greenhouse gas\*" OR ghg\* OR emission\* OR sustainab\* OR green\* OR footprint\* OR mile\* OR traffic OR congest\* OR kilomet\* OR distance OR fuel OR gas OR petrol OR "fossil fuel\*" OR travel\* OR transport\* OR commut\* OR pollut\* OR mobility OR consumption OR consum\* OR efficien\* OR utilisation OR expenditure OR demand\* ) AND ( relation\* OR effect\* OR affect\* OR saving\* OR save\* OR impact\* OR benefit\* OR advantage\* OR improv\* OR frequen\* OR reduc\* OR increas\* OR low\* OR offset\* OR substitut\* OR complement\* OR benefic\* OR cost\* OR "cost-benefit" OR importan\* OR magnitude OR differen\* OR improve\* OR worse\* OR implication\* ) AND ( EXCLUDE ( SUBJAREA , "NURS" ) OR EXCLUDE ( SUBJAREA , "BIOC" ) OR EXCLUDE ( SUBJAREA , "AGRI" ) OR EXCLUDE ( SUBJAREA , "CENG" ) OR EXCLUDE ( SUBJAREA , "CHEM" ) OR EXCLUDE ( SUBJAREA , "NEUR" ) OR EXCLUDE ( SUBJAREA , "DENT" ) OR EXCLUDE ( SUBJAREA , "PHAR" ) OR EXCLUDE ( SUBJAREA , "IMMU

) OR EXCLUDE ( SUBJAREA , "VETE" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) ) AND ( LIMIT-TO ( PUBYEAR , 2019 ) OR LIMIT-TO ( PUBYEAR , 2018 ) OR LIMIT-TO ( PUBYEAR , 2017 ) OR LIMIT-TO ( PUBYEAR , 2016 ) OR LIMIT-TO ( PUBYEAR , 2015 ) OR LIMIT-TO ( PUBYEAR , 2014 ) OR LIMIT-TO ( PUBYEAR , 2013 ) OR LIMIT-TO ( PUBYEAR , 2012 ) OR LIMIT-TO ( PUBYEAR , 2011 ) OR LIMIT-TO ( PUBYEAR , 2010 ) OR LIMIT-TO ( PUBYEAR , 2009 ) OR LIMIT-TO ( PUBYEAR , 2008 ) OR LIMIT-TO ( PUBYEAR , 2007 ) OR LIMIT-TO ( PUBYEAR , 2006 ) OR LIMIT-TO ( PUBYEAR , 2005 ) OR LIMIT-TO ( PUBYEAR , 2004 ) OR LIMIT-TO ( PUBYEAR , 2003 ) OR LIMIT-TO ( PUBYEAR , 2002 ) OR LIMIT-TO ( PUBYEAR , 2001 ) OR LIMIT-TO ( PUBYEAR , 2000 ) OR LIMIT-TO ( PUBYEAR , 1999 ) OR LIMIT-TO ( PUBYEAR , 1998 ) OR LIMIT-TO ( PUBYEAR , 1997 ) OR LIMIT-TO ( PUBYEAR , 1996 ) OR LIMIT-TO ( PUBYEAR , 1995 ) )

TOPIC: ((“at-home work\*” OR “connected work\*” OR “smart work\*” OR “collocated work\*” OR “multi-sited work\*” OR “smart-work\*” OR "e-work\*" OR "virtual work\*" OR "digital work\*" OR “web-work\*” OR telework\* OR "remote work\*" OR “working remote\*” OR "work\* from home" OR “anywhere work\*” OR telecommut\* OR “e-commut\*” OR "home-work\*" OR “homework\*” OR “home-based work\*” OR "flexible-location\*" OR “flexi-work\*” OR “flexible work\*” OR “digital nomad\*”) AND (energ\* OR electric\* OR environment\* OR ecolog\* OR climat\* OR “climate change” OR carbon OR "greenhouse gas\*" OR GHG\* OR emission\* OR sustainab\* OR green\* OR footprint\* OR mile\* OR traffic OR congest\* OR kilomet\* OR distance OR fuel OR gas OR petrol OR “fossil fuel\*” OR travel\* OR transport\* OR commut\* OR pollut\* OR mobility OR consumption OR consum\* OR efficien\* OR utilisation OR expenditure OR demand\*) AND (relation\* OR effect\* OR affect\* OR saving\* OR save\* OR impact\* OR benefit\* OR advantage\* OR improv\* OR frequen\* OR reduc\* OR increas\* OR low\* OR offset\* OR substitut\* OR complement\* OR benefic\* OR cost\* OR “cost-benefit” OR importan\* OR magnitude OR differen\* OR improve\* OR worse\* OR implication\*))

In *Web of Science*, the search term was as follows, and yielded 4,585 results:

Refined by: LANGUAGES: ( ENGLISH ) AND [excluding] WEB OF SCIENCE CATEGORIES: ( RADIOLOGY NUCLEAR MEDICINE MEDICAL IMAGING OR FAMILY STUDIES OR WOMEN S STUDIES OR PEDIATRICS OR PHYSICS CONDENSED MATTER OR SPORT SCIENCES OR SURGERY OR NURSING OR CHEMISTRY ANALYTICAL OR CHEMISTRY PHYSICAL OR DENTISTRY ORAL SURGERY MEDICINE OR TOXICOLOGY OR OPTICS OR MEDICINE GENERAL INTERNAL OR ENGINEERING GEOLOGICAL OR NUTRITION DIETETICS OR ENGINEERING MARINE OR HOSPITALITY LEISURE SPORT TOURISM OR LINGUISTICS OR GERONTOLOGY )

Timespan: 1995-2019. Indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC.

