

THE COSTS OF TRANSPORT ON THE ENVIRONMENT – THE ROLE OF TELEWORKING IN REDUCING CARBON EMISSIONS

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1. Introduction

This final report summarises the output from the project, following the meeting on the 14th February 2007 between David Banister and the clients – Peter Warren (Future Intelligence), Meabh Allen (BT) and Aamir Butt (Giritech) and the subsequent teleconferences with all parties (4th May 2007 and 29th May 2007). The first two sections review the empirical evidence and the literature, and it draws out some of the main elements for further research. The third section sketches out the elements of the proposed full costing approach for the evaluation of the potential for teleworking. The final two sections cover the interviews, the specific issues of technology and security, and the priorities for further work. In the annexes, more details are given on the analysis carried out on the secondary data, a fuller review of the literature and summaries of the interviews carried out.

2. The Empirical Evidence

The headline figures presented here are taken from the three major sources of statistical information in the UK – the National Travel Survey, the Labour Force Survey and the 2001 Census – along with the EU source, Statistical Indicators Benchmarking the Information Society (SIBIS). A fuller review of the data and tables are given in Annex 1.

- a) The number of commuting trips has fallen by 8% from 1995-2005
- b) Journey to work trip lengths have increased from 8.2 to 8.7 miles (1995-2005), about 6%, and business journeys have increased slightly as well, with the average trip now being 19.4 miles (an increase from 19.0 miles in 1995, although down from a peak of 21.1 miles in 2004).
- c) Trip times for journeys to work have also risen over the period 1995-2005 from 24 minutes to 27 minutes, an increase of 13%.
- d) Around 70% of all commuting journeys are undertaken by car, van, or minibus. In all commuting journeys between 6 and 45 minutes in length, car users make a greater proportion of trips than average.
- e) The 2001 Census gives a figure of 9.19% of the working population as working “mainly at or from home” in England and Wales, but this includes 809,713 who are small employers or own account workers – this group includes builders, electricians, and others who are self employed and work from home.
- f) The Labour Force Survey gives the most accurate figure of teleworking on an annual basis from 1997-2006. From their data (2006), about 12.1% are classified as homeworkers¹ (3,474,000 including employees and self employed), of whom 22.2% work mainly from their own home (773,542), and 80% of these (620,000) are teleworkers using TC at home (telephone and computers). This figure has doubled since 1997 (from 42.3%).

¹ Homeworkers include those that use home as a base for work and those working in their own home.

- g) The number of homeworkers who are classed as working mainly in their own homes is likely to reach 850,000 by 2010, most of whom will use TC.
- h) Around 90% of teleworkers work in managerial, professional, associate professional and technical, and skilled trade occupations – the levels of teleworking in the latter is 17% of the workforce. In other less skilled occupations, the potential is substantially less. The proportion of workers who telework in their own home is highest in the banking finance and insurance industry.
- i) Around two-thirds of all teleworkers are male, but a majority of those teleworking at home are female
- j) The frequency of homeworking amongst full-time employees is rising, but 83% still say that it is not possible to work at home. However, 65% of those in work in the UK are “very” or “somewhat” interested in at least one type of telework, while 33% regard their job as feasible for home teleworking at least one day per week
- k) The UK is sixth highest in the EU for those who telework at home for more than one day a week

3. The Literature Review

The main conclusions are summarised here, with a more extensive review in Annex 2:

- **Empirical studies of teleworking show that it typically results in substantial reductions in car mileage for the day on which teleworking takes place.** This is the case, even where studies take account of additional mileage generated as a result of new car travel because of the need to make trips that would otherwise have been made in the course of commuting, or because other household members make extra trips after gaining access to the household car.
- **Some teleworkers show ‘contracted action spaces’.** While ‘rebound effects’ described above can have some impact in eroding energy savings from teleworking, there are some studies where teleworkers have been found to travel smaller distances from home for non-commuter journeys too. Moreover, some studies found that teleworking was accompanied by a reduction in travel by other household members.
- **There is debate as to how far it is legitimate to include travel rebound effects in assessments of the impact of teleworking.** This is because these effects can be regarded as an example of the more general issue of induced traffic. To realise the impact of energy reductions from teleworking it is important to have other traffic restraint measures in place that ‘lock in’ these reductions by preventing induced traffic. Teleworking will be more effective in achieving energy savings where it is reinforced by other policies to support sustainable transport, and its energy savings will be more easily eroded where this is not the case.

- **Teleworking can save energy at the worksite – providing working practices change accordingly.** Very few studies have assessed the impact of teleworking on energy used in the home and the workplace. From those that have, the indications are that the energy savings from travel will outweigh the additional energy used as a result of the extra hours spent working at home. Where the workplace is re-designed to reduce space per employee then there can be substantial additional energy savings as a result. If this leads organisations to re-locate then the choice of location will be critical to the effects on energy use, since it can change commute length and public transport accessibility.
- **Teleworkers typically have longer than average commutes but this does not necessarily mean that teleworking encourages more remote living.** The fact that teleworkers typically live further from work has led to speculation that, over time, they may be prone to move away from the worksite, so that encouraging teleworking could lead to more geographically dispersed living patterns, generating more car travel in the long term. There is however, little evidence, about the influence of teleworking on people's choice of where to live. What evidence exists suggests that teleworking does not have this effect, and lead to decisions to relocate closer to work as well as further away. However, to fully understand these effects it is necessary to look at the relationship between teleworking and choice of home location over the longer term, and to find out how teleworkers working lives change over time. Teleworkers' longer-than-average commutes can skew the results of studies – for example, when travel savings are compared to other energy savings.
- **Mobile working has fuelled a recent growth in teleworking.** Teleworking increased 150% between 1997 and 2005 – a growth driven mainly by an increase in people teleworking in different places with home as a base (up from 2% to 6%). While there has been an upward trend in teleworking for both sexes since 1997, the recent increase has been greater for men than women. This suggests that the current rise in teleworking is less a result of family-friendly policies than of other changes working practices. It also points to the importance of assessing the energy implications and social consequences of specific styles of teleworking, particularly 'mobile working', whose benefits are advocated by some companies in the communications industry.
- **The majority of teleworkers are self-employed or unpaid.** While employers may be encouraged to adopt teleworking by recent employment legislation and by support for family friendly policies, the recent increase in teleworking has been greater among self-employed people and unpaid family workers than among employees.
- **Teleworking has a wide range of benefits for employers, employees and communities.** It has been linked with lower absenteeism, improved recruitment and retention, higher productivity, good work-life balance and good quality of life. Teleworkers tend to work longer hours than non-

teleworkers, and identify this as one reason for their improved performance, but see reduced stress and better concentration as more important factors. Greater autonomy and flexibility in work planning and performance appears to be a key reason for improved work-life balance. Teleworking has also been linked to better health. There is evidence that teleworkers become more involved in their own communities and spend more on local services.

Emerging issues from the literature review:

Promoting telework appears to have the potential to deliver a substantial reduction in traffic. The *Smarter Choices* study concluded that, depending on the intensity of its promotion, teleworking could reduce car commuter trips by 3 – 12% in ten years (Cairns et al, 2004). Strategies to encourage teleworking are especially attractive given its popularity – surveys repeatedly find that employees are interested in working at home to a greater extent than they presently do. There are potential benefits for families, communities and employers. The fact that teleworking is already on the increase also points to the potential ease of encouraging more employers to enable employees to work from home.

However, there are several key issues about teleworking that need to be better understood, and could have important implications for the way in which strategies to promote teleworking are pursued:

- What is the nature of the mobile working that has fuelled recent growth in teleworking and how do its social and environmental impacts differ from more traditional-home based teleworking?
- If, as appears to be the case, the growth in teleworking has been predominantly fuelled mainly by an increase among male workers, then how far has this increase actually helped to realise aspirations that teleworking can deliver more family-friendly working conditions for those with caring responsibilities?
- How does the experience of teleworking go on to influence more long term decisions about where to live and where to work – what do we know about the way teleworkers' working lives and travel habits evolve over time?
- What more is known about the relative energy use in homes and workplaces that could inform our understanding of the likely trade-offs?
- What actions can employers take to ensure that their telecommuting policies result in optimal energy savings?
- What actions can employers take to ensure that telecommuting overcomes potential problems and barriers, such as employee isolation and employer concerns about security and abuse?
- How far should 'rebound effects' on non-commuter travel be included in assessments of the impact of teleworking?

These are questions to be explored with interviewees and further comments are made in the conclusions.

4. Full Costing Approach

In the graphic below, the structure of the full costing approach is outlined. This includes both the primary effects of teleworking in terms of travel, energy and environmental savings, and the potential social impacts. The basic question being addressed would be about the costs and benefits the new flexibility offered by the current generation of technology for teleworking, to whom the benefits (and costs) accrue, and whether working from home can help create a healthier environment – in the graphic + means an increase and – means a reduction.

Energy and environment	Work Place		Travel		Home
	- Space - Energy - Car parking - Equipment	↔	- Travel - Energy - Peak travel - Emissions	↔	+ Space + Energy + Equipment
			+ Additional trips by worker and others + Support for home based technology + New complementary trips		
Social					
	+ Productivity + Health - Absenteeism + Recruitment and retention	↔	+ Review company car policy + “Green” travel image + Company seen as being dynamic and responsible	↔	+ Quality of life +Work-life balance + Personal performance +Health and less stress +Personal control and
	- Support costs higher - Security costs higher				- Increased work hours

In addition to these impacts, there may also be complicating factors such as:

- There may also be second round effects on home location – evidence here seems to work in both directions. Increased community involvement, particularly in rural areas, may also be important with more spending in the local economy and getting involved in their local area, rather than just using the place as a dormitory.
- Other factors not covered in the literature include the possibility of company reorganisation when “sufficient” teleworking takes place, the socialisation function of the workplace, and the balance at home between independence (good) and isolation (bad).
- Problems may also exist for performance testing of employees, career path assessment and trust between workers and employers.
- Strengthening family ties and the value associated with being around more, but also recognising that there may be a value in separating home from workplace.

These changes are taking place against a background of substantial modifications in the workforce, which is also becoming more casual and footloose, as the concept of employment for life and commitment to one employer now being seen as the exception rather than the rule. Labour is much more mobile. A new phenomenon is the growth in mobile working that may encourage more travel and longer journeys, negating some of the potential benefits of teleworking. The potential for the latest generation of technology (e.g. MSN, IP and videolinks) to address some of the limitations of the older technologies may act as a counter balance?

Full Costing Approach – Energy Savings and CO₂ Reductions

All data here for 2005 – unless stated otherwise. Energy use is split between transport (25%), buildings (45% - 25% domestic and 20% non residential) and industry (30%). An average individual in the UK produces about 13t of CO₂ per year (the global average is 5.8t).

2005	Work	Travel	Home	NTS 2005
Low 1 day per week <10 hours	Marginal or no savings – less than 5%	80 MJ per journey = 217 kg CO ₂ for 40 days	Heating, lighting computing = 173 kg CO ₂	8% telework less than 1 day a week
Medium 2-3 days per week 11 – 20 hours	About 20% - need case studies and numbers of employees involved	200 MJ for 2.5 journeys = 543 kg CO ₂ for 100 days	Heating, lighting computing = 432 kg CO ₂	23% telework 2 or 3 days a week
High 3 or 4 days per week >21 hours	About 50% - need case studies and numbers of employees involved	280 MJ for 3.5 journeys = 760 kg CO ₂ for 140 days	Heating, lighting computing = 606 kg CO ₂	9% telework more than 3 days a week
	Savings and space requirements depend on the type of firm – Office buildings in the UK Heating = 38% Light = 23% IT = 11% Cooling = 14% Other = 14% (DETR, 2000) – reductions in parking space can save £1000 - £3000 per annum	Annual figures Based on average work trip of 8.7 miles (or 28 km return) Those already doing it may be the longer distance travellers	For 1 Room, Gas 17C and 5 working days per week – 77% of energy is for heating and 23% for other uses Room = 800 kg CO ₂ and energy is 1039 kg CO ₂ . but lighting and computing = 27% of 23% = 65 kg CO ₂ – so total is 865 kg CO ₂	Note that 37% telework less frequently and 23% never do it

Note: These are very preliminary and need further research – based on DETR (2000) and Lynas (2007). The Tickbox.net survey for Microsoft (2007) suggest that 19.1% telework <16 hrs per week, 7.5% telework between 16 and 25 hrs per week, and 7.9% telework >26 hrs per week. The remaining 52.8% say that teleworking is not applicable or say they do none (12.6%).

