Annex 1
Teleworking and virtual mobility

A-S-I: avoid (fewer/shorter trips)

Context: passenger road transport, urban/rural

Time frame: short term

A1.1 Definition

The meaning of teleworking has changed over time, following the evolution of technology. An early definition of the term was the use of 'telecommunications technology at home, or at a location close to home, during regular work hours, instead of commuting to a conventional workplace' (Mokhtarian, 1991). Nowadays, teleworking is often used to identify working arrangements outside employers' premises enabled by information and communications technology (EU, 2019d). In more detail, the European social partners ([8]) define telework as 'a form of organizing and/or performing work, using information technology, in the context of an employment contract/relationship, where work, which could also be performed at the employers premises, is carried out away from those premises on a regular basis' (ETUC et al., 2002). A comprehensive review of how the definition has evolved over time can be found in a recent Eurofound publication (Eurofound, 2022b).

Relevant to this factsheet is that such a working arrangement permits avoiding one or more commuting trips during the week, shortening their distance (e.g. if work is carried out in a co-working space closer to the employee's home) or shifting them to times in which their impact is lower (e.g. due to reduced congestion; for a detailed discussion of this aspect, see also Factsheet 7 and Annex 7), in which case the environmental impacts will be smaller. Teleworking can have an impact on transport demand, not only if implemented on a regular basis but also when used only occasionally, albeit to a smaller extent, as will be discussed in this annex.

Depending on how these arrangements are configured, the magnitude of their impact on the transport system and the environment could be different, as also discussed by Eurofound (2022a). One can telework at home for all or part of the day (e.g. to avoid rush hour) or at another location for all or part of a day. The other location can be a co-working space that is shared by workers of different companies or a satellite office of the worker's company. In that case workers can make use of office facilities they require for their job. It could also be a non-dedicated location (e.g. café, library). An further case is the that of people who normally work at home (e.g. self-employed people) or people with decentralised activities.

Teleworking is enabled by many of the digital technologies presented in Chapter 3, such as the internet, email, broadband connectivity, laptops, smartphones, cloud computing and videotelephony.

A1.2 Context

Teleworking mainly acts on the demand for passenger transport for commuting. As anticipated, it affects the number of commuting trips and, when it is done from a location different from the worker's home, their average distance. Depending on the remote work location, the share of urban/non-urban travel can also be affected. Considering urban mobility in 12 EU Member States ([9]), commuting is responsible on average for approximately 27-47% of the daily distance travelled, with a daily distance ranging between 5.6km and 19km (Eurostat, 2021b).

According to the Labour Force Survey reported by Eurostat, the share of employees who usually work from home ([10]) increased to 10.8% in 2020 in the EU-27, while this share ranged between 2.6% and 3.3% in the 2010-2019 period. In the case of self-employed people, the share grew less prominently, going from 16.3% to 19.4% in the previous

([8]) The social partners represent employees and employers: the European Trade Union Confederation (ETUC) and three organisations on the employers' side: BusinessEurope (private firms), SMEunited (small businesses and craft businesses; formerly UEAPME) and CEEP (public employers).

([9]) 'Urban mobility' is defined as trips made by urban residents with an origin and destination within the same functional urban area (a city and its commuting zone). The 12 Member States are: Austria, Belgium, Croatia, Denmark, Germany, Greece, Italy, Latvia, Poland, Portugal, Romania and Slovenia.

([10]) 'Usually working at home' is defined as doing at home any productive work related to the current job for at least half of the days worked in a reference period of 4 weeks.

decade to 22% in 2020. When both groups are taken together, the share grew from around 5% in the previous decade to 12.3% in 2020 (Eurostat, 2021c). In parallel, the share of people (employees and self-employed) who sometimes work at home grew from 6.2% in 2010 to 9% in 2019, falling somewhat in 2020 to 8.6%, again due to COVID-19 containment measures.

In 21 NUTS 2 regions ([11]) the share of employed people usually working from home was at least 12.0 percentage points higher in 2020 than in 2019. These included the capital regions of Belgium, Finland, Denmark, Germany, Ireland, Spain, France, Italy, Austria and Portugal, while the remaining regions mostly consisted of urban areas. One of the explanations for such geographical disparities is the economic structure of these regions, which have a large share of the professional, financial, information and communication, education and government sectors. For people working in the agriculture, manufacturing or distributive trades sectors, it is difficult or even impossible to work at home (Eurostat, 2021d).

In the past 2 years, because of the policy measures to contain the COVID-19 pandemic, a lot of people have worked from home. The Eurofound e-survey 'Living, working and COVID-19' showed that, in spring 2021, 24% of workers worked only at home and 18% in combination with working at their employer's premises or in other locations (Table A1.1) (Ahrendt, et al., 2021).

Although the COVID-19 pandemic has accelerated the uptake of teleworking and demonstrated its large-scale feasibility, not all work can be performed remotely. Sostero et al. (2020) estimate the maximum potential for teleworking in the EU-27. The study defines teleworkability as 'the technical possibility of providing labour input remotely into a given economic process'. It is determined based on occupational task descriptions and indicators from the European Working Conditions Survey and the Italian survey 'Indagine Campionaria delle Professioni'. Figure A1.1 presents the share of teleworkable employment by sector in the EU-27. It is highest in the financial services sector (93%), in information and communication (79%) and around 65% in real estate, professional, scientific and technical activities, education and public administration. The share is lower in health (30%), retail (27%) and accommodation and food services (16%). The primary sector, manufacturing and construction sector have the lowest shares (10-20%). Because of sectoral specialisation at the regional level, there are significant differences in access to telework between urban and rural areas. In cities, where the share of service employment is generally high, the share of teleworkable employment is also higher (44%) than in towns or suburbs (35%), or rural areas (29%). The differences are also significant across income quintiles. Of those employed in the highest paying quintile, 74% can telework. For the mid-paying and mid-high paying jobs (third and fourth quintiles) this lies above 40% and 50%, respectively. For the second quintile it is around 12%, and for the lowest paying quintile it is only 3%. As income quintiles are related to education level, teleworkability is also lowest for people with a low education level.