## Supplementary Material 2: Detailed analysis of each study in final sample

Study no.	Authors and date	Region	Method	Data	Metric(s)	Energy/ energy proxy impact(s) of interest	Scope (number of impact categories considered)	Net energy proxy savings/non-savings	Mechanism(s) of impact	Positive or negative impact?	Key condition(s) of impact	Appraisal of methodological approach
1	Asgari, H. & Jin, X. (2018)	USA	Analysis of survey data	Separate hazard function models were developed for non-teleworkers, regular and non-regular part-day teleworkers. Data were obtained from the 2010–2011 Regional Household travel Survey (RHTS) conducted in the New York Metropolitan region.	Congestion reduced	Whether flexible commutes (part-day teleworking) enable reduced congestion.	1 (commuting travel only)	Teleworking during peak travel times could potentially reduce peak travel (and thus congestion) by 20%.	Indirect, cross-temporal	Unclear	Depends on the method of peak-time travel that is being displaced.	Poor. The study does not establish which peak-time commutes are being reduced – from cars or public transport.
2	Atkyns et al. (2002)	USA	Analysis of survey data	Survey of staff	Miles	Miles avoided by working from home.	1 (commuting travel only)	Having one fifth of AT&T employees working one day a week from home could reduce vehicle distance travelled by 110,000 miles, reduce gasoline use by 5.1 million gallons, and reduce carbon emissions by 48,450 tons.	Indirect, substitution	Reduce	Non-work travel does not increase, inducing a rebound effect (this survey did not measure this variable)	Average. Rich survey data used but only focuses on a single firm and makes no attempt to aggregate findings.
3	Balepur et al. (1998)	USA	Evaluation of teleworking pilots	Experimental comparison between sample of centre-based teleworkers and non-teleworkers	Miles, no. of trips	Vehicle distance and person distance avoided in working at telecentre Vs. traveling to work/home-based telework	2 (commuting travel, non-commuting travel)	A telecentre commuting frequency of one day a week led total weekly person travel to be reduced by 19% (17 miles) and weekly vehicle travel to be reduced by 19% (10 miles) compared with regular commuters who travel to the office every day.	Indirect, minimization of travel distance to work	Reduce	That gains from shorter commutes to telecentres are not offset by an increase in driving alone or increase in trips home for lunch.	Good, but the study does not attempt to extrapolate wider impacts across the economy from its findings.
4	Bussière, Y. & Lewis, P. (2002)	Montreal and Quebec	Scenario modelling	Surveys of current work habits and scenario modelling	No. of peak-time trips	Peak-time trips are reduced through working from home.	1 (commuting travel only)	Over 20 years (1996 to 2016) and assuming teleworking rates of 3.3% of the workforce in Montreal and 3.6% in Quebec, the number of peak-time trips would be reduced by 2.3% in Montreal and by 2.5% in Quebec.	Indirect, substitution	Reduce	Main avoided trips are by those living further out of the city.	Poor, no discussion of distance travelled per trip or any other environmental proxy and multiple generalizations and bold assumptions made.