These values are illustrative, but they already give some ideas as to what might be the balances between the different styles of teleworking and the distances travelled. They are similar to those produced in a recent survey of some 900 BT

employees, 225 of whom had been recently made use of conference calls that had resulted in an average of 247 “avoided miles” of travel (James, 2007). The land based element in this figure is 142 miles with nearly 29,000 miles of “avoided travel” for the whole sample (204 people excluding those that only used air), giving a total reduction of 9242 kg of “avoided CO₂” or 45 kg per trip (this gives a figure of 0.31 kg CO₂ per mile). James (2007) also calculates that “avoided cost” in terms of the reductions on travel costs and time saved, which is seen as being an opportunity cost as it increases productive time – the “avoided cost” per land based trip is calculated at £52. Several issues are raised by the approach presented above, some of which need further research:

1. For an average journey about 80% of the travel savings are lost through additional costs of heating and lighting/computing at home – this is based on one room being allocated for work and for all costs of heating and lighting that room being allocated to work. But still worth it if the rebound effects do not erode the benefits.
2. The distance taken for the journey to work is an average one – about 65% of work journeys (2001 Census) are under the average (14kms), but the other 35% are longer journeys – half are slightly longer (17.9% are 15-20km in length), but the others are substantially longer (7.9% are 20-30km and 9.5% are over 30km).
3. The values in the workplace column are “guesstimates” as offices vary substantially in their individual characteristics as reflected in the DETR 4 types. For example Sun Microsystems through their iWork scheme with 35,000 workers have saved 25% of their workspace as 70% now hotdesk (3 to a desk) and more than 50% of their employees work from a variety of locations (including home), saving more than 2 hours a week in commuting time. Case studies of a range of different companies are required to assess the extent of any change – it also depends on the numbers of employees involved and the frequency with which they telework (Forum for the Future, 2004).
4. The SusTel report on BT and BAA suggested that savings in distance for teleworkers was 253 miles (BT) and 61 miles (BAA), with some rebound effects of 60 and 16 miles respectively (James, 2004). In both cases this gave substantial savings. Other evidence from the US and EU suggests that in about 40% of cases teleworkers make no additional use of the car, but in 60% of cases there is a 75% saving in car use.
5. Estimates of the maximum saving vary from 11% in the Smarter Choices report to 3% in the Forum for the Future report (2004). But there are also savings from peak hour traffic reductions – the evidence from the NTS suggests here that journey times for the work trips have increased at a faster rate than distances – this is a congestion effect. Chou et al. (2005) suggest that the overall savings in travel miles could be 0.8%
6. The levels of household energy costs are high (see 1), and the figures from the US suggest that additional household costs are 11-20% of the transport savings. It part this may be explained by longer journeys in the

US and less efficient cars, but the differences merit further investigation (Mokhtarian et al., 1995).

7. A key area here is how households make use of their space heating at home and the use of average figures here in the calculations. If households leave their heating on anyway on a normal cycle and there is no supplementary heating, then the cost increases are zero. But if they change the typical central heating cycle (morning and evening), so that the heating is on all the day, then the figures (averages) used here are sound. Teleworking has lower home energy heating costs in the summer and this is when teleworking should be encouraged. More detailed empirical research is required on this important element in the full costing approach.
8. The figures can be calculated for the different types of employment and this in turn can be related to the range of housing types. Energy costs in offices (2000 prices) – combines gas and electricity.

	£/m ²	CO ₂ kg/m ²
Type 1 – Naturally ventilated cellular	5.86	54
Type 2 – Naturally ventilated open-plan	7.19	69
Type 3 – Air conditioned standard	14.21	139
Type 4- Air conditioned prestige	19.79	207

From DETR (2000) and Pout et al. (1998)

9. Growth in UK homeworkers has been 3.5% pa over the 9 year period from 1997-2005 (2.3m to 3.1m), and this could rise to 4.16m in 2010. Within this group, 768,000 (2005) are classified as those who mainly work from home and their numbers have been increasing by 1.5% pa giving a possible increase in numbers to 827,000 by 2010. Teleworkers are a subset of this figure and they have increased in number by 8% pa from 1997-2005 to 603,000 – their number could be 886,000 by 2010 assuming a similar growth rate. So teleworking is increasing at a much greater rate than other forms of homeworking.

5. Interviews

The final stage of the scoping study carried out a series of targeted interviews with key individuals to elaborate on the findings from the secondary sources above and to explore the main areas of uncertainty for both the energy and environmental aspects of teleworking and the social issues raised. It also reports briefly on recent surveys carried out by a variety of organisations.

Dave Dunbar – BT: Very positive about all aspects of teleworking, with some 70% of BT employees working remotely saving £500m on property since its introduction. Productivity is seen to increase and absenteeism is reduced. There are few problems with the technology, but it is the cultural issues that raise most concerns – leadership, no disadvantage in working at home, and that it can be made attractive to middle management. Careful planning of implementation is key to the successful take up of the technology. In the future, some convergence

is necessary to increase the range of places to use the technology and to enhance the switch to mobile working.

Richard Swann – IOD: Relatively recently introduced flexible working for 35 of the 275 staff, initially with separate lines and PCs, but now with own equipment. Main benefits have been the better life/work balance, and people growing accustomed to new ways of working. Various security systems have been used (e.g. Citrix), but now standardising on AEP to maintain integrity of the links. “Barriers have been behavioural rather than technological”. It is important to encourage the independence and trust of workers. Feedback is very positive.

Barry Goldberg – Swansea University Health Informatics Department: About 7 people have been working remotely since 1990, and most have PC with VPN and a Mytel teleworker phone so that files can be shared. There is also substantial teleconferencing and videoconferencing. Recent addition of broadband has been instrumental in improving the quality of links, and it is now “working like a dream”. There are no technological barriers, with younger workers treating it as normal.

Annette Keane – KPMG: Works 2 days a week at home and is a “flexible working champion” for KPMG in the UK. All equipment is provided by the employer, including broadband connections, and there is an internal website dedicated to flexible working. Strong family benefits for parents with young children and output is substantially increased. Isolation or security not seen as a problem, and there have been positive spin offs in terms of a more environmentally oriented lifestyle in other respects.

The following summary of the main points from the recent Tickbox.net survey for Microsoft (April, 2007) suggests that there is a huge variability in the numbers of hours that their respondents² spent in the office, ranging from 56% being there over 36 hours, a further 32% between 16 and 35 hours, and the remaining 12% less than 15 hours. Nearly 57% felt that it was important to have a permanent place of work to carry out their job effectively.

Table 1: Reasons for choice of working environment

Sample size 1020	Percent
1. Do not have the proper equipment to work effectively elsewhere	36.5%
2. I would not choose to work remotely	31.5%
3. Would miss the social interaction with colleagues too much	30.8%
4. I work better when in of the office	18.4%
5. Not enough self discipline to make it work	18.0%
6. Prefer face to face meetings	12.6%
7. Worried people will think I am not working if at home	11.5%

Source: Tickbox.net Survey (2007)

² This was a representative sample of 1020 UK adults (over 16 years old) carried out online between 5th April and 12th April 2007.

Table 2: Location of work

Sample size 1020	Percent
Only work at permanent place of work	60.1%
Work at home	23.8%
Work in the field or on the road	13.1%
Work in another office	6.1%
Work elsewhere (not specified)	3.8%

Source: Tickbox.net Survey (2007)

Table 3: Integration of remote working with the workplace

Sample size 1020	Percent
1. Mobile working is not allowed	28.9%
2. Mobile working is allowed but there are no formal policies in place	19.6%
3. Staff can work flexibly only in special circumstances	18.8%
4. There is a formal mobile working policy in place	16.4%
5. I don't know what this means	16.3%

Source: Tickbox.net Survey (2007)

Table 4: Benefits of working remotely

Sample size 1020	Percent
1. Not sitting in rush hour traffic	56.6%
2. Enjoy a less stressful working life	51.6%
3. Happier	49.1%
4. Able to conduct personal appointments at a time that suits me	46.0%
5. Able to be more involved in family life (school's sports days and taking children to school)	42.2%
6. Less tired	42.1%
7. Being more productive at work	34.8%
8. None of the above	14.1%

Source: Tickbox.net Survey (2007)

The most interesting part of the survey commented on the reasons why individuals either chose to work remotely or chose to work in a conventional office environment (Table 1). The survey also produced clear evidence about the emerging flexibility in notions of remote working, as it now includes home, “in the field or on the road”, and at another office (Table 2). The survey also looked at the company policy with respect to mobile working in terms of its integration with the place of work (Table 3). Finally (Table 4) there are a list of positive reasons for working remotely, with not sitting in congestion, less stress and happiness all featuring strongly. In summary, 45% of the sample reported that working remotely would have no impact on their productivity, 39% said that their productivity would be improved and the remaining 16% suggested that they would be less productive.

6. Technology and Security

From the interviews and several recent reports, conclusions can be drawn about the issues of technology and security. For larger firms, flexible working is now a key factor in choosing a new job (73% in the 2007 Tickbox survey – see above), but only 16% of businesses have a formal flexible working policy in place. Younger workers (16-24) are particularly keen, but they are also aware of possible negative consequences as perceived by employers on their commitment and productivity. This concern is still perceived, even though surveys suggest that about 75% of employees believe that their productivity is improving and 61% think that managers do as well. The lack of trust is also an issue picked up by Mitel (2006) where some 29% of the 200 senior decision makers surveyed did not allow teleworking because they were concerned about less work and time input from teleworkers, and it was perceived by some teleworkers (30%) that there would be less promotion opportunities for them.

In the THUS (2006) survey of SMBs, 36% cited the lack of proper equipment as a key barrier to remote working, with the lack of out-of-hours support being seen as the major limitation to remote working. There are packages available from many providers that link together telephony, voice conferencing and high speed broadband services, including web access. These packages can be linked to a business local area network (LAN) and PDAs (e.g. Blackberry 7130v™) to give mobile facilities. The technological issues are relatively easy to solve as broadband is widely available (70% of all internet connections in 2006), as is IP telephony and the means for mobile working, but there may still be security risks, as home and mobile networks are unlikely to be as secure as office networks. The SonicWALL survey (May, 2007) found that security was considered a very low priority, with 88% admitting that passwords were stored in “easy access” locations, with 56% of teleworkers using their own memories. Only 12% used encrypted files to store and manage their login data. Security can be easily maintained through a VPN³, and there are many companies specialising in providing secure connections for SME/SMBs⁴.

Network Box (2007) found that 63% of SMEs had no protection against phishing attacks and 38% could also be subject to spyware invasion. Knowledge about anti-virus protection was limited, particularly on whether it was regularly updated, and 30% of SMEs do not have anti-spam filters in operation. Although many of these small surveys are carried out by organisations with interests in promoting improved technology and security for remote working, a general picture of a lack of knowledge about both the latest opportunities for new forms of remote working and the security implications is apparent in SME/SMBs. These small businesses may be more at risk and hence less likely to encourage teleworking. The Mitel

³ Virtual private network enables two computers to send encrypted data over the network securely.

⁴ Examples here include Plan-Net, McAfee, Ipswitch, HoundDog, FutureSoft, Bloxx, Astaro, and CheckPoint

(2006) report concluded that only 26% of SMBs offered teleworking as compared with 68% of organisations with over 100 employees. With 90% of the 4.3 million businesses in the UK, this means that most workers are not being offered the opportunity to telework. The THUS survey (2006) produced slightly different results, as 80% of the SMBs contacted had remote working policies in place, but only 45% of employees took advantage of them. Part of the reason for this was that 57% of SMBs expected their employees to pay for at least some of the technology required.

The interviews and the reviews of the recent surveys carried out for various employers suggest that there is a convergence of views. The issues of technology and security are perceived to be less of a barrier than in the past for the larger firms (over 100 employees), but it still remains an issue for SME/SMBs, and it seems that it is partly based on ignorance of the risks involved. This is likely to become more important as broadband connections and IP links have greatly facilitated the range of activities that can be carried out remotely. The next generation of mobile technologies will again give even greater flexibility that will allow people to work in a variety of locations, and this may become commonplace for the younger members of the workforce. The potential social and environmental advantages are also substantial, but the implementation of schemes, the technology and security, together with the training and management of teleworkers are all important considerations, particularly in the SME/SMB sector.

7. Conclusions

This study has helped bring together a disparate literature that is continuously changing as the rate of technological innovation increases, and the full potential for teleworking is realised both as an activity carried out in the home and whilst on the move. In the conclusions, the main message from the analysis of the data, the literature and the interviews are picked up as a set of four themes that need further investigation.

1. There has been a reduction in the numbers of work trips, but the average distance travelled has increased and it is likely that the trip lengths for teleworkers are longer than the average. These trips are car dependent and the travel time for work trips is increasing. The trip distances for business trips are also increasing. The importance of teleworking to reduce energy use in transport for both the work and business related journeys is becoming more important. Those that telework are mainly male and from the professional and managerial occupations. The potential for increase is substantial, with about 83% stating that it is possible and 65% are interested, with some 33% stating that it is feasible for at least one day a week. The total number of people teleworking is about 10% (2007). There is a question over whether additional trips that are undertaken as a result of teleworking should be

included as this is a form of induced travel common in transport. This additional travel takes place because of the opportunities presented in this case by the fact that the car is now available at the home for other uses.