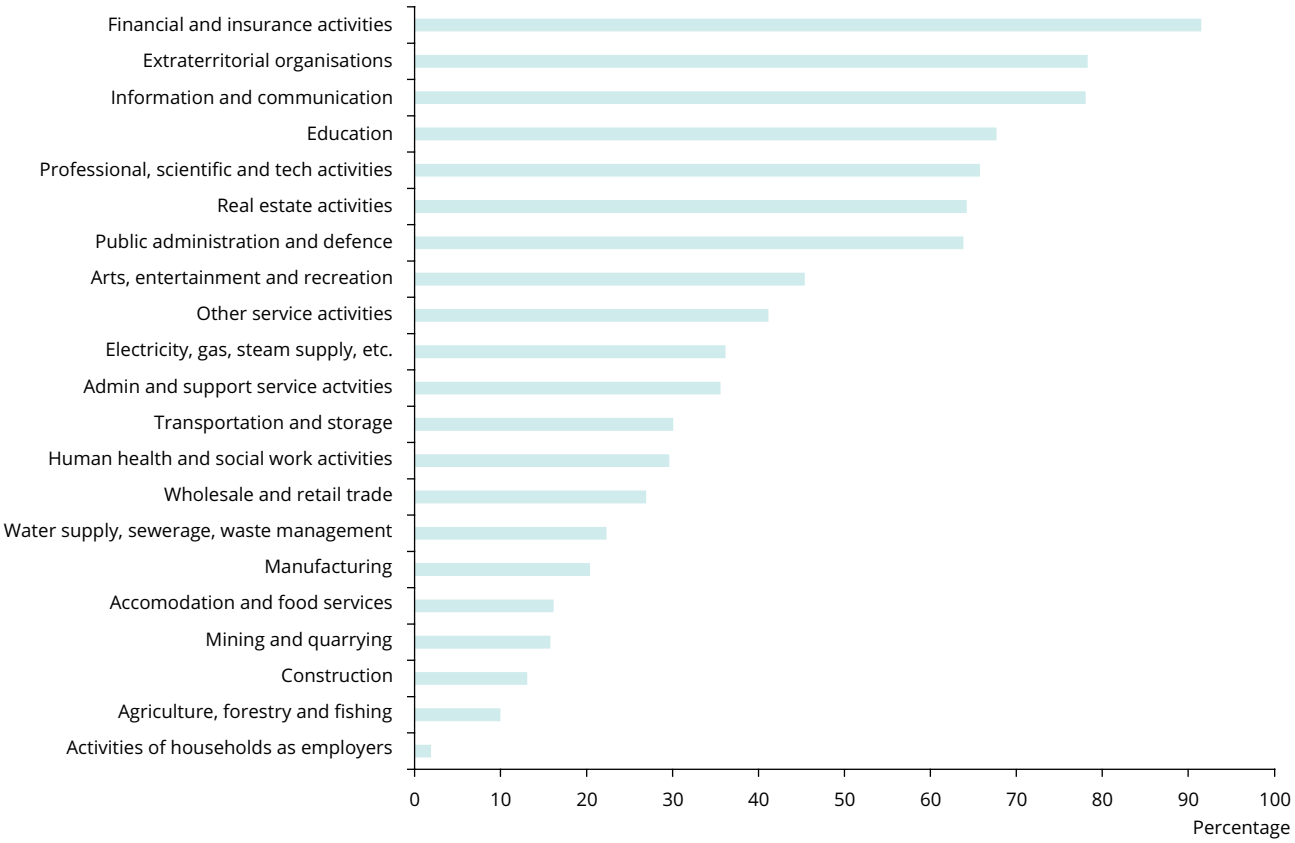
Table A1.1 Location of work and average hours worked during the pandemic in the EU-27 (%)

	Summer 2020	Spring 2021
Home only	34%	24%
Combination of home and employer's premises/other locations	14%	18%
Employer's premises/other locations only	52%	59%
Average hours worked from home (overall)	35%	36%
Average hours worked from home (for people who worked from home)	77%	73%

Source: Ahrendt et al. (2021).

([11]) The NUTS classification (Nomenclature of Territorial Units for Statistics) is a hierarchical system for dividing up the economic territory of the EU and the United Kingdom. While the NUTS 1 regions are the major socio-economic regions, the NUTS 2 regions are the basic regions for applying regional policies.

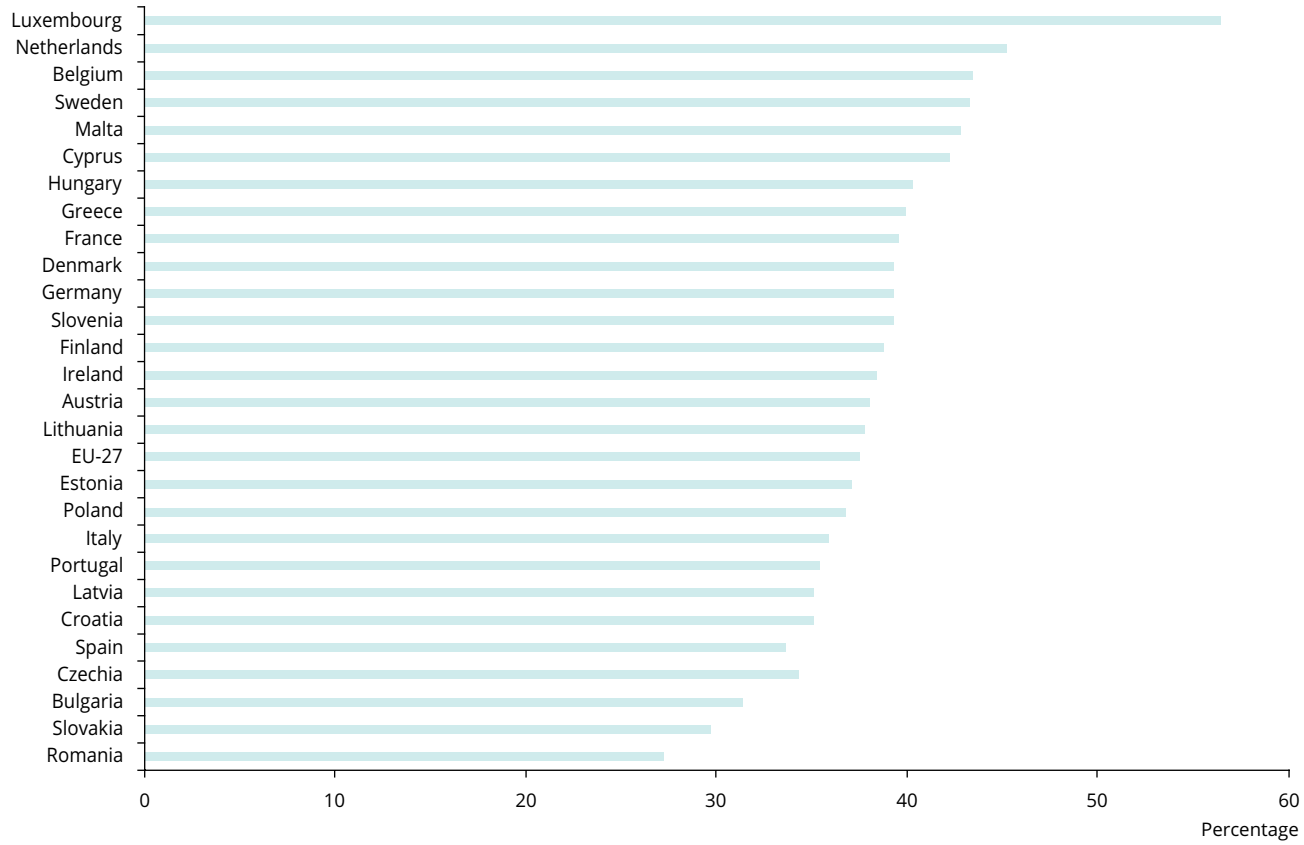
Figure A1.1 Share of teleworkable employment by sector in the EU-27