5	Chakrabarti, S. (2018)	USA	Analysis of survey data	Regression analysis of relationship between transport variables and teleworking based on 2009 U.S. National Household Travel Survey data	No. of cars trips and miles travelled	Annual vehicle miles travelled	2 (commuting travel, non-commuting travel)	Frequent teleworkers travel 5.9% further by car each year than non-teleworkers and occasional teleworkers travel 8.0% further. This is because the longer commutes of teleworkers on days they work more than offset the savings made on teleworking days.	Indirect, substitution	Increase	Distance from work and frequency of telecommuting.	Good, but does not specify what frequency of telecommuting leads to higher total miles per year.
6	Choo, S et al. (2005)	USA	Analysis of survey data	Box-Jenkins approach to time series analysis of aggregate nationwide data on vehicle counts and estimations of teleworking rates reported in national surveys.	Miles	Vehicle distance travel avoided by working from home Vs. traveling to work	1 (commuting travel only)	Teleworking by 12% of the workforce once a week has reduced total annual vehicle miles travelled in the US (estimated as 2.4 trillion miles) by 0.8%.	Indirect, substitution	Reduce	That non-work trips from home, residential relocation, or the realization of "induced or latent demand", do not outweigh work travel avoided.	Average. The authors base their calculations of historic gains from teleworking on rough estimates, and large ranges of frequency and proportion of the population teleworking. Data is also now 20-30 years old (from 1988-1998).
7	De Abreu e Silva, J. & Melo, P. C. (2018)	UK	Analysis of survey data	Structural Equation Modelling (SEM) based on survey data drawn from National Travel Survey (2005–2012)	Miles	Vehicle distance travel avoided by working from home Vs. traveling to work for one and two-worker households	2 (commuting travel, non-commuting travel)	For single-worker households where the person teleworks once a week, there is an average increase of 9.7 miles travelled by all modes (9.0 by car, or 3.9%, 0.5 by public transport, or 2.4%, and 0.2 by non-motorized modes, or 3.8%). For two-worker households where, one day a week teleworking increases miles travelled by car by 1.6 miles (or 0.4%). This is lower than above because workers share trips.	Indirect, substitution	Increase	Wealthier and larger households and those located more rurally are more likely to have higher car usage.	Good. Robust methods and multiple variables considered.
8	Dissanayake, D. & Morikawa, T. (2008)	Thailand	Scenario modelling	Nested logit model for evaluating teleworking impacts under the disaggregate assessment trial. Raw data were obtained from the household travel survey conducted by the Urban Transport Database and Model Development Project (UTDM, 1998) in the Bangkok Metropolitan Region (BMR) during 1995/96.	Vehicle kilometres travelled (VKT) and emissions avoided	Vehicle distance travelled reduced and emissions avoided through the hypothetical placement of five satellite telecentres in the outer suburbs of Bangkok Metropolitan Region.	1 (commuting travel only)	The modelled scenario for satellite telecentres reduces private vehicle usage in the area by 18–20%.	Indirect, minimization of travel distance to work	Reduce	Dependent on certain measures of vehicle sharing.	Poor. Multiple bold assumptions made, and the scenarios described are highly unrealistic.

9	Elder, E. (2017)	Sweden	Analysis of survey data	Regression model of interaction between teleworking and travel behaviour based on travel diary data from the Swedish National Travel Survey (RES) carried out in 2011 (Trafikanalys 2012).	Distance travelled avoided, km	Whether teleworking reduces travel distance.	2 (commuting travel, non-commuting travel)	Teleworkers travelled further than non-teleworkers on both teleworking and non-teleworking days. While non-teleworkers travelled an average of 46 km per day, teleworkers travelled 54km on teleworking days and 64km on non-teleworking days.	Indirect, complement	Increase	Depends on non-work travel in teleworking day by teleworkers.	Good, but study does not extract data on travel distances for the same worker over the course of a week; thus, it does not offer insights about how teleworking frequency (e.g. how many times per week) contributes to an overall lower or higher level of travel, taking into account also residential location.
10	Fu et al. (2012)	Ireland	Analysis of survey data	Econometric model of estimated energy use in work- and home-based work derived from data from the Irish Place of Work Census of Anonymised Records (POWCAR), the Central Statistics Office (CSO) data, energy consumption factors from 1995 to 2006 from TREMOVE, Ireland, and Energy Balance Statistics of the Sustainable Energy Authority of Ireland (SEAI).	Energy use (kW/h)	Energy used in commuting lifestyle vs home-working lifestyle	2 (commuting travel, home energy use)	If 5% of the Irish population teleworked full time, final energy consumption would fall by 0.14%.	Indirect, substitution	Reduce	Energy mix that powers home/transport system.	Good. Robust model and rich primary data. Projections based on realistic measures of future teleworking frequency.
11	Giovanis, E. (2018)	Switzerland	Analysis of survey data	Econometric model based on Swiss Household Panel (SHP) Survey consisting of 5000 households and 12 waves, during the period 2002-2013.	Traffic volume, air pollutants (NO2, SO2, CO, PM3, O3)	Traffic and pollutants reduced	1 (commuting travel only)	Teleworking by 8.43% of the population is associated with a reduction in traffic volume on average by 1.9% and equivalent reductions in various pollutants.	Indirect, substitution	Reduce	Depends on weather, how pollutants disperse in environment, etc.	Average. Does not specify what 'teleworking' means, i.e. how many days per month constitutes teleworking, merely assigns it a 0 or 1 binary.