2. Substantial energy savings are possible through working at home, particularly if no additional space heating is used. The key question here for further empirical research is the extent to which time clocks on home heating systems are adjusted when individuals telework. There will certainly be substantial energy savings in the summer when less space heating is necessary, but research is required on average use and changes resulting from working at home. The average figures presented here suggest that the savings are limited if additional energy is used, but that the threshold is for return journeys to work over 14 miles (22 kms).

There may also be substantial social benefits from working at home, resulting from being able to spend more time with the family and being more focused in the work regime (see comments made in Section 5 on the Microsoft survey). The costs would include the assumption that space for teleworking is available and that the worker can separate home from work, and overcome the potential isolation effects. Again, further qualitative work is required here.

3. For the employers there are again substantial benefits, but this depends on the frequency of teleworking and the proportion of the workforce teleworking. With small numbers teleworking one day a week, it is unlikely that office space will be saved, but with a greater number and frequency of teleworking, the opportunities for space savings and the on costs of energy, security and insurance etc are substantially increased. Again, a series of case studies are needed to evaluate the real potential in a range of different types of employers.

There are clear potential benefits in terms of productivity, with the meetings held in the office taking on both professional and social importance. Hot-desking and other space saving measures are common. In larger firms, the reasons for not teleworking do not seem to include the lack of equipment or fears about security (Section 6), but more for personal reasons. For SME/SMBs, knowledge about the technology and the security risks need to be given greater attention if the full potential for teleworking is to be realised.

4. The most interesting new area is that of mobile working, where individual work away from the office, but at different locations at different times. It is here that the new flexibility of the mobile phone, the laptop and wireless communications have revolutionised the nature of some people's work patterns. In terms of the transport implications, there are important implications as some of the savings from not travelling to work may be eroded by this flexibility as the transport mode becomes the office.

ANNEX 1: Data analysis

1. Commuting patterns

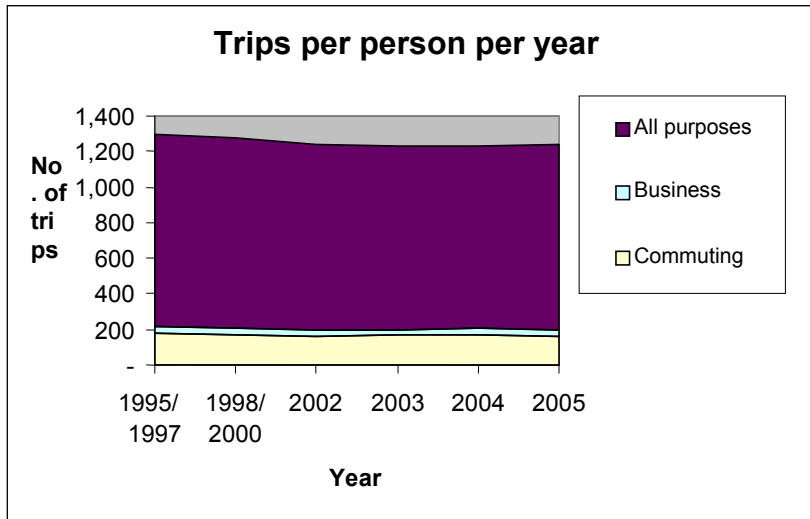


Figure 1: Trips per person per year 1995-2005

Source: National Travel Survey

The number of commuting trips per person has shown a steady decline over the last decade as illustrated in Fig.1, suggesting that teleworking is already having some effect. Between 1995/7 and 2005, the average number of commuting trips per person decreased by 8% from 174 to 161. The number of business trips showed a smaller percentage fall, from 38 in 1995 to 34 in 2007, with an increase at the end of the time period to 37, suggesting that changing habits is more difficult in this area.

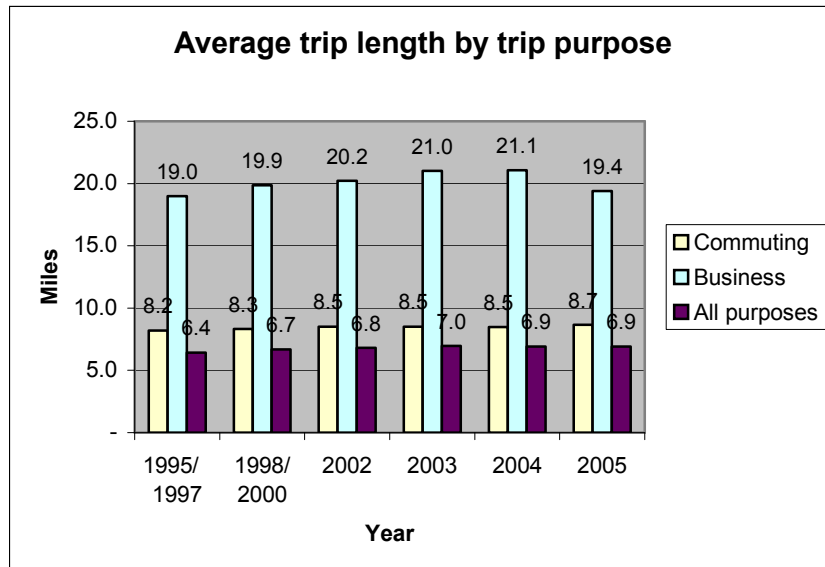


Figure 2: Average trip length by trip purpose 1995-2005

Source: National Travel Survey

Despite the reduction in the overall number of commuting trips, the average length of a commuting trip increased by 6% during the same period from 8.2 to 8.7 miles. Consequently, the total distance travelled by commuters has remained roughly constant during this period.

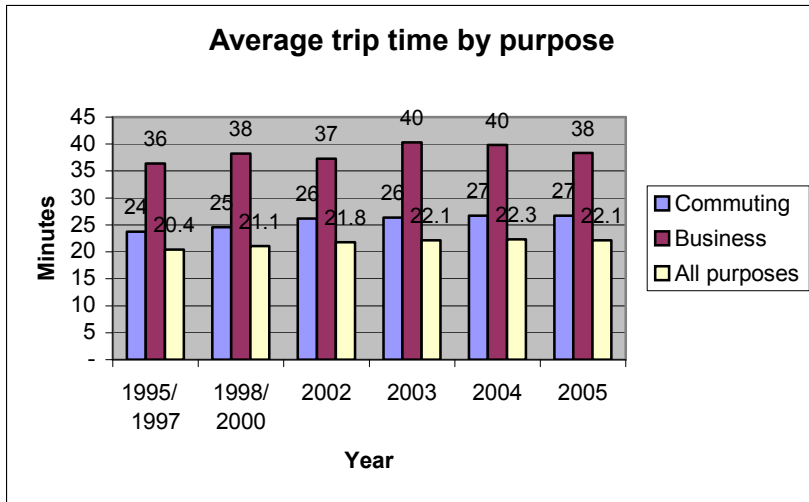


Figure 3: **Average trip time by purpose 1995-2005**

Source: National Travel Survey

In addition to an increase in trip length, the average time spent commuting has also increased from 24 minutes in 1995 to 27 in 2005.

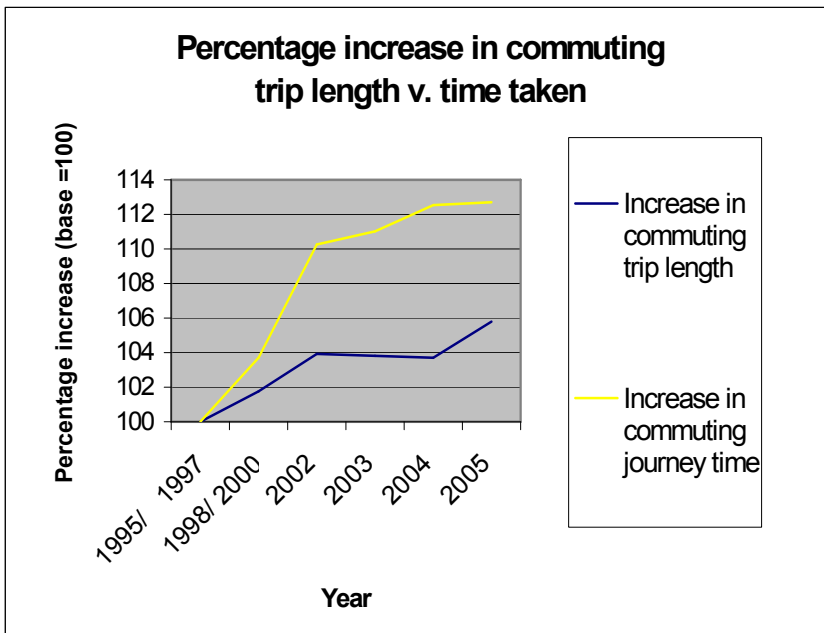


Figure 4: **Percentage increase in average commuting trip length v. time taken 1995-2005**

Source: National Travel Survey

The increase in trip length is outpacing the increase in journey time – while commuting trips increased by 6% in length, they took an average of 13% longer, suggesting that congestion is having an increasing effect on journey times.

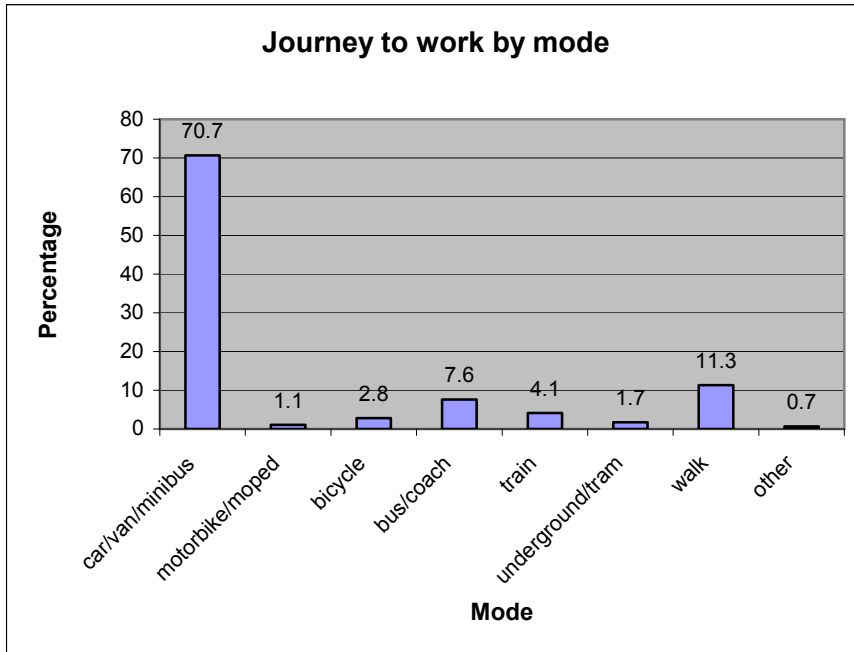


Figure 5: **Journey to work by mode, 2005**

Source: Labour Force Survey

Cars still overwhelmingly remain the dominant form of commuting, responsible for over two-thirds of all commuting journeys.

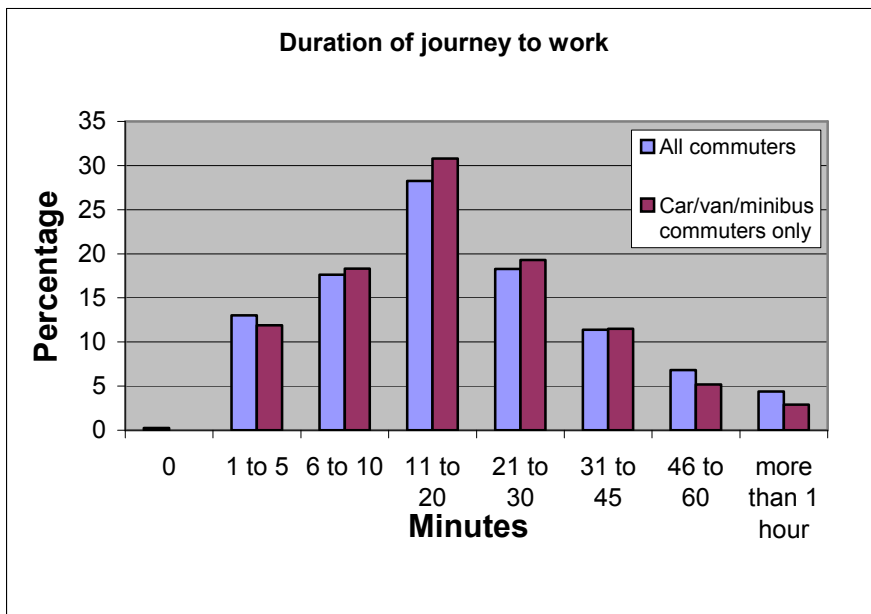


Figure 6: **Duration of journey to work, 2005**

Source: Labour Force Survey

The most common commuting journey length is between 11 and 20 minutes. In all commuting journeys between 6 and 45 minutes, car users make a greater proportion of trips than the average for all commuting modes.