Note: Employees only.
Source: Sostero et al. (2020).

The share of teleworkable employment varies not only between urban and rural areas but also across the different EU Member States (Figure A1.2). The share ranges from 27% for Romania up to 54% for Luxembourg, with an EU-27 average of 37%. This is again linked to the relative importance of the economic sectors and their specific teleworkable profiles across the Member States. These findings on the share of teleworkable jobs are broadly in line with estimates for European countries given by Dingel and Neiman (2020).

Figure A1.2 Share of teleworkable employment in the EU-27, by Member State



Note: Employees only.
Source: Sostero et al. (2020).

A1.3 Time frame

The widespread use of teleworking during the COVID-19 pandemic has made it possible to investigate on a large scale its potential advantages and disadvantages, for both workers and companies. This offers a window of opportunity for a structural increase in the uptake of teleworking in future years and to find solutions for the problems encountered. As an example of the interest in the development of this technology, in the period between January and September 2020 in the United States, the share of teleworking-related patents among new applications more than doubled (The Economist, 2022).

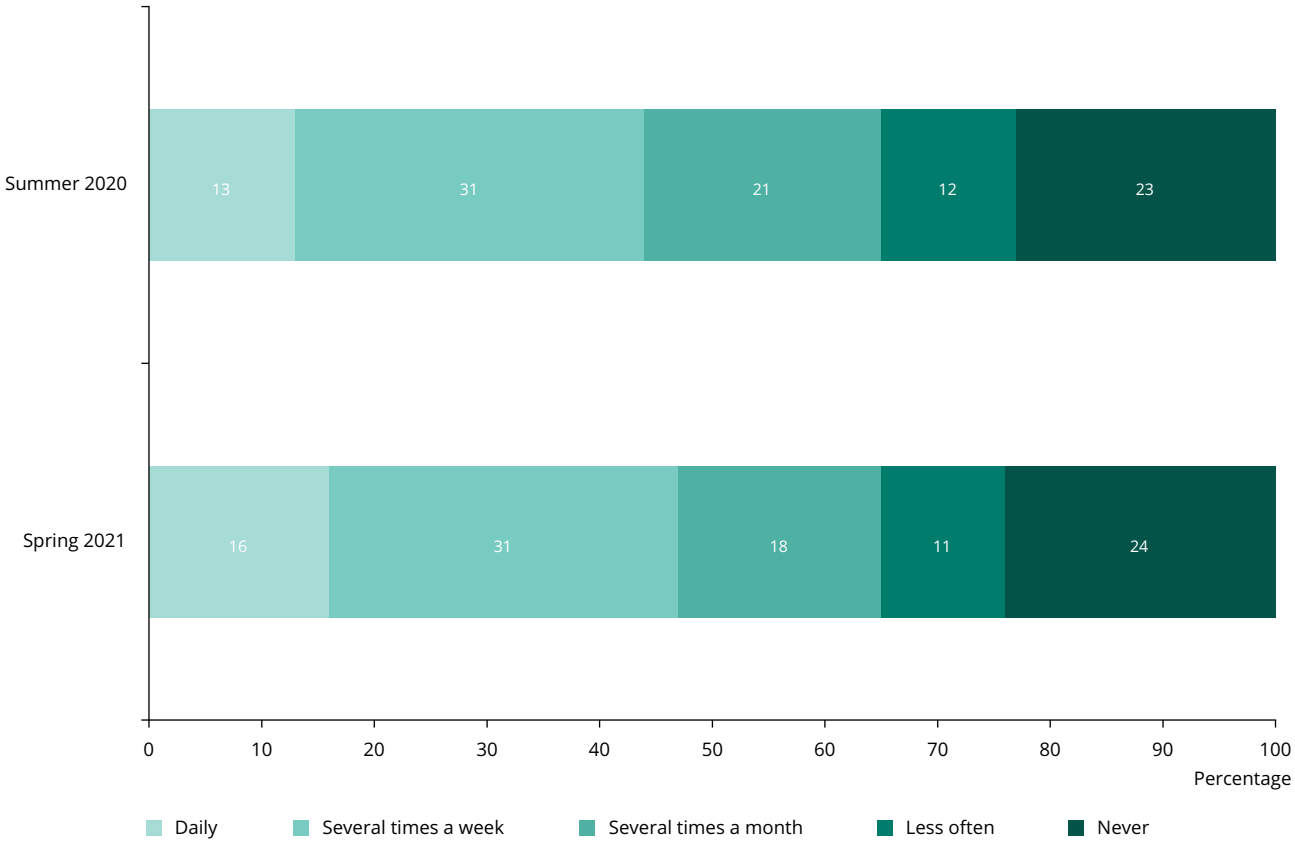
The positive experience of teleworking during the COVID-19 pandemic is likely to have a beneficial effect on the uptake of teleworking, especially in the short- and medium-term future. At the EU level, results from a Eurofound e-survey, 'Living, working and COVID-19', reported in Figure A1.3, indicate that in the post-pandemic period, most employees still express a preference to combine working from home with working from the employer's premises, with the most popular choice being to work from home several times a week (Ahrendt et al., 2021).