12	Gubins et al. (2019)	Netherlands	Analysis of survey data	Comparison of commuting distance travelled for workers who "work in teleworking professions" (i.e. those jobs that use ICT and could be done from home) in 2010 with the commuting distance for workers in the "comparable" jobs in 1996. Data drawn Dutch Labor Force Survey for the years 1996 and 2010.	Commuting distance, km	Commuting distance reduced by ICT prevalence	1 (commuting travel only)	The existence of ICT has increased commuting distance by 13% for each worker between 1996 and 2010.	Indirect, complement	Unclear	Depends on location of teleworkers and their travel distance on non-teleworking days. Non-teleworking workers have shorter commuting distances than teleworking workers.	Average. Study based on numerous bold assumptions and unexamined causalities. As such, is not able to establish why distance has increased for certain professions or what frequency of teleworking for those professions could lead to aggregate reductions in distance travelled.
13	Helminen, V. & Ristimäki, M. (2007)	Finland	Analysis of survey data	Analysis of a nationwide Labour force survey of over 19,000 respondents and of a Monitoring System of the Spatial Structure, which is a GIS-based monitoring system of built-up environments developed by the Finnish environmental administration	Commuting distance, km	Commuting distance reduced by teleworking	1 (commuting travel only)	Teleworkers in the survey commute 3.7km further than non-teleworkers. But the use of teleworking (at least once a week) by 4.7% of the Finnish labour force reduces total commuting distance travelled in Finland by 0.7%.	Indirect, substitution	Reduce	Depends on frequency of teleworking and location of residence.	Good. Multi-methods approach taken and large dataset used.
14	Henderson et al. (1996)	USA	Evaluation of teleworking pilots	Analysis of data from pilot telecentre project, comparing travel patterns (personal miles travelled, and vehicle miles travelled) of participants with non-telecentre commuters. 104 teleworkers' travel diary data and the data of 41 non-teleworkers used.	Commuting distance (miles), emissions	Commuting distance and emissions reduced by cutting down on need for daily commutes.	2 (commuting travel, non-commuting travel)	On non-teleworking days, telecentre-based teleworkers have 91% higher VMT than non-teleworkers, while home-based teleworkers have 54% higher VMT - suggesting they live further from work than regular commuters. On teleworking days, home-based teleworkers have 67% less travel distance than commuters and telecentre workers have 54% less distance.	Indirect, minimization of travel distance to work	Reduce	Effectiveness of policy depends on up-take, which is currently unclear nationally, and the ability of firms to design and build centres appropriately.	Average. Does not estimate aggregate overall reductions in miles travelled based on actual telecentre/home teleworking propensity - merely compares distance travelled on teleworking and non-teleworking days.

15	Hjorthol, R. J. (2006)	Norway	Analysis of survey data	Analysis of a survey conducted in Oslo, Bergen, and Trondheim in 2001 information on teleworking habits and commuter travel patterns.	Commuting distance (miles)	Commuting distance reduced by cutting down on need for daily commutes.	1 (commuting travel only)	Home-based teleworkers have 'work travel totals by car' that are 8% lower per month than non-teleworkers.	Indirect, substitution	Reduce	Depends on distance to work, occupation, etc. as to whether teleworking is practised.	Poor. Good analysis of factors influencing telework decision, but weak analysis of impact of teleworking across society and no explicit disaggregation of work and non-work travel and rebounds, etc.
16	Jaff, M. M. & Hamsa, A. A. K. (2018)	Malaysia	Scenario modelling	Analysis of labour survey results collected in 2013 of female 454 respondents who worked in the financial intermediation and banking, real estate, education, and telecommunication industries. Survey comprised travel diary and questionnaire.	Commuting kms travelled	Commuting distance avoided by cutting down on need for daily commutes.	1 (commuting travel only)	Based on sample, if 2% of female workforce teleworked three times per week, peak-hour traffic could be reduced by 1.3-7.8%. If 2% of female workforce teleworked once per week, peak-hour traffic could be reduced by 0.6%-3.7%	Indirect, substitution	Reduce	Depends on frequency of teleworking per week, which the article does not theorize.	Poor. Only 10 out of 454 respondents within the sample study were reported to be teleworking, so the sample of teleworking patterns is very small.
17	Kim et al. (2015)	South Korea	Analysis of survey data	Regression analysis of data from the 2006 Household Travel Survey in the Seoul Metropolitan Area.	Work and non-work distance travelled, kms	Distance travelled avoided through the head of house teleworking	2 (commuting travel, non-commuting travel)	For dual- or multiple-earner households, the household has lower commute travel for the teleworking head (compared to households without a teleworking head), but greater amounts of the other four types of travel (teleworker's non-work travel and other household members' work and non-work travel). As a result, the vehicle miles reduced by the head of household teleworking (-7.8km per day) is offset by the teleworkers' non-commute trips (+24.2km), non-work trips (+11.7km), as well as by other household members' non-work trips (+1.5km). This is because the car (of which there are only 0.91 per household in South Korea compared to 1.79 in the USA) gets used more by other members for other purposes.	Indirect, complement	Increase	Depends on exact travel habits by other household members in displacing avoided commute-travel and distance teleworking family lives from workplace.	Good. Robust method based on broad panel data set.