2. Workplace v. home

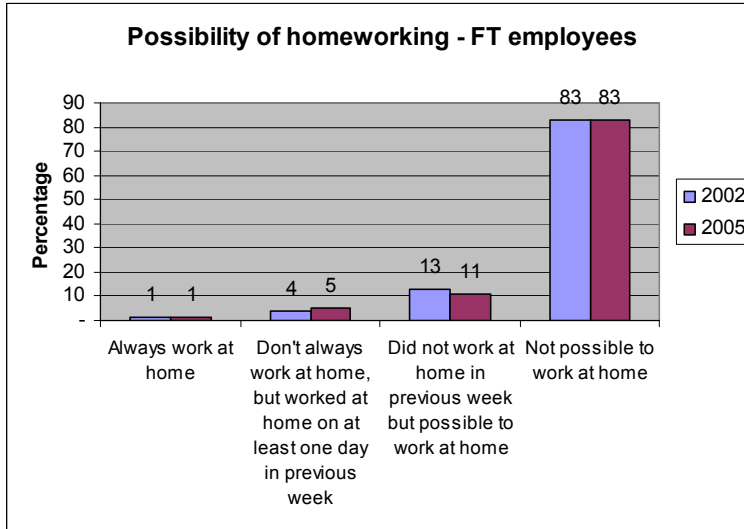


Figure 7: **Possibility of homeworking among full-time employees, 2002-2005**

Source: National Travel Survey

Amongst full-time employees, 6% of respondents who were full-time employees in 2005 had worked at home in the previous week (1% of whom always worked at home) – an increase of 1% on 2002 – while a further 11% had not done so but said that it would have been possible – a decrease of 2%. While this demonstrates scope to increase the frequency of those who did not but could have teleworked, the figure of those who said it was not possible to work at home remained unchanged at 83%.

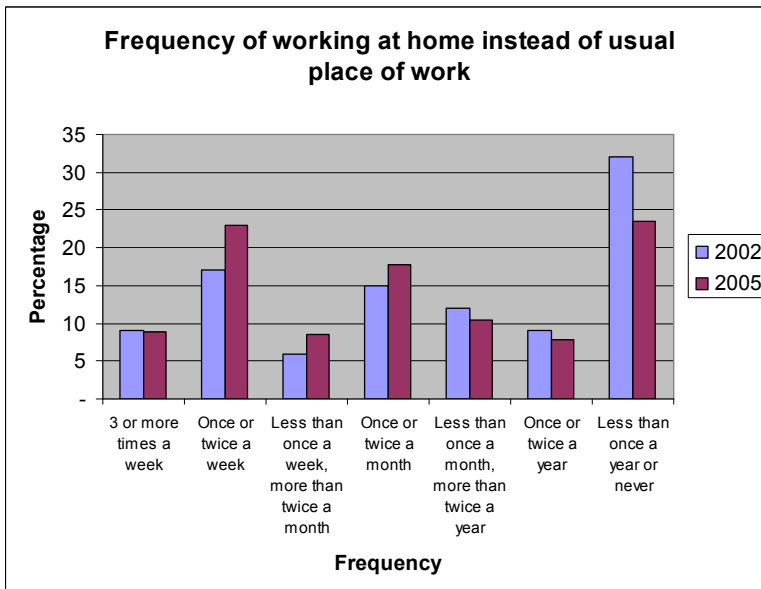


Figure 8: **Frequency of working at home instead of usual place of work 2002-2005**

Source: National Travel Survey

Of those who sometimes work at home, 32% did so once a week or more in 2005, up from 26% in 2002, while 46% did so less than once a week but at least once or twice a year, up from 42% in 2002. While the trend is clearly towards more homeworking it suggests a large pool whose frequency could potentially be increased if the conditions were more suitable. (Note: these figures include the self-employed.)

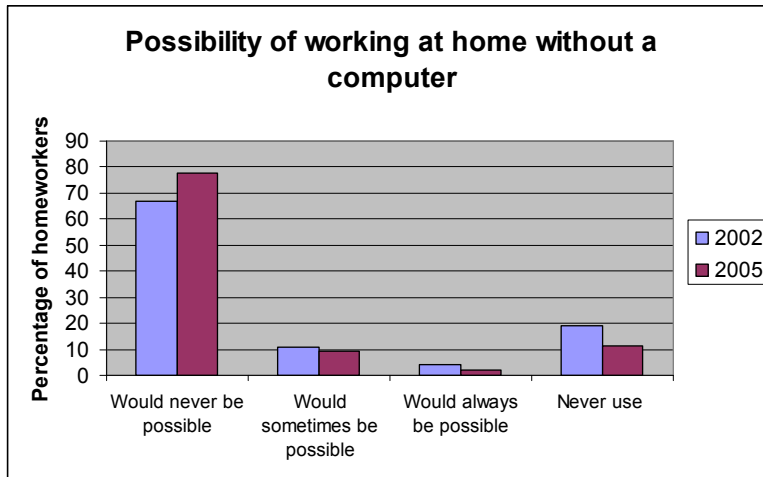


Figure 9: **Possibility of working at home without a computer 2002-2005**

Source: National Travel Survey

Of those who work at home at least once or twice a year, the increasing need for a computer is obvious – those who deemed it essential increased by 10% from 67% to 77% between 2002 and 2005, while those who never use it fell from 19% to 11%. It could be inferred from this that the need for comprehensive broadband links is likely to increasingly be seen as essential as well.

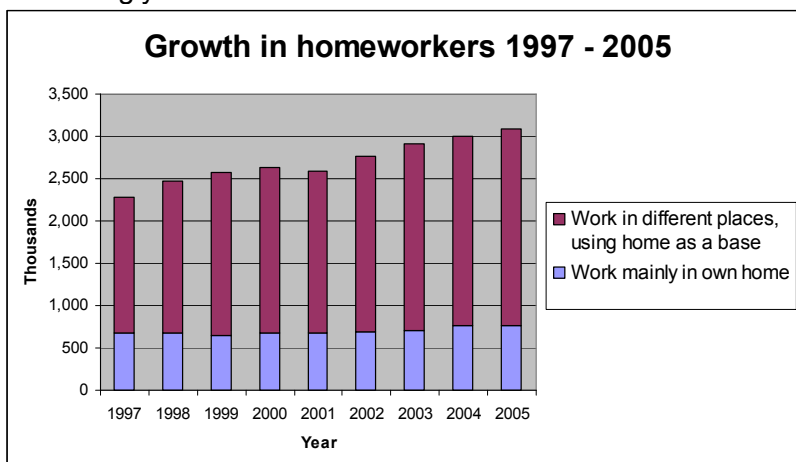


Figure 10: **Growth in homeworkers 1997-2005**

Source: Labour Force Survey

Using the Labour Force Survey definition of homeworkers (those who work mainly in their own home or use it as a base), as at spring 2005 there were around 3.1m

homeworkers. This number has increased by almost 50% since spring 1997, although this is mainly due to those who use home as a base rather than who mainly work there.

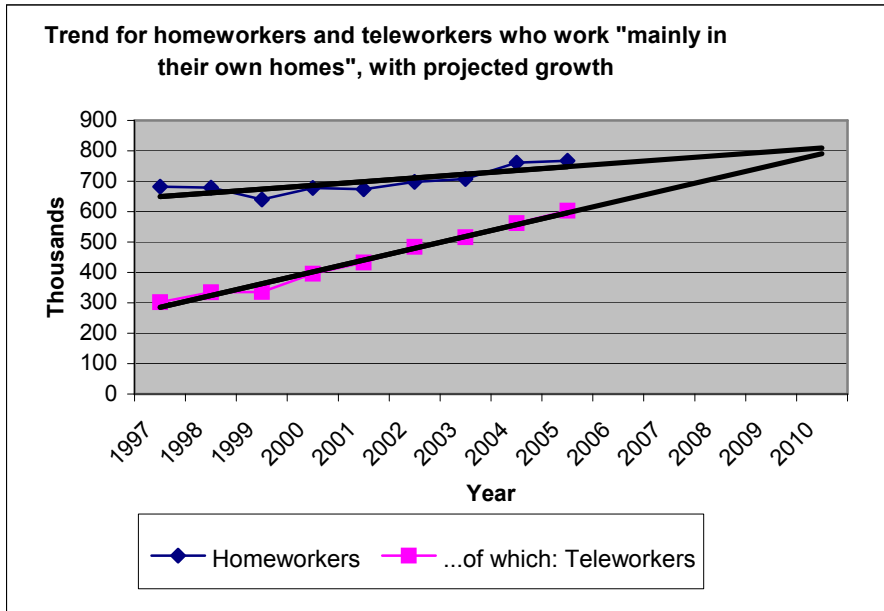


Figure 11: **Trend for homeworkers and teleworkers who work “mainly in their own homes”, with projected growth, 1997-2010**

Source: Labour Force Survey

A regression analysis shows that the steady rise in the number of homeworkers who are classed as working mainly in their own homes is likely to reach 850,000 by 2010 – by which time the use of computers and telephones will be so commonplace as to encompass virtually all homeworkers.

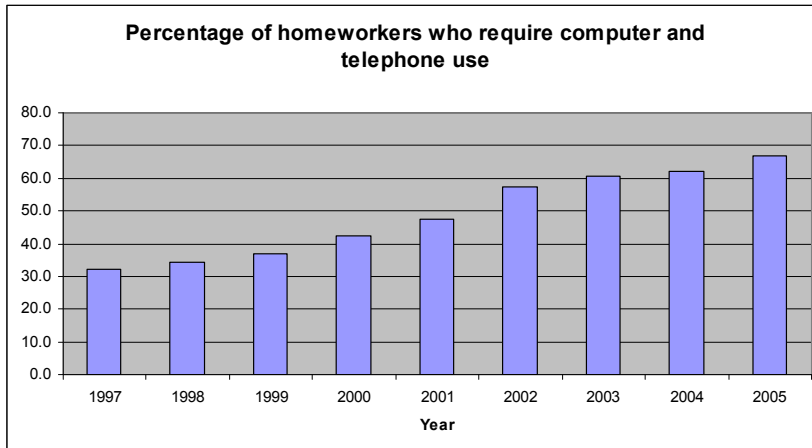


Figure 12: **Percentage of homeworkers requiring telephone and computer use 1997-2005**

Source: Labour Force Survey

Of the 3.1m homeworkers, 2.4m of these were classed as teleworkers, needing a telephone and computer (although only 0.6m of this figure worked mainly in their own

home). In 1997, teleworkers represented 40% of homeworkers; by spring 2005 this had risen to 77%.

3. Teleworking by sector and gender

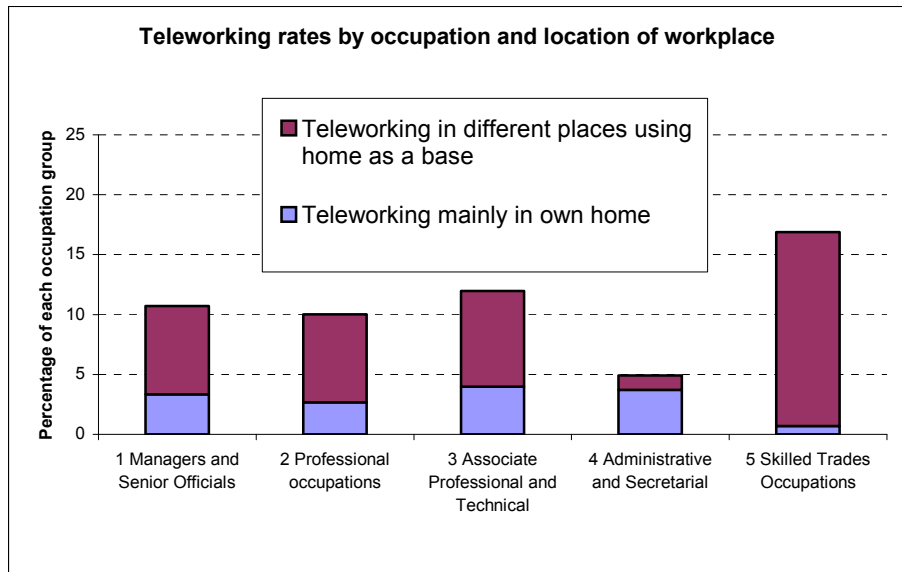


Figure 13: **Teleworking rates by occupation and location of workplace, 2005**

Source: Labour Force Survey

Around 90% of teleworkers work in managerial, professional, associate professional and technical, administrative, and skilled trades occupations. As fig.13 shows, by profession, teleworking rates are highest amongst skilled trades occupations – although this group also has a much higher percentage of trades people working out of their own home than other categories. Amongst administrative and secretarial workers, the majority are likely to be working in their own home.