In another survey by Olde Kalter et al. (2021) among 1,515 Dutch employees, office workers state that they will telework more after COVID-19 than before. Positive experiences of teleworking, such as the potential for a better work-life balance without loss of productivity, increased familiarity with information and communications technology (ICT) facilities and other support offered by the employers, strengthened this effect. Similarly, a Eurofound e-survey indicates that 'most of the EU workers expressed a preference to work from home several times per week in the long term' (Eurofound 2021). Additional information on this specific topic can be found in

a recent report from the US National Bureau of Economic Research (Bloom et al., 2022). Ton et al. (2022) studied willingness to telework after the COVID-19 pandemic among train travellers in the Netherlands (both frequent and less frequent train users). Of these people, 71% reported a high willingness to telework, which could potentially have a large impact on public transport use. In contrast, about 16% reported a low willingness to telework, mostly because they disliked it or their organisations are not yet ready. Lastly, 12% were self-employed workers whose working arrangement was almost not affected by the pandemic.

It is likely that the future uptake of teleworking will be strengthened by several ongoing developments, including those related to new regulatory frameworks, as discussed in Section A1.5. For example, with an increasingly digitally-enabled society, the potential for teleworking will also grow, expanding to include jobs in which remote intervention has been impossible until now. The growing share of the tertiary sector will also lead to greater potential for teleworking, especially for office-based knowledge-intensive work (Hurley, 2021). ICT and software tools for teleworking are also expected to be developed further, making the experience even more attractive and virtual exchanges more effective (Frey, et al., 2020).

Figure A1.3 Preference for working from home post pandemic in the EU-27 (%)



Source: Ahrendt et al. (2021).

A1.4 Expected environmental impacts

Using the taxonomy set out in Chapter 3, the following higher order environmental impacts of teleworking can be identified.

A1.4.1 Indirect effects — efficiency effects

The first group of environmental effects is related to the change from the conventional workplace to the home office or another location. For employers, teleworking offers the potential to reduce the environmental impacts of the office locations (conventional workplace, satellite offices or co-working locations). Indeed, with teleworking, firms have opportunities to optimise their offices (e.g. in terms of occupancy), which may lead to smaller offices and less need for new buildings. This is discussed in more detail in case study 1.1, in which the importance of the options chosen for office buildings is investigated.

In this context, it is important to evaluate the extent to which any reduction in energy consumption at the office is offset by a corresponding increase in energy consumption at home. This depends, first, on the energy efficiency of the home office and the share of more environmentally friendly energy sources at home. In the EU, the average energy consumption per dwelling in 2019 was 1.3 tonnes of oil equivalent (toe) ([12]). It ranged from 0.5toe/dwelling in Malta to 2.3toe/dwelling in Luxembourg. On average, space heating accounted for 65% of this average energy consumption or 0.85toe/dwelling in the EU. The consumption per dwelling fell by 1.0% per year (Enerdata, 2021). The average external cost in the residential sector in the EU in 2018 was EUR 884/toe, an estimate based on a life cycle analysis (Smith, Moerenhout et al., 2020). In 2020, the main use of energy by households was for space heating (62.8% of final energy consumption in the residential sector), while the electricity used for lighting and most electrical appliances represented 14.5% (Eurostat, 2022g). In the EU-27, since 2000, the energy consumption per m^2 for space heating fell by 2.1%/year over 2000-2014 and to 0.6%/year over 2014-2019 (Enerdata, 2021). This is a relatively slow decrease, as dwellings are typically used many decades before they are rebuilt or fully renovated. The weighted annual energy renovation rate at EU level is only around 1% ([13]). This applies to both residential and non-residential buildings (EC, 2021s). The share of renewables and biofuels in space heating was 26.8% in 2020 (Eurostat, 2022g).

The extent to which energy consumption at home increases with teleworking is the second factor that determines the environmental cost of teleworking at home. It can vary significantly depending on the specific situation. For example, if other household members stay at home on the days that one works in the office, and consequently the home is heated or cooled anyway, the extra energy required for teleworking will be relatively small. Moreover, the additional surface that needs to be heated or cooled will vary from person to person. Case study 1.1 illustrates the impact of teleworking on greenhouse gas (GHG) emissions at home in France.

Over time it can be expected that the environmental impact associated with the choice of a specific work location will change, as the environmental performance of the buildings will improve. Under the influence of policies such as the Renewable Energy Directive (recast) and the Directive on the energy efficiency of buildings, both of which are being revised at the moment, the building stock will become more energy efficient and energy sources will become cleaner.