18	Kitou, E. & Horvath, A. (2003)	USA	Scenario modelling	This paper applies a systems model to telework and non-telework scenarios in order to quantify and compare greenhouse gas and other air emissions generated by a single work through transportation, heating, cooling, lighting, and electronic and electrical equipment both at the company and the home office. Data drawn from a range of sources: data on California's average electricity mix, United States emissions data and national average values for typical United States teleworkers obtained from literature, surveys, and personal interviews.	Emissions, g	Emissions reduced through telework.	3 (commuting travel and office and home energy use)	Teleworking between one, three, and five times a week decreases CO <sub>2</sub> emissions by 2-80% (rounded).	Indirect, substitution	Unclear.	The nature of impact depends on a range of factors. The size of office space, the temperature in the state in winter and summer, the type of energy heating and cooling homes and powering cars, the exact home-based energy patterns, etc. are also factors	Good. Could have been improved by building aggregate scenarios based on specific frequency and proportion of population teleworking.
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19	Koenig et al. (1996)	USA	Evaluation of teleworking pilots	Analysis of travel behaviour and personal emissions of participants in the State of California Telecommuting Pilot Project. Data based on travel diaries.	Vehicle-miles travelled, emissions (NOX, CO, TOG, PM)	Commuting distance and emissions reduced by cutting down on need for daily commutes.	2 (commuting travel, non-commuting travel)	Teleworkers had an overall daily travel of 10.2 miles on teleworking days compared with 32.7 miles for non-teleworkers. While non-commute trips increased by 1 per day for teleworkers, their non-commute travel on teleworking days reduced by 0.7 miles, from 34.6 miles per day to 33.9 miles per day. On non-teleworking days, travel distance for teleworkers was 36.9 miles per day, slightly higher than for non-teleworkers (around 32 miles per day), suggesting that teleworkers live further away from work than regular commuters.	Indirect, substitution	Reduce	Exact emissions reductions depend on weather, travel speed, etc.	Good, but data are from 1988 and no effort is made to estimate the aggregate emissions reductions from teleworking based on a specific frequency (e.g. once a week) of teleworking by a specific proportion of the population (e.g. 5% of population); nor to extrapolate wider social benefits of teleworking based on the findings from this pilot.
20	Lachapelle et al. (2018)	Canada	Analysis of survey data	Regression analysis of time use data from the 2005 Canadian General Social Survey to establish relationship between teleworking arrangements and travel outcomes.	Travel time (minutes), trip length (km)	Travel time and distance reduced by working from home.	1 (commuting travel only)	Full time teleworking reduces daily travel time by 13 minutes. Morning peak trips were not avoided because of school runs. Part-day teleworking has no effect on overall travel.	Indirect, substitution	Neutral	Depends on non-work travel habits, e.g. whether commute is replaced with trips to café to work, etc.	Average. Does not try to estimate distance in miles or emissions avoided. Only calculates time spent commuting, which has limited use in terms of environmental variables due to lack of information about type of vehicle trips that are avoided by teleworkers (e.g. car or bus, etc.). Also, does not offer projections of time/distance avoided through part-time teleworking approach.

21	Lari, A. (2012)	USA	Analysis of survey data	Online surveys and travel diary data were analysed from the eWorkPlace programme, administered by the Minnesota Department of Transportation (Mn/DOT), with the University of Minnesota's Humphrey School of Public Affairs, to examine individual travel behaviour changes effectuated by the U.S. Department of Transportation's Urban Partnership Agreement.	Travel distance, miles; CO <sub>2</sub> , lbs	Travel distance avoided through teleworking.	1 (commuting travel only)	On teleworking days, vehicle miles travelled per person was 27.96 miles lower than on a traditional commuting day. Overall, 7.46 million vehicle miles travelled per year were avoided by teleworking among 678 teleworkers. Assuming 1.10 lbsCO <sub>2</sub> per mile travelled, eWorkPlace participants saved 4070 tons of CO <sub>2</sub> .	Indirect, substitution	Reduce	No discussion of conditions.	Poor. Study shows that teleworking led to reduced VMT compared with regular commuting but does not investigate causality or attempt to extrapolate broader patterns from the data.
22	Larson, W. & Zhao, W. (2017)	USA	Scenario modelling	Modelling of impacts of counterfactual teleworking scenarios of the working population of a hypothetical city based on aspects of actual cities, such as commuting speed, dwelling energy demand, earnings, emissions from electricity generation, etc.	Commute distance (miles), emissions, energy consumption	Commuting distance and emissions reduced by cutting down on need for daily commutes.	2 (commuting travel and home energy use)	If 20% of workers telework 1 day a week, commuting energy consumption would decrease by 20%, but home energy consumption would increase by 5.3%. Overall energy consumption from the household would increase by 0.4%.	Indirect, substitution	Unclear	That 20% of population manage to take up telework.	Poor. Robust enough model but makes multiple bold assumptions and data drawn from multiple studies across 30 years.
23	Mamdoohi, A. R. & Ardeshiri, A. (2011)	Iran	Scenario modelling	Modelling potential impacts of teleworking from a sample dataset of the travel habits of 14% of government employees in Tehran	Number of peak hour trips avoided	Peak hour commuting trips avoided through teleworking by 36% of government employees	1 (commuting travel only)	If 36% of the 148,551 government employees teleworked once a week, 53,898 peak hour trips could be avoided	Indirect, substitution	Reduce	That 36% of workers are actually able to telework.	Poor. Makes numerous bold assumptions and does not attempt to estimate reduction in travel distance avoided or any other environmental indicator associated with reduced traffic.