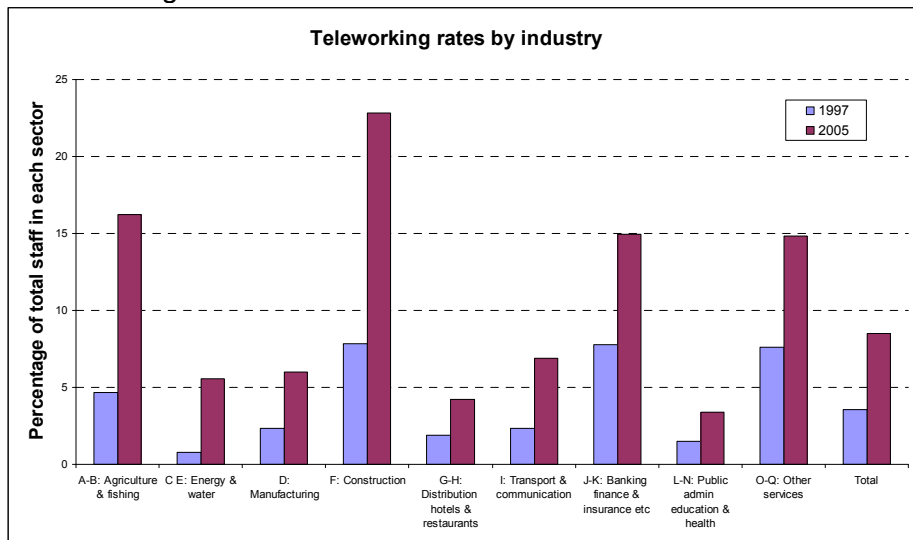


Figure14: **Teleworking rates by industry sector, 2005**

Source: Labour Force Survey

Teleworking has increased across all sectors since 1997, although most significantly in the construction industry – although this is people who work mainly in different places using home as a base. Teleworking (across all sectors and in different places) using home as a base is more common than teleworking at home. The proportion of workers who teleworked in their own home is highest in the banking finance and insurance industry sectors (5%).

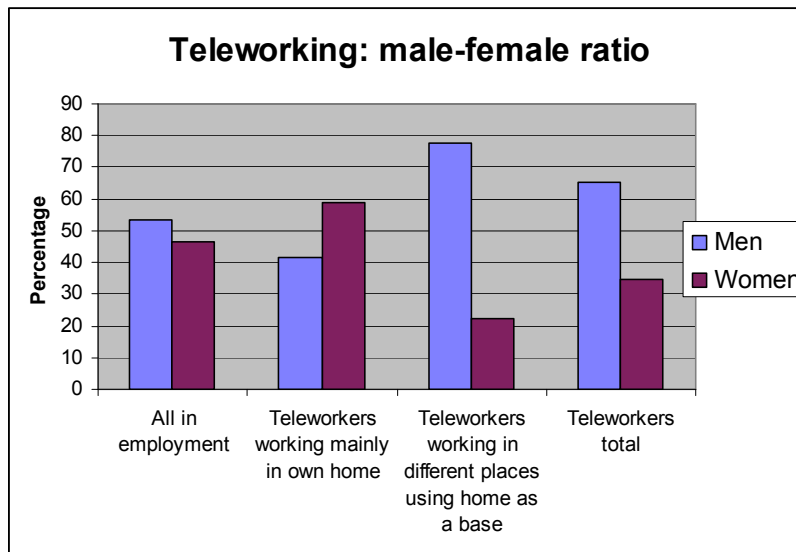


Figure 15: **Teleworking rates by gender, 2005**

Source: Labour Force Survey

Around two-thirds of teleworkers are male, although there are clear differences within this – a majority of those teleworking at home are female, possibly because of the advantages this allows in combining work with childcare. In contrast, three-quarters of teleworkers who use home as a base are male. Since 1997 there has been an upward trend among both sexes, although the increase has been greater for men than women. The difference may reflect the fact that the figures also include self-employed people, most of whom are men.

4. Growth in home PC use, broadband and telecommuting

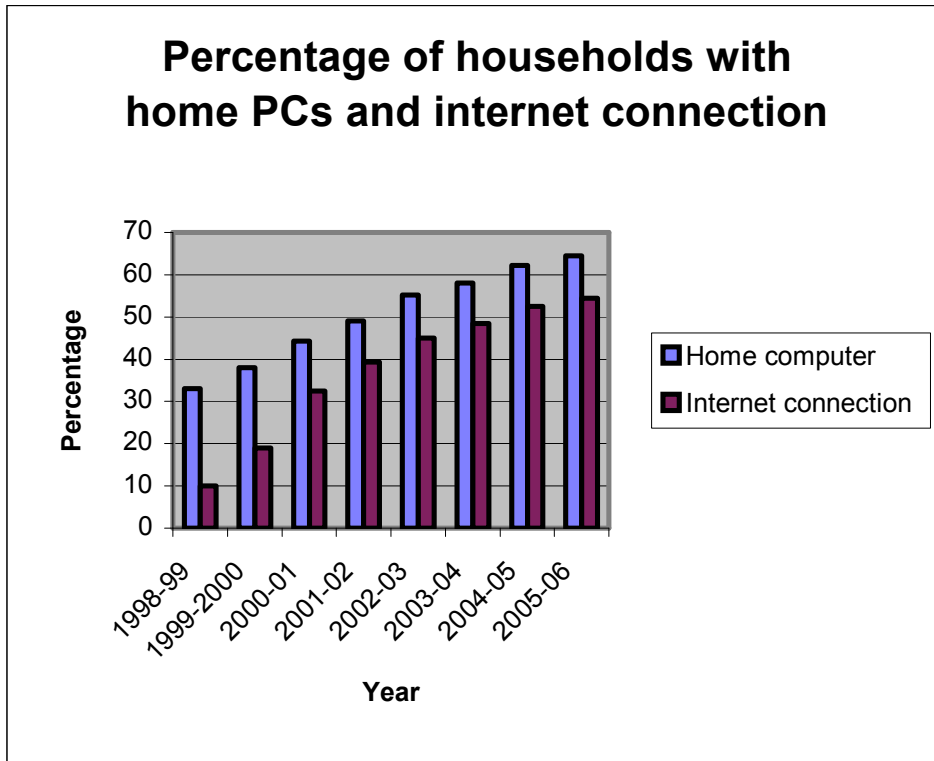


Figure 16: **Percentage of households with home PCs and internet connection 1998-2006**

Source: ONS, Family Spending 2005-06

Ownership of home computers has doubled between 1998-09 and 2005-06, and home internet access is now taken up by 85% of these, up from 30% in 1998-09.

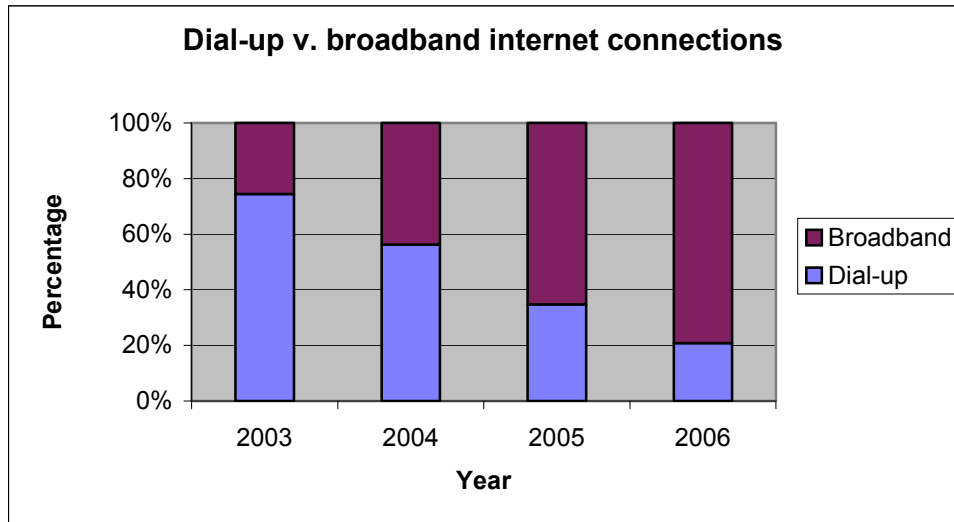


Figure 17: **Dial-up v. broadband internet connections 2003-06**

Source: ONS, Internet Connectivity Dec 2006

There has been a clear shift towards broadband connections in the last four years, rising from 25% to nearly 80% of all connections during this time.

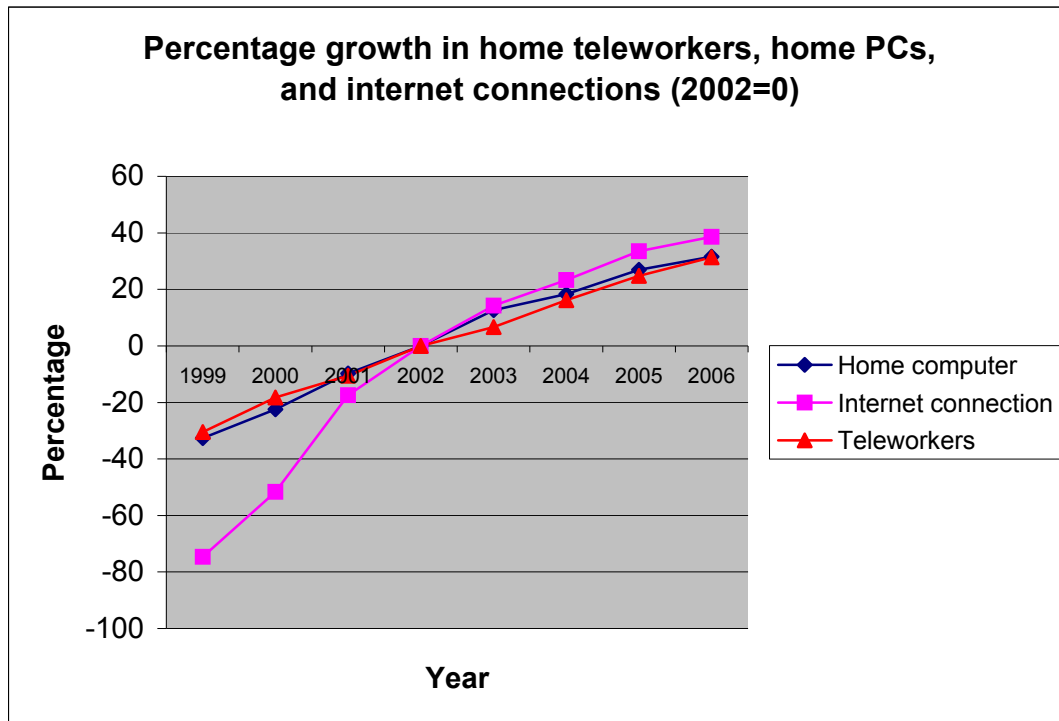


Figure 18: **Percentage growth in home teleworkers, home PCs, and internet connections 1998-2006**

Sources: ONS, Family Spending 2005-06; Labour Force Survey

The correlation between the rise in home teleworkers and home computer ownership is clear for the whole of this period. Within the last five years, although growing at a slightly faster rate, internet connections have show the same trend.

4. European Comparisons

This indicator includes all types of home-based telework with the exception of self-employed freelancers in small offices at home (SOHOs). There are big variations between EU countries on teleworking: the Netherlands and the Scandinavian countries are well ahead of the rest of the EU, and on a level to the USA and Switzerland. The UK has one of the highest levels in the EU, with an average of 2.4% who work at home for more than one day a week. When 'supplementary' telework – those who spend less than one day a week teleworking – is taken into account, the UK is the fifth highest level of the EU countries.