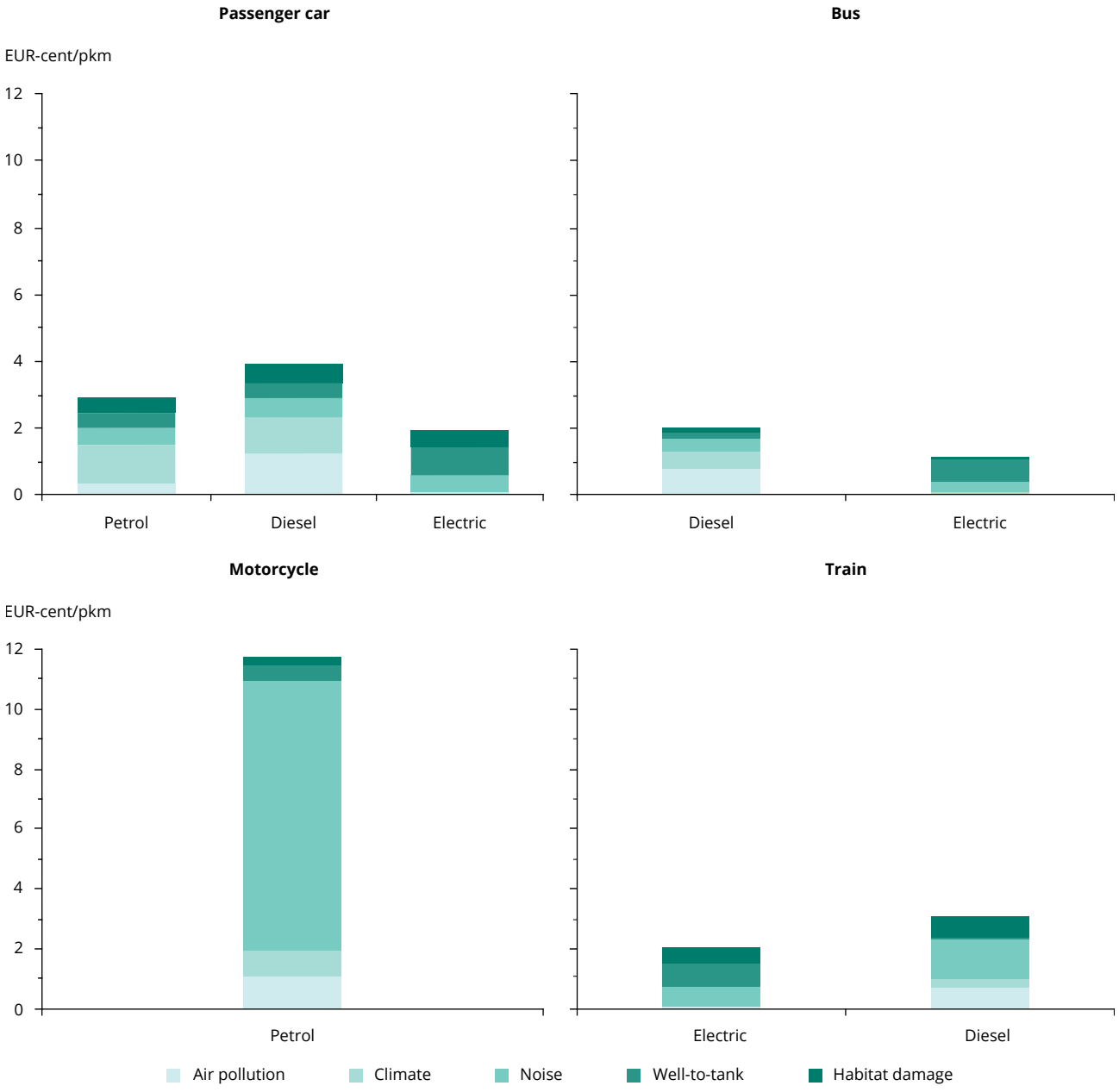
A1.4.2 Indirect effects — substitution effects

As discussed in previous sections, teleworking brings environmental benefits, as the number of commuting trips is reduced or shortened (e.g. if a co-working space closer to the employee's home is used). To a lesser extent there could also be environmental benefits when commuting trips by car are shifted to times with less road network congestion, reducing emissions per kilometre. Everything else being equal, the potential environmental benefits increase with the commuting distance to the conventional workplace. In the case of people who telework at locations other than home, they still need to make a trip. While the number of trips does not change in this case, the commuting distance does. In some cases, the distance can be much shorter, making active transport modes more attractive.

The environmental impacts also depend on the transport modes normally used when commuting to the conventional workplace. Following the approach presented in the *Handbook of the external costs of transport* (EC, 2019a), it is possible to estimate the costs per passenger-km for different transport modes. As shown in Figure A1.4, these are highest for people commuting by a petrol motorcycle, a car with an internal combustion engine or a diesel train. Hence, these people realise the highest potential benefit from teleworking. For people normally commuting by electric car, electric train, bus/tram/metro or active transport modes the positive impact is smaller or zero.

([12]) 1toe corresponds to 41.84GJ.
([13]) The term 'weighted annual energy renovation rate' refers to 'the annual reduction of primary energy consumption in the total building stock achieved through the sum of energy renovations at all depths (light, medium and deep)'.

Figure A1.4 Average external cost per passenger-km in 2016 (EUR-cent/pkm)