24	Martens, M. J. & Korver, W. (2000)	Netherlands	Scenario modelling	Scenario modelling based on several different Dutch National Central Planning Agency Scenarios projections of potential teleworking demand	Number of commuting trips avoided	Commuting trips avoided by teleworking.	1 (commuting travel only)	Between 71,000 and 529,000 daily commuting trips could be substituted in the Netherlands through teleworking assuming teleworking rates of 20% and 60%, respectively. This equals a maximum of 5% reduction in commuting travel, and 1% reduction in overall travel.	Indirect, substitution	Reduce	That 20-60% of workers are able to telework. That the commuting being displaced is being done by car; where commuting is done by public transport, the trips avoided will be lower.	Poor. Reveals few specific assumptions made relating to teleworking patterns (e.g. distance from work, work and non-work travel displacement, etc.) and does not estimate any environmental indicator.
25	Matthews, H. S. & Williams, E. (2005)	USA, Japan	Scenario modelling	Analysis of estimated energy savings from current teleworking adoption. Based on a range of estimated data from USA and Japan on average energy use per commute and residential/commercial building energy use, etc.	Energy use (kW/h)	Net energy savings from teleworking (due to avoided transportation energy use and net building energy consumption)	3 (commuting travel, home and office energy use)	For current estimated teleworking populations and practices in the US (currently 0.4% of total worker days, once a week) and Japan (currently 2.5m workers, once a week), there are national level energy savings of only 0.01–0.4% in the US and 0.03–0.36% in Japan. Where 50% of information workers telework 4 days per week, United States and Japan national energy savings are estimated at only about 1% in both cases.	Indirect, substitution	Neutral	Savings depend on energy efficiency of buildings and method of commuting transport, e.g. buses or cars. For commuters using buses, there could be a greater relative increase in residential building energy consumption compared with energy saved in commuting.	Good, but acknowledges some of the more problematic assumptions about realism of projections, e.g. assumptions of telework adoption by non-disaggregated profession data; assumptions about commercial energy savings.
26	Mitomo, H. & Jitsuzumi, T. (1999)	Japan	Scenario modelling	Scenario modelling based on projections of teleworking uptake of 9-14 million commuters per day	Congestion rate at peak times compared with non-peak times	Congestion at peak times is avoided by trips being avoided.	1 (commuting travel only)	If 9-14 million workers telework daily, the congestion rate during peak hours will be reduced by 18%-28%.	Indirect, substitution	Reduce	Benefits depend on mode of transport being displaced.	Poor. No estimation of specific environmental proxies (i.e. total commuting distance or single-occupancy car trips avoided, or emissions avoided as a result of reduced congestion).

27	Mokhtarian et al. (2004)	USA	Evaluation of teleworking pilots	The study analyses retrospective data on teleworking and residential and job location changes over a ten-year period, from 218 employees (62 current teleworkers, 35 former teleworkers, and 121 people who had never telework) of six California state government agencies which had actively participated in a pilot program from 1988 - 90.	Commute distances, miles	Commuting distance displaced by teleworking.	2 (commuting travel, non-commuting travel)	Average quarterly per capita total commute distances are generally 15% lower for teleworkers than for non- teleworkers, indicating that they telework often enough to more than compensate for their longer one-way commutes (which tend to be on average 16 miles compared with 11 miles for non- teleworkers).	Indirect, substitution	Reduce	Depends on distance from residence to office and frequency of teleworking.	Good, but based on old datasets (1988-1990).
28	Mokhtarian, P. L. & Varma, K. V. (1998)	USA	Evaluation of teleworking pilots	An evaluation of the results of the Neighborhood Telecenters Project, a multi-year research program designed to evaluate the effectiveness of teleworking centres, or telecentres, as an alternative work arrangement and as a transportation demand management strategy. Data based on travel diaries.	Commute distances, miles; pollutants, g	Commuting travel and travel-related emissions avoided through centre-based teleworking	2 (commuting travel, non-commuting travel)	On teleworking days, distance travelled by centre-based teleworkers decreased significantly compared with regular commuters, by 51 person-miles (58%) and 35 vehicle-miles (53%). There were no increases in non-work travel on teleworking days. When weighted by teleworking frequency (which was just over one time a week for the sample), there were average reductions in total PMT of 11.9% and in VMT of 11.5% over a week compared with non- teleworkers.	Indirect, minimization of travel distance to work	Reduce	That gains from shorter commutes to telecentres are not offset by an increase in driving alone or increase in trips home for lunch.	Good, but limited disaggregated data and no comparison with a control group.