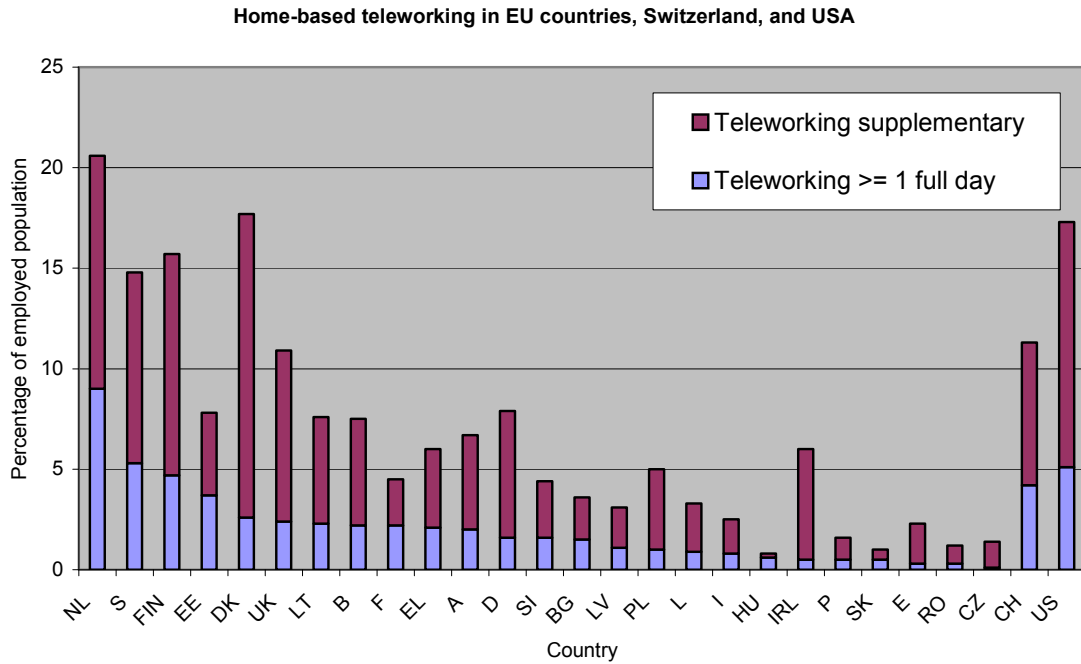


Figure 19: **Home-based teleworking in EU countries, Switzerland, and USA**
 Source: Statistical Indicators Benchmarking the Information Society (SIBIS) 2002, 2003

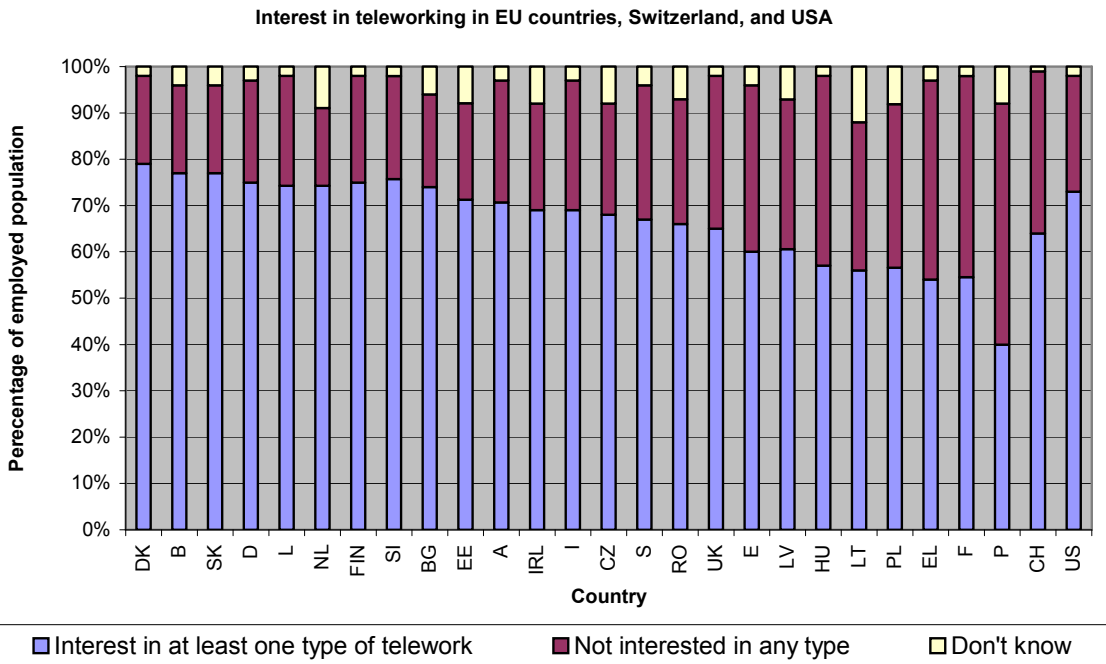


Figure 20: **Interest in teleworking in EU countries, Switzerland, and USA**
 Source: SIBIS 2002, 2003

The degree of interest in telework is considerable: in virtually all countries, over 50% of the workforce say they are “very” or “somewhat” interested in at least one type of telework (a figure rising to 80% in some cases). In the UK, 65% of respondents expressed interest.

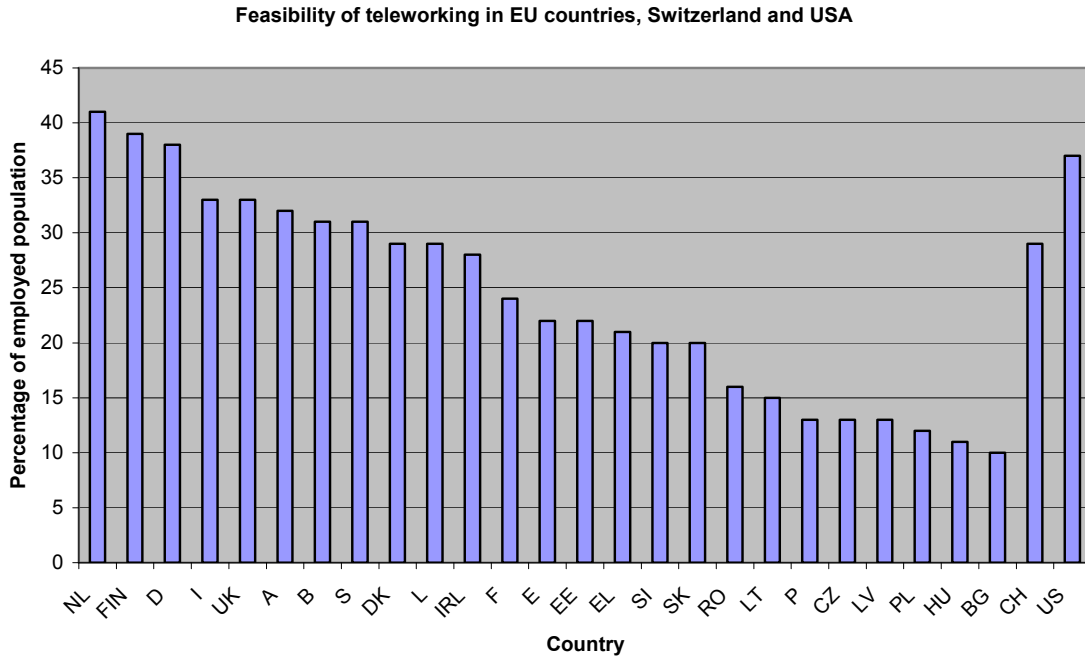


Figure 21: Feasibility of teleworking in EU countries, Switzerland and USA

Source: SIBIS 2002, 2003

33% of all UK workers in this survey regard their job as feasible for teleworking from home at least one full working day per week – one of the highest in Europe. This suggests that the interest in telework is not being translated into actual teleworking even though it is considered feasible for jobs to be undertaken this way. Reasons for jobs not being seen as feasible include the need for face-to-face contact, access to machines or other resources which cannot be provided at home, and companies not approving of the concept.

ANNEX 2: Literature Review - Assessing the impacts of teleworking

1. Introduction - Could an increase in teleworking help us to move towards a lower carbon future? If it could, what would be the impacts, both environmentally, and socially? How far would the emissions savings from commuting be offset by new emissions from other sources? And, if teleworking became more prevalent, what would be the impact on families and communities? This paper considers evidence about the effects of teleworking from existing studies, and identifies the factors that would need to be considered in arriving at a full environmental and social assessment. It draws particularly on material already included in *Smarter Choices – Changing the way we travel* (Cairns et al, 2004).

Over half of households in Great Britain now have access to the Internet – 57% in early 2006⁵. Our growing ability to make use of communications technology from our homes – through the web, mobile phones, home computers and laptops – can be expected to give rise to new working practices, enabling more people to work away from a central place of work, whether at home, on the move or in some other location, and whether for all or part of the working week. The Labour Force Survey shows that such changes are already well underway. The percentage of the workforce that the survey classifies as teleworkers⁶ rose from 4% in spring 1997 to 8% in spring 2005. There is also evidence of relatively high levels of occasional home working, with an appetite among employees for more. A Department for Education and Employment survey on work-life balance found 20% of employees worked at home at least occasionally, while around a third of those who did not currently do so, said they would like to (Hogarth et al 2001). More home-based working may also be facilitated by the Employment Act 2002, which gives employers a duty to consider requests for flexible working from parents of children under six or of disabled children.

In addition to being advocated as ‘family-friendly’, policies to encourage teleworking have also been promoted in the context of workplace travel planning, as one means of reducing employees’ need to travel and so cutting traffic. On the face of it it seems entirely plausible that more teleworking will result in less vehicle mileage and lower emissions. But there are a number of reasons why the emissions saved by working remotely could be partly offset by new emissions, whether through additional miles driven or other energy uses. In terms of mileage, three ‘rebound’ effects are repeatedly identified in the extensive literature on teleworking:

- People who avoid the daily commute by telecommuting may nevertheless make additional car journeys for other purposes
- People who telecommute may free up a family vehicle enabling other household members to make additional journeys they could not otherwise have made

⁵ Source: national statistics, www.statistics.gov.uk

⁶ The survey classified teleworkers as people who worked mainly in their home or in different places using home as a base and who used a telephone and computer to carry out their work.

- People who telecommute and are freed from having to travel every day, may over time choose to live further away from their main place of work, so that when they do make journeys into work their mileage will be higher.

In the US literature particularly there has been a tendency to suggest that additional travel generated by these means will counterbalance or even outweigh any mileage savings. In terms of empirical evidence, however, the rationale for this is unclear. This point has been taken up by HOP Associates et al (2002) in their comprehensive review of research on the impact of communications technologies on travel, carried out for the Department for Transport. The authors comment that “*an influential school of thought in the US (Ben Akiva, Mokhtarian, Niles) seems to have formed the view that while the direct effects of teleworking may be to reduce travel, the wider effect of telework and other ICT use is to generate a sufficient number of new trips to eliminate the benefit (which is seen as marginal in any case) or even to increase traffic levels...*” The reviewers conclude, however, that the evidence for this is “*partly anecdotal, partly speculative modelling, but mostly repeated assertion by experts.*”

One theoretical reason for expecting a reduction in commuter travel to result in more travel at other times is the finding that average daily travelling time is relatively constant across very different environments and cultures, at slightly above one hour per person (Schafer et al, 2000). It has been suggested on this basis, that saved travel times from telecommuting may be reinvested in additional transport at a societal level, so that travel ‘time wins’ will be compensated by greater travel distance (Schallabock et al, 2003).

A number of empirical studies have attempted to assess the impact of these rebound factors. The majority of the studies described below are taken directly from the *Smarter Choices* study. Since that study further light has been shed on this issue with final results from the SusTel research, a European project which involved 30 case studies and six surveys in five countries, and which is also reported below.

2. Empirical evidence on the effect of teleworking on teleworkers’ non-commuting journeys

State of California Telecommuting Pilot Project

A travel diary study of 40 participants in the State of California Telecommuting Pilot Project found that on average, telecommuters made 27% fewer trips in total on days when they worked at home, made up of a reduction in car trips to work and an increase in car trips for other purposes. They travelled 77% fewer miles by car (down from 44.8 miles to 10.2 miles) on teleworking days, compared to their behaviour before they began teleworking (Koenig et al. 1996). While non-work trips increased, non-work mileage fell, as the telworkers made shorter but slightly more frequent non-work car trips on teleworking days. The mileage reduction was the sum of fewer miles driven to work *and* fewer miles driven for other trips.

California residential area-based offices project

Two Californian studies have looked at the impacts of telecentre-based commuting where the worker travels to a neighbourhood telecentre (Balepur et al 1998; Mokhtarian et al. 1998). Both studies found significant reductions in car mileage on telecommuting days, of between 53% (reported by Mokhtarian et al) and 65% (reported by Balepur et al). Workers generated additional car mileage by driving home in the middle of the day

for lunch and back to the telecentre in the afternoon. However, the number of non-commuting trips on teleworking days either fell or remained constant.

Teleworking in Denmark

This study involving a questionnaire to a panel of 946 Internet users in Denmark who teleworked some of the time (Jensen et al. 2003), and excluded people working from home all the time. The travel behaviour of teleworkers on days when they worked at home was compared with their travel behaviour on commuting days. The total amount of time spent travelling in the teleworkers' own cars was 48.6% lower on days when they worked at home, and travel time for all other modes apart from walking (i.e. cycling, bus, train and travel in someone else's car) also fell by between 21% and 74.8%.

AA call centre in the UK

HOP Associates et al (2002) reports a study by Hopkinson et al (2001), which looked at the changed travel patterns of 103 AA call-centre staff who moved to home-based working. Before the shift to working at home, 88% of commuting trips were by car and journey length was on average nine miles. As a result of eliminating commuting trips almost completely, 3680 vehicle miles were saved per employee per year. This was offset by occasional employee visits to the office and home visits by managers, with came to about 30 – 40% of the miles saved. Of 29 employees who gave information about non-work travel, most said that this had also reduced, but nine said they now made longer or more frequent journeys.

Small sample of existing UK teleworkers

Research by Mitchell and Trodd (1994) looked at the behaviour of a small sample of existing UK teleworkers and found an average reduction in travel of 113 miles per week, after allowing for remaining travel to work and additional non-work trips. Half the sample reported no extra non-work trips.

National Opinion Polls study of Internet users

Fogarty (2004) carried out a survey that involved interviews with Internet users in December 2003. Of 1,600 Internet users who worked from home for some or all of the time, the average round trip saved was 16.3 miles. Some 56% made non-work related car journeys, whilst working from home of an average length of 4 miles, with the result that the net effect per teleworker was 12.3 miles saved per day.