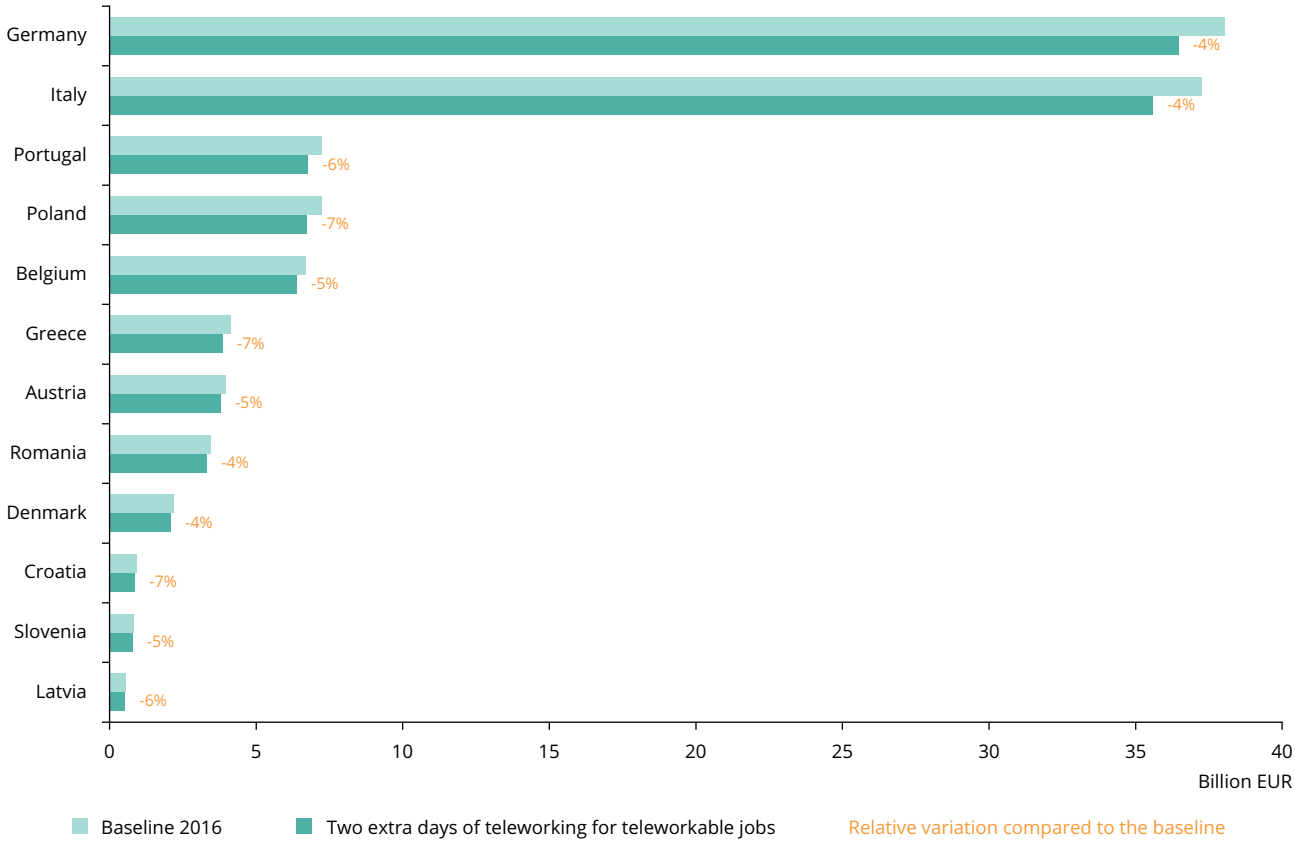


Note: Due to the unavailability of an estimate for the noise costs of electric vehicles, these are assumed to be the same as for vehicles with an internal combustion engine.

Source: EC (2019a).

On the basis of these costs, Figure A1.5 presents an approximate indication of the substitution effect that can be obtained by two extra days per week of teleworking at home (for the jobs for which this is possible) in 12 EU Member States, under a series of assumptions. First, the baseline external environmental costs are based on the Commission's estimates for 2016 (EC, 2019a). The baseline teleworking situation reflects that of the same year. Second, the share of commuting in passenger transport is based on passenger mobility statistics for the 12 countries for urban trips, as published by Eurostat (2021b). Third, the maximum share of teleworkable jobs in each country is taken from Sostero et al. (2020) and is applied to all workers, although these estimates apply to employees only, as no information is available for self-employed people (Figure A1.2). Under these assumptions, the impact of the two additional days of teleworking on environmental costs ranges between 4% and 7%. It should be stated that, given the assumptions made and not considering rebound effects, such an approximate estimate could be optimistic. It is, however, in line with other estimates, such as the two case studies discussed at the end of this factsheet and in Eurofound (2022a).

Figure A1.5 Approximate estimate of the substitution effect of two additional days of teleworking for employees who can telework — impact on the external environmental costs of passenger transport in 12 EU Member States (EUR billion)



Notes: Approximation assuming that the share of commuting in passenger-km is the same for all transport modes and for urban and non-urban trips, and that the share of teleworkable jobs applies to employees and self-employed people.
The percentages refer to the percentage change compared to the baseline.

Source: EEA compilation, based on EC (2019a), Eurostat (2021b) and Sostero et al. (2020),

The environmental benefits of less travel by motorised modes are likely to diminish in the future, as these modes will become more environmentally friendly. This is illustrated by the difference in environmental costs per passenger-km between vehicles with an internal combustion engine and electric vehicles in Figure A1.4. The change to cleaner transport will take place gradually, as new vehicles penetrate the fleet. The average lifespan of cars in Europe ranges between 8.0 and 35.1 years, with a mean of 18.1 years in western Europe and 28.4 years in eastern Europe (this difference reflects the importance of cross-border trade) (Held et al., 2021).

A1.4.3 Structural and behavioural effects — direct rebound effects

By teleworking people spend less money and time on commuting. This frees up resources that can be spent on other trips or other goods and services. The car used for commuting could also be used by family members. (Henderson, and Mokhtarian, 1996; Koenig et al., 1996; Zhu, 2012; Greenworking and ADEME 2020).

A1.4.4 Structural and behavioural effects — economy-wide rebound

The economy-wide rebound can include several effects. For example, if fewer people commute by car, this will reduce congestion, and this could attract new car traffic. Transport models can give an insight into the magnitude of such effects. An example is given in case study 1.2.

Similarly, a reduction in the demand for public transport may cause revenues from public transport to fall. As a consequence, the supply of public transport may be negatively

affected in the short and mid-term, leading to more private transport being used by the workers that can afford it.

In general, there can be environmental impacts in multiple markets owing to economy-wide adjustments in prices and quantities (e.g. when congestion is reduced because of teleworking, this will benefit sectors that are heavily dependent on road transport).

The first two impacts will depend on transport policy, for example the extent to which transport externalities such as congestion are internalised or the extent to which public transport is subsidised. The last type of environmental impacts is more difficult to quantify. Its evaluation requires complex economic models that can capture the economic consequences of teleworking.

A1.4.5 Structural and behavioural effects — transformational changes

Teleworking can lead to transformational changes. For example, as teleworkers spend less money and time on commuting, they can decide to change their work location or place of residence. For example, they may decide to move to a more distant location with lower house prices and more environmental amenities. Such decisions have an impact on the distance of the remaining commuting trips. On the other side of the labour market, teleworking increases the recruitment area or the locational patterns of firms. Through these channels, teleworking can be expected to affect urban structures (e.g. demand for residential or office spaces) and land use in the long term. Such changes are, however, difficult to quantify.

A1.5 Policy corner

During the COVID-19 pandemic many employees and employers adopted teleworking. From this experience, lessons have been learnt about the possible advantages of teleworking, such as:

- There is a financial benefit for workers, as commuting costs are lower. In times of rising inflation and more expensive commuting, telework also offers a way to save money.
- Workers have extra flexibility in how they combine work and private life.
- Work activities become more robust in the event of exogenous shocks, of which the pandemic is an example. Other examples of shocks include the ongoing energy crisis, natural disasters, national security issues or public transport strikes.

Other advantages for employees are that they have access to more job opportunities. With the same money and time budgets for commuting, jobs at greater distances become possible. If teleworking is applied at a larger scale in combination with additional pricing measures, such as those investigated in Factsheet 7 and Annex 7, it can be expected to lead to less congestion, and therefore shorter commuting times on the days without teleworking. On public transport it may lead to less crowding during peak hours. Employers can have access to a larger pool of potential workers and increase their attractiveness compared to other employers by offering the possibility to telework.