29	Nelson et al. (2007)	USA	Evaluation of teleworking pilots	Analysis of the ecommute program, launched in 1999, that used incentives to encourage firms in 5 metropolitan (Chicago, Washington, DC, Houston, Los Angeles, and Philadelphia) to enrol their employees. Data collected in these programmes was on commuting patterns and emissions benefits of alternative commuting arrangements.	Emissions reductions, g	Emissions avoided through teleworking programme.	1 (commuting travel only)	Impossible to derive meaningful estimates.	Indirect, substitution	Unclear	Emissions efficiency of car.	Poor. No attempt to compare participants in programme with a control group.
30	O'Keefe et al. (2016)	Ireland	Analysis of survey data	A multinomial logit regression model was used to estimate relationships between telecommuting and other variables, such as commuting time and distance. The data set was 2011 census of Ireland specifically a dataset is known as Place of Work, School or College - Census of Anonymised Records (POWSCAR). Data was also collected on deprivation and access to public transport and was supplemented with an additional survey.	Emissions reductions, kg	The reduction in emissions through travel-savings via teleworking.	2 (commuting travel, non-commuting travel)	Based on patterns in the sample data (which showed that 44% of the population in the Greater Dublin Area teleworks once a month and which showed how certain segments travel to work), teleworking by between 20% and 50% of the population once a week would contribute to emissions reductions of between 31,000 tonnes and 78,000 tonnes of CO <sub>2</sub> per year.	Indirect, substitution	Reduce	Emissions reductions are dependent on very high levels of telecommuting which are much higher than census data (4%). Savings are also dependent on car trips being displaced and non-work travel not out-weighting savings made.	Good, but very limited data presented on environmental impacts of telecommuting by a percentage of the workforce – most of the paper is concerned with examining the reasons for telecommuting or not. Also, uses a proxy (average speed times travel time) to calculate travel distance, which is then used to calculate emissions in terms of kg of CO <sub>2</sub> per km travelled, which may lead to imprecise results.
31	Pratt, J. H. & Trb. (2002)	USA	Analysis of survey data	Analysis of responses to questions about teleworking habits and travel behaviour added to the American Housing Survey and the Current Population Survey.	Travel distance, miles	Daily travel distance avoided through teleworking	1 (commuting travel only)	Individuals who part-time telework travel 3.6 miles (or 17%) less on teleworking days for work-related travel than employer-based workers.	Indirect, substitution	Reduce	N/A	Poor. Very patchy data and little attempt to investigate broader travel patterns within households or across society based on the travel savings of those who travel less on days they work from home that were discovered in this study.

32	Röder, D. & Nagel, K. (2014)	Germany	Analysis of survey data	Multi-Agent Transport Simulation model based on data from the "BVG household survey" from 1994 which contains detailed trip-diary information of a person on the specified day. The survey contains data on 57,688 persons performing 209,416 trips. This corresponds to approximately 1% of the population in Berlin-Brandenburg. 56,160 persons of those perform home activities, 23,097 perform work activities. 23,095 build a cut set of persons performing both activity types.	Energy consumption, kwh	The potential reduction in energy demand through teleworking.	3 (commuting travel, home and office energy use)	Teleworking by 10% of the sample (unspecified frequency) within this model reduces commuter mileage and transport energy consumption by 10% but increases energy consumed at home by about the same amount. By contrast, office energy consumption is barely affected.	Indirect, substitution	Neutral	The extent to which offices are completely or partially 'emptied' through teleworking.	Poor. Robust data set but multiple bold assumptions made in the model, and does not specify the frequency and proportion of the population teleworking.
33	Roth et al. (2008)	USA	Scenario modelling (based on assumptions drawn from Henderson et al. (1996))	Life Cycle Analysis of teleworking impacts on transportation, residential and commercial building energy consumption. Teleworking frequency estimated from EIA's Residential Energy Consumption Survey (RECS) and the American Community Survey. Data on heating site energy consumption by energy source drawn from EIA data. Office floor space and heating requirements based on EIA data.	Energy consumption (kwh); CO2 emissions (tonnes); gasoline consumption (gallons)	Avoided energy consumption, emissions, and gasoline consumption through teleworking.	3 (commuting travel and office and home energy use)	Teleworking by 4 million U.S. workers (3% of the total workforce) one or more days per week could reduce annual primary energy consumption by between 0.13% and 0.18% and CO <sub>2</sub> emissions by between 0.16% to 0.23%. It could also decrease US light-duty vehicle gasoline consumption by 0.8%.	Indirect, substitution	Reduce	Depends on size of office no longer being heated and the ability of firms to stop using office spaces altogether (rather than keeping the offices going but having fewer employees using them).	Average. Ambitious model but assumptions based on multiple different studies across different time periods and contexts.

34	Shabanpour et al. (2018)	USA	Scenario modelling	Ordered probit model of potential impact of 50% telework adoption on travel behaviour, congestion, and emissions. Data drawn from Travel Tracker Survey conducted by the Chicago Metropolitan Agency for Planning (CMAP).	Commuting distance avoided (miles); pollutants avoided (g)	Avoided commuting distance traveled and pollutants from teleworking.	2 (commuting travel, non-commuting travel)	When 50% of workers have 'flexible working schedules', total daily VMT and vehicle hours travelled (VHT) can be reduced by up to 0.69% and 2.09%, respectively. Considering the same comparison settings, this policy has the potential to reduce greenhouse gas emissions by up to 0.71%.	Indirect, substitution	Reduce	Depends on very high uptake of teleworking.	Average. Does not specify what is meant by 'flexible working', i.e. how many days per week and all day working from home.
35	Shimoda et al. (2007)	Japan	Scenario modelling	An end-use energy simulation model for the residential sector and non-residential sectors. Household types containing teleworkers and their ratios are estimated from survey results (Japan Industrial Policy Research Institute 2001, Japan Teleworking Association 2001). Data on occupants' schedules of living activities are calculated based on the results of a time allocation survey of living activities conducted by the Broadcasting Culture Research Institute of Japan Broadcasting Corporation (Broadcasting Culture Research Institute 2001).	Energy saved	Reduced energy consumption from the reduction in commercial energy consumption overweighing increases in residential energy consumption.	2 (home and office energy consumption)	Provided the floor area of office buildings being utilized decreases as the rate of teleworking increases. A teleworking level of 60% of the population could lead energy consumption to decrease by 0.6% of the total energy consumption of the residential and non-residential sectors in Osaka City.	Indirect, substitution	Reduce	Energy savings at home depend on prior occupancy of residence; if household contains live-at-home family members and energy was being used anyway, relative energy reductions would be greater as there would be minimal 'extra' energy being used at home.	Average. Does not consider other forms of energy consumption such as commuting distance/method.