3. Empirical evidence on the effect of teleworking on both non-commuting journeys and journeys of other household members

Washington Metropolitan Area telework demonstration project

In this project eight organisations in the Washington metropolitan area were provided with help to expand or start formal telework schemes. Six were private sector organisations, one a government body and one a non-profit organisation. Most of the teleworkers worked at home one or two days a week, although one site's teleworkers worked at home full time (Metropolitan Washington Council of Governments 1999). The study gathered evidence on the effect of teleworking on vehicle use and vehicle miles travelled. It asked about non-commute trips that were eliminated (such as not going out for lunch) and non-commute trips that were made (such as going shopping after work). Interviewees were also asked if any other household member had used their vehicle on the most recent telework day. Amongst 100 employees surveyed the average number of

vehicle trips per day fell by 0.6, and average vehicle miles per day fell by 16 per teleworker.

State of California Telecommuting Pilot Project

An earlier survey as part of the State of California Telecommuting Pilot Project referred to above, used three day travel diaries for telecommuting state employees and their adult household members. From an original sample of 137 telecommuters, 73 completed the 'after' survey. The study found a decrease of 75% in miles travelled by all modes on telecommuting days and a 90% reduction in freeway miles (Pendyala et al. 1991). This research also found evidence that teleworkers were choosing non-work destinations that were closer to home – showing 'contracted action spaces' on both telecommuting and non-telecommuting days. Total travel savings were slightly higher (about 6%) than the savings from the commute alone. The study also found a small but significant decrease in travel by household members who made 0.9 fewer trips per day at the end of the telecommuting programme, or 23% fewer trips. The authors hypothesise that both telecommuters and household members were streamlining their trip-making activity and visiting destinations closer to home as a consequence of their telecommuting experience. Other researchers have observed that in US studies telecommuting households tend to have one vehicle per licensed driver so that the availability of the telecommuter's car would not be expected to have an impact on household travel.

Teleworking in the Dutch Ministry of Transport

Hamer et al (1991) analysed the travel diaries of 30 employees at the Dutch Ministry of Transport who spent between 20 and 60% of their time teleworking. In addition the study surveyed the travel activity of members of the teleworkers' households. For the teleworkers, they found that the overall number of trips fell by 17% compared to the number of trips made before teleworking began. Both trips as a car driver and distance travelled as a car driver fell by 19%. For other household members, the study found the overall number of trips fell by 9%, with most of this decrease for non-work related travel, while the estimated distance travelled by household members showed hardly any significant change.

A small group of teleworking pilots in the Dutch Ministry of Transport have also been reviewed by Marshall and Banister (2000), in a study which looked at a range of transport reduction measures. These pilots, which took place in 1997, were originally monitored as part of the EC Dante project. In one group of 30 teleworkers:

- Teleworking reduced total trips by 17%;
- Other household members reduced total trips by 9%;
- Teleworkers reduced distance travelled by 16%;
- Teleworkers reduced car travel by 27%.

In a second group of 30 teleworkers:

- Total trips reduced by 10%;
- Distance travelled reduced by 14%;
- Public transport trips reduced by 63%;
- Car travel did not increase;
- Distance travelled at weekends increased by 72% for teleworkers and 137% for other household members.

For a third larger group of 204 teleworkers:

- Average number of trips on teleworking days was 50% reduced from normal days;
- Average distance travelled was less than 10% of a normal day
- Average travel time was around 40% of a normal day.

Teleworking in Greater Munich

Glogger et al (2003) examined the travel behaviour of teleworkers in eight large organisations in Greater Munich using travel diaries before and after teleworking was introduced, completed by 37 teleworkers and 29 members of their households. The study found that people who began teleworking reduced their total number of trips (for all purposes) by 19%, while the number of trips made by other household members also fell. Taking the household as a whole, the total number of trips for all purposes fell by 14%.

The SusTel project

SusTel is a Sustainable Teleworking project funded by the European Commission’s Information Society Technologies programme. Questions about teleworking were researched through 30 case studies in five countries, and surveys of teleworkers in six organisations (James, 2004).

The study looked in some detail at whether savings in travel commuting were offset by rebound effects such as non-work travel previously undertaken as part of commuting trips; the use of the cars which had become available for other purposes when people did not commute; and travel for work purposes other than commuting.

In each country a considerable proportion of respondents identified trips that they had to make that would otherwise have been carried out when commuting.

Table 1: Journeys made which otherwise would be carried out when commuting

	Anonymous public sector organisation, Denmark	Insurer, Continentale, Germany	Emilia Romagna, regional authority, Italy	Subsidiary of Oracle, The Netherlands	BT, UK	BAA, airports operator, UK
Shopping	61.7%	32.4%	19.2%	31.8%	23.3%	16.7%
Transporting children	34.0%	11.8%	26.9%	31.8%	13.6%	5.6%
Leisure	12.8%	-	-	4.5%	10.2%	5.6%

Source: SusTel

[NB Paper says between 11 and 39% of respondents made special trips – but does not seem to be clear what this means. Doesn’t tie in with table.]

Between 11 and 39% [also] said that they or other household members had undertaken additional journeys which would not have been possible if they had [not] been commuting. [again paper appears confused!] Respondents were asked to make estimates of both their reductions in weekly commuting and their additional travel. On

this basis the researchers were able to calculate a ‘rebound effect’ showing the percentage of commuting savings that were accounted for by new journeys. The range was considerable – from as little as 14% at the regional authority in Italy, to 73% at a Danish public sector organisation. In none of the organisations, however, did the additional travel generated outweigh the reduction in commuter travel.

Table 2: Telecommuting commuting reductions and rebound effects – estimates from six organisations

	Anonymous public sector organisation, Denmark	Insurer, Continentale, Germany	Emilia Romagna regional authority, Italy	Subsidiary of Oracle, The Netherlands	BT, UK	BAA, airports operator, UK
Mean estimated reductions in weekly commuting (km)	105	283	242	98	253	61
Mean estimated additional travel (km)	77	53	33	42	60	15
‘Rebound effect’ as a % of commuting savings	73%	19%	14%	43%	24%	25%

Source: SusTel

4. Effects of teleworking on in-work travel

The SusTel surveys also examined the effect of telecommuting on travel in the course of work. In five of the six survey organisations, few respondents said that teleworking had any impact on their in-work travel. The exception was BT in the UK, where 18% of respondents stated that their in-work travel had increased, with a mean distance of 267 miles, while 9% said it had decreased with a mean distance of 394 miles. The main reason for this appeared to be additional visits made by people who no longer had to travel to an office at the start and finish of the working day. The authors also connect this rebound effect specifically with mobile teleworkers – i.e. people who spend at least ten hours per week away from home or their main place of work, for example, on business trips, travelling or at customers’ premises, and who use online computer connections during this time. The researchers suggest that rebound effects on work travel may be more significant among mobile workers, but add that research into a larger number of organisations is needed to confirm this.

Understanding the differences between the effects of mobile working and the effects of more conventional home working is likely to be particularly important in analysing the impacts of teleworking. The SusTel report observes that whilst all teleworking is increasing, mobile teleworkers are the fastest growing group forming around 5% of the European workforce.

5. Empirical evidence on relocation issues

There is evidence to suggest that teleworkers commuting to a workplace have longer than average commute journeys. In a review of telecommuting programmes, Mokhtairan et al (1995) found telecommuters living nearly twice as far from work as the regional

average. Some commentators have taken this association as evidence that teleworking will eventually lead people to live further from work. The idea has reasonable common sense appeal. Mokhtarian et al (1995) comment that *“Clearly, if there is any desire to relocate, even unrelated to telecommuting, then all else being equal, the ability to telecommute can only influence that desire in the direction of increasing distance from, rather than movement toward, the workplace.”* On this basis it can be hypothesised that telecommuting may precipitate more geographically dispersed living patterns and urban sprawl, which could in turn lead to greater car dependence for all journey purposes.

In their review, HOP Associates (2002) identify several alternative explanations for teleworkers' longer commutes: early adopters of teleworking are more likely to be people with longer journeys; teleworking is generally likely to be more tempting for people with longer or more difficult journeys and the promotion of teleworking and provision of centre based facilities has tended to focus on people with longer journeys. In short, it can be argued that people with longer journeys are more likely to telecommute, rather than that telecommuting itself encourages people to live further from work.

Unfortunately the empirical evidence on this issue appears extremely thin. Nevertheless, two of the studies described above, included relevant questions.

In the Washington metropolitan area teleworking demonstration project, the study identified 22 people who had moved or were planning to move. It was found that the move was equally likely to be closer to work or further away.

In the study of teleworking in Denmark by Moller-Jensen et al (2003), the researchers examined whether working from home had affected choice of where to live. While 4% of respondents said teleworking had influenced their choice of where to live, equal numbers said it had led them to move closer to and further away from work. Some 7% said that in future the opportunity to work at home would have considerable influence on their choice of where to live, while 21% said it would have some influence. However, the number that said they would be likely to move further away was approximately the same as the number who said they would move closer to work. Just over 3% of respondents had changed where they worked because they wanted the opportunity to telework. Equal numbers had moved to a workplace that was closer to, and further away from their home. Six per cent said they were considering changing their workplace in order to be able to telework, and again, half said the distance between home and work would increase and half said it would decrease. The authors conclude that the opportunity to telework will potentially affect long term decisions about place of residence and place of work, but that it is impossible to say whether the result will be spatially a more or less dispersed pattern, and that, at present, it seems that teleworking will have a limited effect on these choices.

A subsequent paper by Moller-Jensen et al (2005) sheds further light on the relationship between home location and the tendency to telework. This is again based on responses from Internet users (2680 respondents of which 1009 said they sometimes teleworked) and examined the decision to telework in relation to the geographical distribution of teleworking. The researchers hypothesised that teleworking enables people to buy more affordable homes at some distance from more expensive areas, but that they would still be inclined not to move very far away from larger urban areas, whose attractions in cultural and entertainment terms, are of interest to both teleworkers and non-teleworkers. The observed spatial pattern indicated that teleworking was most frequent

in mixed urban/rural areas close to or on the fringe of larger urban areas, and that teleworking occurred at the lowest frequency in areas that were remote from these urban areas. The researchers suggest that the relationship between being able to telework and the choice of home location is a two-way one. While the geographical location in relation to the workplace may influence the decision to telework, having the opportunity to telework may also influence the decision on where to settle down. They observe that for part-time teleworkers, the length of the journey to work remains a constraint, even if commute trips are not made daily.

[NB The Wuppertal Institute/Forum for the Future study mentions another study which summarises panel data from four countries, and appears to show that in the US and British projects telework influences choice of living place, extending the distances between private homes and workplaces, while the German study could not confirm this. However, it is unclear what evidence this is based on and I have not been able to find the paper, which was in German.]

The findings from the Danish research imply that telecommuting has to be viewed in the context of wider land use policies. The SusTel researchers warn that relocation rebound effects may be a specific problem in areas with very high differentials in property prices (such as England) and/or relatively cheap and uncongested long distance road transport (such as America).

Overall then, the studies considered here, do not support the idea that higher levels of teleworking will lead to longer commutes and more dispersed living. However there is a lack of evidence from longitudinal studies that could show how teleworkers are likely to respond to their working conditions over time.

6. The impact of telecommuting on use of space, light and heating

While the *Smarter Choices* study was primarily concerned with the impact of teleworking on car use, this is clearly not the whole story of its environmental impact. People who work from home but have another workplace elsewhere, may be heating rooms they would not otherwise have to heat, and may even extend their homes to provide home-office space. In some cases home working may mean office space and equipment are provided both at home and at work. Any assessment of the impact of teleworking on emissions needs to take account of these factors.

Several studies have looked at these impacts, and there are a number of examples where employers have redesigned and downsized office space to reap the economic benefits of telework.

HOP Associates (2001), include two reports from travel plan literature, with implications for space:

- An IBM 'Smart' project, which mixed home-based working with shared office 'touchdown points'. The project resulted in a 13% reduction in travel time, a 36% increase in time spent with customers and a total space-saving of 30%.
- ADAS Consulting Limited adopted ICT based working practices. In five years it reduced its number of office sites from 90 to 26 with more than 500 staff working from home. Travel savings for each employee were estimated to be around 2000 miles a year.

The SusTel project also examined the effects of teleworking on the built environment and concluded that it could enable organisations to make more effective use of office space through hot-desking and other methods. Out of the 30 SusTel case studies, 12 needed less office space as a result of their telework and three were expecting to need less space in future. In one case – the UK company Word Association – teleworking had led to the closure of a central office. The other 15 organisations in the study had not reduced their space requirements.

SusTel's case studies showed that the way in which organisations respond to new styles of working is critical to the impact on space, equipment and building use and that changes in design could also reflect a changing working culture to suit the demands of teleworking. At Oracle BV, for example, buildings were re-designed to meet staff needs for working spaces more efficiently, with greater use of hot-desking and electronic access to documents, while at the same time facilitating more interaction between individual staff and departments, through convivial meeting space, such as central café. Space per employee was reduced from 23 sq metres to 13.