Nevertheless, there are also challenges associated with teleworking, for example the organisation of working hours (Predotova, and Vargas Llave, 2021), which may require further legislative initiatives. A Eurofound publication presents an overview of existing regulations and the need for new regulations to improve the working conditions of teleworkers. This could involve, for example, regulations on the right to disconnect to ensure a good balance between work and private life and the employer's provision of equipment for the home office, etc. (Eurofound, 2022b). To maximise the benefits, a framework that supports the positive environmental effects of teleworking (e.g. encouraging the optimal organisation of office spaces) and mitigates the negative rebound effects (e.g. internalisation of external costs, good land use planning, taxation of housing in urban and rural areas) should also be considered.

A1.6 Bottom line

While teleworking is already in use in many cases and forms part of current possible working arrangements, also in response to the COVID-19 pandemic, its net environmental impacts are generally complex and therefore difficult to quantify. Hook et al. (2020) carried out an extensive review of 39 empirical studies on the impact of teleworking on energy use. While most of these studies indicate energy savings, the authors point out that this is because the scope of those studies is relatively narrow, as they focus on the substitution effects. The structural and behavioural effects are often not considered and are in some cases difficult to estimate properly. These are potentially large and can easily counteract the substitution effects. Therefore, it is important to include them in the analysis as far as possible.

The size of the environmental impacts may change in the future, as the environmental performance of both transport and buildings will evolve in response to the policy framework and new technological developments. The policy framework also determines the extent of the behavioural changes. Similar considerations were reported also by Eurofound (2022a).

Many studies conclude with a cautious message: the net impact on energy use may be small or even negative, due to the potentially significant rebound effects involved. This extends to the environmental impacts such as GHG and pollutant emissions. The relative size of the impacts can vary across case studies, as commuting patterns, the composition of the vehicle stock, land use, etc., can vary. For this reason, teleworking can be a measure to complement policies that aim to reduce commuting or car travel, similar to those described in Factsheet 7.

A1.7 Case study 1.1: The impacts of teleworking in France on greenhouse gas emissions

The environmental impacts of teleworking in France were recently assessed by Greenworking and ADEME (2020), on the basis of three focus groups with a total of 25 employees and interviews with 26 organisations employing 350,000 people. The aim was to estimate to what extent higher order effects can reduce the environmental benefits achieved through substitution effects. As a reference, in a previous study, ADEME found that, thanks to the substitution effect, annual GHG emissions fall by 271kg CO_2e (CO_2 equivalents) per person per weekly teleworking day. To put this in perspective, that study estimated the total GHG emissions at about 12.2 tonnes CO_2e per person per year.

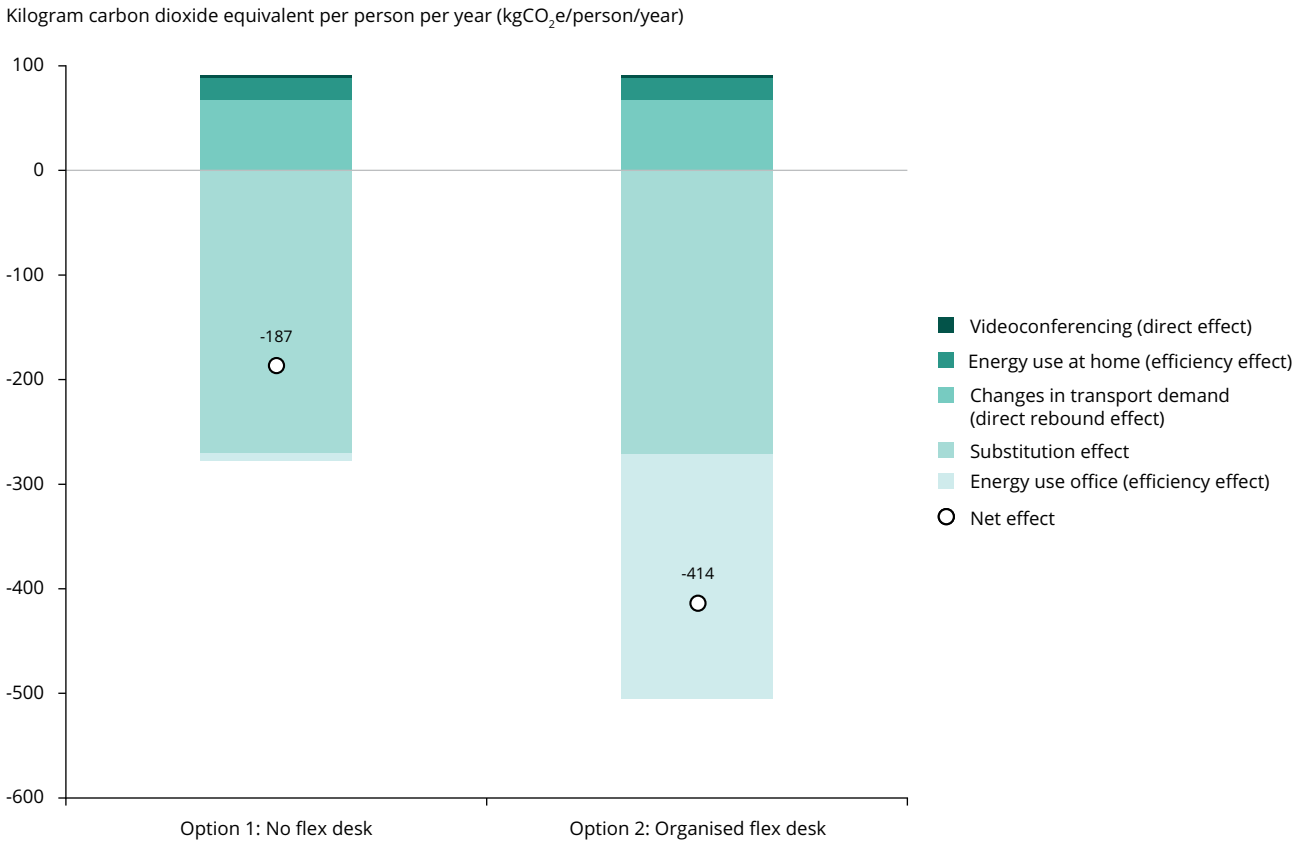
The following effects were investigated:

- changes in daily travel for non-commuting purposes by teleworkers and their household members during teleworking days, including the possibility that this travel uses other modes;
- short-term changes in living locations or recruitment areas of employers (found to be irrelevant from the responses in the surveys);
- additional energy use at home;
- the change in energy use in the office, comparing two options (depicted in Figure A1.6) and assuming an energy consumption of 78kg CO_2/year/m^2 over the life cycle of the office and an average area of 15 m^2 per employee: (1) 'no flexdesk' —energy consumption at the office is optimised without any major reorganisation of the workplace; (2) 'organised flex desk' — each additional weekly teleworking day reduces the office space by 20%;
- the environmental impact of additional videoconferencing services.