36	van Lier et al.. (2014)	Australia	Scenario modelling	Forecasting model to estimate impacts of teleworking on vehicle km travelled in urban areas. Model assumptions are drawn from data from other studies on distance travelled to work, teleworking frequency, etc. Raw data run into the model was drawn from employment from New South Wales in 2001.	Distance travelled avoided, km	Car distance travelled avoided by teleworking.	1 (commuting travel only)	Assuming a 60 km commute, a once-a-week teleworking frequency by 18% of all workers in New South Wales, and a rate of single-occupier driving of 70%, 3 million vehicle-km (4.2% of the total) could be avoided by 2001 and there could be a reduction of 15.5% of the total by 2021.	Indirect, substitution	Reduce	All workers teleworking once a week – a very high proportion.	Average. Good model for analysing just work travel, but data is also old - pre-internet.
37	Vu, S.T. & Vandebona, U. (2007)	Belgium	Analysis of survey data	Analysis of data from survey of six large companies in Brussels Capital Region (BCR) and a discussion with the mobility managers of these six companies. The survey comprised an online questionnaire for employees containing questions on travel behaviour of the employees in order to understand how they commuted to headquarters and satellite offices (if applicable), and which trips were conducted when working at home (if applicable).	Commuting travel (km)	Commuting distance displaced by teleworking.	1 (commuting travel only)	Difficult to say. All that is reported is that working from home reduces teleworkers' commute by 45 km per day on teleworking days and that working in a satellite centre reduces the commute for these workers from 60 km to 22 km per day.	Indirect, substitution	Reduce	Depends on proportion of commuting trips displaced that are taken by car. If public transport is used, vehicle miles will not be reduced by teleworking. Also depends on non-work trips not rising as commuting trips fall.	Poor. Data shows that working at home reduces travel but does not explore the aggregate impact of teleworking across the week, including days when teleworking is not practised.

38	Williams, E. D. (2003)	Japan	Scenario modelling	A macro-modelling of energy saving potential of teleworking. Based on data from	Energy consumption, MJ	Office building energy consumption (heating and cooling) reduced by teleworking.	3 (commuting travel and office and home energy use)	The adoption of 4-day per week teleworking by mobile sales and specialist/technical workforce (approx. 14% of the total workforce) could reduce national energy consumption by 1.0%. If clerical workers (and additional 23% of the workforce) also telework an additional 1.1% of savings become possible.	Indirect, substitution	Reduce	Depends on extent to which teleworkers actually affects office energy occupation and energy use and the extent to which residential energy use offsets the gains from lower office energy use.	Poor. Does not also consider changes in commuting energy consumption as a result of the shift to teleworking.
39	Zhu, P. Y. (2012)	USA	Analysis of survey data	Using data from the 2001 and 2009 National Household Travel Surveys (NHTS), this study uses a Two-Stage Least Squares (2SLS) regression model to examine data from two large national samples to try to identify the impact of teleworking on workers' travel patterns.	Distance travelled avoided, km	Whether teleworking reduces overall distance travelled (both work and non-work together) or whether teleworking is a complement to other forms of travel.	2 (commuting travel, non-commuting travel)	In 2001, teleworkers' work trips were 34.2% longer in distance than non-teleworkers (39 km instead of 29 km); their non-work trips were 17.1% longer (39km instead of 33km). Teleworkers also take more non-work trips than non-teleworkers, 4.39 per day instead of 3.87 per day. In 2009, teleworkers' work trips were 43.3% longer in distance than non-teleworkers, 43 km instead of 30 km; their non-work trips were 15.7% longer, 36km instead of 32 km. Teleworkers also take more non-work trips than non-teleworkers, 4.18 per day instead of 3.77 per day.	Indirect, substitution/complement	Increase	Reducing the commuting distance by teleworking depends on non-commuting work trips also being reduced. This data seems to suggest that work travel is still high for teleworkers because they still have to do work travel, as well as other non-work travel.	Good, but does not discuss what the aggregate comparison is at specific frequencies of teleworking. E.g. how does total weekly travel compare between the two groups when teleworking is 100% for teleworking workers? Also, does not specify how many times a week reporting teleworkers are teleworking, merely states that teleworking means 'at least once a week'.