While other higher order effects are discussed in the report, such as the long-term effect on the location of households and firms, or the impact of the change in congestion on road traffic, because of the complexities related to their proper estimation, these are not quantified and hence not included in Figure A1.6.

With only optimising energy consumption at the office ('no flex desk'), the net effect on GHG emissions is 31% smaller than the substitution effect. With an organised flex desk system, the opposite is the case. In this case the net reduction in GHG emissions is 53% larger than the substitution effect. Hence, such reorganisation can significantly strengthen the effect of teleworking. All the effects quantified hold for the current emission factors of transport and buildings, but do not consider future developments.

Figure A1.6 Impact of a weekly teleworking day on greenhouse gas emissions per person per year with two options for the organisation of the conventional office (kg CO_2e/teleworker/year)



Source: EEA compilation based on Greenworking and ADEME (2020).

A1.8 Case study 1.2: The impact of increased uptake of teleworking on passenger transport in Belgium in 2040

The Belgian Federal Planning Bureau (FPB, 2020) considered the impact of a higher rate of teleworking in Belgium on the passenger transport outlook for 2040. It compared the baseline scenario for 2040 with a scenario in which the share of employees working at home increases from 17% to 39% and the average number of days homeworking per week increases from 1.4 to 2. A selection of results is presented in Table A1.2. While this study does not consider the environmental effects linked to energy use at home or in the office, it does shed light on another higher order aspect, namely the impact on the transport sector as a whole.

The teleworking scenario has the greatest impact on commuting to the central employment area of the Brussels conurbation, and in relative terms on commuting by rail (a reduction in passenger-km travelled of 16.2%). Both aspects are related to the typically longer distances travelled by train from home to work in Brussels and to the positive correlation observed between train use and teleworking for jobs in the administrative, financial and business services branches. These branches are largely represented in Brussels. In absolute terms, the use of cars for commuting would fall the most (a reduction of 6.9 million passenger-km per day).

Table A1.2 Impact of increased homeworking on transport demand and external environmental costs in Belgium in 2040

	Commuting			Total passenger transport		
	Baseline scenario 2040	Impact of teleworking scenario		Baseline scenario 2040	Impact of teleworking scenario	
	Million passenger-km per day and % change compared to baseline 2040					
Car	96.2	-6.9	-7.2%	367.3	-2.7	-0.7%
Train	13	-2.1	-16.2%	30.5	-2.2	-7.2%
Bus/tram/metro	4.3	-0.3	-7.0%	27.7	-0.2	-0.7%
Motorcycle	1.7	-0.2	-11.8%	5.3	-0.2	-3.8%
On foot/bicycle	1.7	-0.2	-11.8%	19.5	-0.1	-0.5%
Total	116.9	-9.7	-8.3%	450.3	-5.4	-1.2%
	Approximation of external environmental costs (EUR million/day and % change compared to baseline 2040)					
With ICE vehicles	3.8	-0.3	-8.1%	14.3	-0.1	-1.2%
With battery electric vehicles	2.3	-0.2	-8.6%	8.4	-0.1	-1.4%

Note: ICE, internal combustion engine.
Source: EEA compilation based on FPB (2020) and EC (2019a).

The absolute impact on total passenger-km travelled is, however, 44% smaller than the impact on solely commuting-related transport. First, the FPB takes into account that, on homeworking days, people will travel more for non-work-related purposes than in the baseline scenario (direct rebound effect). For car transport the reduction in congestion also makes the car a more attractive mode (economy-wide rebound effect). As a result, it is projected that the total impact on passenger transport is relatively small: the total number of passenger-km travelled is reduced by 1.2% compared to the baseline scenario and car passenger-km travelled are 0.7% lower than in the baseline.

The study does not calculate the environmental impacts. However, given the small effects on passenger transport and the larger share of electric cars in 2040, the environmental benefits in transport are likely to be small. This can be approximated using the estimates for the average external environmental costs of passenger transport from the European Commission handbook (EC, 2019a). Under the simplified assumption that these values, estimated for 2016, can also be used in this case, teleworking reduces the external environmental costs by about EUR 170,000 per day, which corresponds to a 1.2% reduction compared to the baseline. This is 46% lower than if only the impact on the external costs of commuting is considered. In the — optimistic — scenario that all cars, buses and motorcycles are electric in 2040, the reduction in environmental costs is only EUR 120,000 per day, or a reduction of 1.4% compared to the baseline with electric vehicles. This is 39% lower than if only the impact on the environmental costs of commuting were considered.

An older study on the Flanders region in Belgium (Delhaye, et al., 2013), which investigated the rebound effects of teleworking on energy consumption and time savings for 2010, indicated that these effects can be large. Table A1.3 presents the results for 1 teleworking day per week for 9% of employees and a car sharing rate of 51% in commuting. The net effect on energy consumption is almost zero. This could be improved if offices become smaller and/or fewer offices need to be built. Moreover, the energy consumption of residential buildings has decreased over time. For the time savings, the net effect is 29% of the substitution effect. This is because other transport users save time thanks to the reduction in congestion.

Table A1.3 Rebound effects of teleworking in Flanders, 2010

Effect	Energy consumption (million kWh/year)	Time savings (million h/year)
Substitution effect	-265	-15
Efficiency effect Energy consumption at home	+69	
Direct rebound effect and location effect	+120	+7
Impact of reduced congestion on transport system	+72	+4
Net effect	-4	-4
Net effect as percentage of substitution effect	**1%**	**29%**

Source: Delhaye et al. (2013).