Changing office requirements may also have knock-on effects on travel. The SusTel study quotes the example of Kankercentrum Midden Nederland, which was able to reduce its office space by almost half, making it feasible to move to new premises in the centre of Utrecht. The office's bus and train connections made it easier for staff to travel by public transport for both commuting and in-work journeys. In another SusTel case study however, new offices were being built on the edge of cities making public transport access much more difficult.

In terms of resource consumption, the SusTel study found substantial duplication of equipment, such as desks and computers, in 16 out of the 30 case studies. The organisations that avoided this were those introducing hot-desking arrangements. Questions about paper consumption produced a mixed verdict: 2 – 29% of survey respondents felt teleworking created more printing of documents, while 4-31% thought it created a decrease. In three organisations however, a majority perceived a significant decrease and this appeared to be linked to extensive use of the Internet.

The SusTel surveys also asked about increases in home occupancy, as an indicator of increased use of heating, lighting and other energy-consuming activities in the home. In three of the surveys a large number of people – 53% in the Italian regional authority, Emilia Romagna, 41% in the German insurer Continentale, and 37% in BT, UK – reported their home occupancy went up by 21 hours a week or more. These were all organisations with home-based or mobile teleworking schemes. In contrast, 94% of respondents from a Danish public sector organisation and 54% of BAA, UK respondents were at home for an additional 10 hours or less.

Some additional information on the use of equipment is provided in SusTel's report on its UK case studies (2003). This found that in two of the case studies, teleworkers had dedicated equipment which might have been shared in a central office, and two others had partial duplication of equipment and desks. Duplication was lower where organisations had changed their working practices, as in the BT 'Workabout' scheme which was designed to support people in giving up a permanent office. At BT only 9.4% of respondents had an office desk, 8.8% an office filing cabinet and 4.4% an office desktop.

The overall implication of the SusTel research is that the way in which telework is conducted will be critical to its effects on energy use in the office and the home. The study does not attempt any estimate of the net impact of these changes. However, it concludes that the impact of teleworking on resource consumption will be negative where telework does not result in more efficient use of office space, as is currently the norm, but positive where this kind of re-design takes place, because buildings are energy and material intensive to operate and run.

A paper by Mokhtarian et al (1995) reviews three studies that made estimates of the impact on household energy use due to telecommuting. These were a study of telecommuting in Puget Sound (Quaid and Lagerberg, 1992); a State of California study (JALA, 1990) and a survey of telecommuters carried out with the Southern California Association of Governments (Mokhtarian, 1991). For all three studies, estimates were made of the additional energy used in the home, and were then compared with reductions in travel energy for each telecommuting occasion.

Table 3: Net energy savings for three telecommuting organisations

Study	Travel energy reduction (kwh/TC occasion)	Home energy increase (kwh/TC occasion)	Home increase as percent of travel savings	Net energy savings (kwh/TC occasion)	Sample size
Puget Sound	58.6	7.9	13.5	50.7	63
Southern California Association of Governments	50.4	5.5	10.9	44.9	18
State of California	80.6	20.5	25.4	60.1	73
Weighted average	68.1	13.6	18.8	54.5	154

Source: Mokhtarian et al, 1995.

Mokhtarian et al calculate that the increases in household energy use represented 11–25% of energy savings, meaning that the net energy saving is 11–25% less than the energy savings due to travel. The researchers caution that these are, at best, rough approximations because of difficulties in obtaining definitive data. There is a further issue in comparing the energy saved from the commute with the energy expended by working at home. In all three case studies the commute was longer than average so that the savings would also be greater. If telecommuting were to become more prevalent the average commute distance of the telecommuters would be expected to decrease, so that commute energy savings would be lower and any increase in home energy more significant by comparison.

Another limitation of this data is that it takes no account of energy reductions at the central office. While the researchers comment that this is expected to be minimal this is clearly not the case in some of the SusTel examples, where offices have been redesigned accordingly.

One UK study has directly compared the use of energy by employees in the workplace with that of employees working at home. This research, by Wright (1997) (quoted by

HOP Associates, 2002), looked at energy use at the Department of Employment in Sheffield, measuring the total energy consumption of employees in the office, teleworkers in their homes and vehicle use. The study concluded that where the commute trip was limited and office space decommissioned, homeworking could produce around an 80% reduction in energy use. One reason for this was that the office environment was much more energy intensive. This was due mainly to the fact that systems and equipment, such as lighting, heating, ventilation and photocopiers, were left on, whereas in the home they were turned off when not needed. Meanwhile, the extra lighting and heating used in the home environment was lower than might be expected. Remarkably, around two-thirds of an office worker's energy consumption was attributable to travel.

A further issue in terms of costs and benefits related to the built environment is the impact of telecommuting on the provision and maintenance of car parking. UK travel plan literature shows that parking pressure is a common driver for company travel plans, and that parking restraint is also a key determinant of travel plan success in reducing car use. Construction of surface level parking in the UK costs some £1,000 - £3,000 per space (Transport 2000, forthcoming) while the annual cost of car park maintenance to organisations has been estimated at around £300 - £500 (Cairns and Newson et al, 2002), a figure that may since have risen.

7. Other impacts of telecommuting

The SusTel research provides many insights into the social and behavioural effects of telecommuting and gives a picture of considerable positive benefits for both the employee and the company. The research linked teleworking with lower absenteeism, improved recruitment and retention, higher productivity, good work-life balance and good quality of life.

A number of previous studies have shown that teleworkers tend to work longer hours than other employees. The EcaTT project reports that among European teleworkers, 80% work more than their contractual hours, as against 50% of non-teleworkers (EcaTT, 2000). The SusTel surveys bore this out, with a large number of respondents believing that their working hours had increased rather than decreased in the previous two years. This was particularly the case at BT in the UK, where 76% of respondents said their working hours had gone up, and 40% said that this was by 6 – 10 hours a week. The survey was unable to provide comparable information on the perceptions of non-teleworkers, who may also have been experiencing longer working hours, given the working culture of the UK.

More positively, the majority of respondents in all the surveys felt their work performance had improved in recent years, with most feeling that teleworking had made a contribution to this. Two of the case study organisations had been able to provide an objective measure of higher productivity from teleworkers:

- At an Italian call centre, teleworking employees spent 15% less time on calls than non-teleworkers and consequently took 3.3% more calls an hour.
- In a UK teleworking scheme for benefits staff at Bradford Council, monitoring of electronically processed benefit claims showed that teleworkers were on average 25% more productive than non-teleworkers.

Whilst survey respondents identified increased working hours as one reason for better work performance, they considered reduced stress and better concentration to be more important factors. Despite their lengthening working hours, a large majority of respondents (75 – 94%) said they had a good or very good quality of life, and a similarly large majority felt that telework made a positive contribution to this. A large majority also felt they had a good or very good work-life balance. However, while most other respondents felt that their work-life balance was neither good nor bad, UK respondents were somewhat less satisfied with 22% of BT and 11% of BAA respondents feeling that it was poor.

A key reason for improved work-life balance overall, appeared to be telecommuters' greater autonomy and flexibility in work planning and performance, with 86 – 100% of survey respondents saying that telework gave them better control of when to work. Researchers comment that many teleworkers do routine tasks such as washing and cooking during breaks in the working day, and that this enables them to create more 'quality time' when they need it, for instance, when children come home or at weekends.

The SusTel surveys also asked people to assess the effect of telework on their health, and found a majority of respondents felt the effects were positive. The reasons given for this however, were very varied, but included effects on work stress, effects on personal stress, better domestic harmony, less driving, more exercise and better diet. Researchers comment that the link between telework and reduced absenteeism is partly because people are often prepared to work from home when they would be too ill to travel.

As mentioned earlier, some studies have suggested that teleworkers exhibit 'contracted action spaces' – spending more time in their own communities. The SusTel surveys sought to explore this, by asking respondents whether they made increased use of local services as a result of teleworking. The numbers responding positively to this question were significant – for example, in the UK, 59% at BT and 50% at BAA. The survey also asked whether teleworking made it easier for respondents to be involved in organised community activities, and found that significant numbers thought it did.

The benefits of increased involvement in the community need to be set against the risk of social isolation, commonly perceived to be a problem for teleworking. The SusTel surveys confirm that this can be the case: 38 – 58% of survey respondents felt more isolated from work colleagues, with very few feeling less isolated. A positive benefit identified was a greater ability to concentrate while the main negative factors were feeling unsupported and missing the human interaction of the office. The researchers conclude that negative effects such as social isolation do exist, but that they can be minimised through careful design and implementation of the scheme.

Table 4: Survey respondents stating that teleworking makes it easier for them to be involved in organised community activities

Anonymous public sector organisation, Denmark	Insurer, Continentale, Germany	Emilia Romagna, regional authority, Italy	Subsidiary of Oracle, The Netherlands	BT, UK	BAA, airports operator, UK
43.5%	51.7%	61.5%	35.3%	40.2%	33.3%

Source: SusTel

8. Discussion

Overall, the evidence reviewed here suggests that policies to encourage teleworking could help in reducing energy use and could also be beneficial in other ways, for both employers, employees, their families and their communities.

Evidence about rebound effects on non-commuter travel

The evidence on transport re-bounce effects is that these can be both positive and negative since, in some studies both teleworkers and other members of their households appeared to reduce their travel for non-commuting journeys. However, even where telecommuting is accompanied by an increase in non-commuter journeys, these increases tend to be relatively small when compared to the savings from the commute.

It is not clear to what extent an assessment of the environmental impacts of teleworking should include all identifiable re-bounce effects on other forms of travel by the teleworker or other household members. Any reduction in car use frees up road space which may ultimately release suppressed demand and result in new trips being generated. The extent to which this can be avoided is likely to depend on a whole range of external conditions such as the cost of fuel, the implementation of road pricing, the reallocation of road space and the extent to which these suppressed journeys are in fact amenable to walking, cycling and public transport. In a highly car dependent society the impact of any measures that reduce car use will be minimised because prevailing conditions will encourage car use and suppressed demand will be higher. Alternatively, where prevalent conditions support more sustainable travel then the saving in energy from the commute will be more secure since the teleworker is more likely to walk to local facilities. In either case, it can be argued that it does not make sense to attribute causality for the additional car trip or the lack of it to the fact that the individual is teleworking rather than the surrounding conditions. There are many examples in the study of travel behaviour where the observed effect of modal shift could in principle mean that a car that would otherwise have been used becomes available to another household member. It is arguable that trying to identify all conceivable rebound effects in each case risks an over-simplistic and over-deterministic analysis of travel behaviour, by focusing only on an immediate short term effect and taking an artificially narrow view of causality. For example, if, as a result of teleworking a car becomes available for use by another household member, this may lead them to make additional trips in the short term, but in the long term may equally avert a decision to buy an additional car that would in turn lead to higher levels of car use.

Evidence about the influence of teleworking on location

Although employees who telecommute tend to live further away from work than other employees, the studies reviewed here provided no evidence that on average teleworkers are more inclined to move further away from work. Clearly the ability to telework makes it more viable for some people to work in remote places. However, the predominance of mobile working may mitigate against a general trend for teleworkers to move away from urban centres, since mobile workers still have to travel to see their clients. None of the studies examined here provided a longitudinal view of the way in which teleworkers' working lives evolve over time. A study which sought to identify more long term effects of this kind would provide a more definitive understanding of the relationship between the opportunity to telework and an employee's choice of home location.

Evidence about energy use in the home and office

Evidence about the relative energy use of employees at home and employees in an office environment, is rather limited. What there is however suggests that energy saved through not commuting will often outweigh the additional energy used in the home. That said, there is likely to be considerable variation on energy use and efficiency between different homes and different workplaces. Energy savings are most certain where worksites are re-designed around new working practices, such as hot-desking, with reductions in space and equipment allocated to each employee.

Distinguishing between teleworking styles

“I work for the mobile phone industry and effectively carry a mobile office in my rucksack, which means I can work anywhere I park my bike. Monday and Thursday I’m in the office, and Friday at home.” – Commuter, Oxford station.

The recent growth in teleworking has been driven mainly by an increase in people working in different places with home as a base – from 2% in 1997 to 6% in 2005 (Ruiz and Walling, 2005). The environmental and social effects of this rising ‘mobile working’ deserve particular attention. The SusTel survey showed that between different companies there was considerable variation in responses to survey questions, suggesting that different styles of teleworking may have different impacts. Some researchers have suggested that more mobile working could ultimately be expected to lead to more time spent travelling (Schllabock et al, 2003) though this does not appear to be supported by the evidence of the SusTel case studies.

Understanding these different styles may also be important in understanding their consequences for work-life balance and for the impact on families. The SusTel report comments that mobile working seems to exacerbate the tendency towards longer working hours and can be a stressful way of working which is not for everyone. At the same time many mobile workers appreciate their control of their own time and use this to improve their work-life balance and quality of life. Whilst teleworking is frequently viewed as a family-friendly working practice, it is not at all clear that family considerations are the main driver behind the recent increase in telework. In the DfEE study of work life balance (Hogarth et al 2001) the most frequently cited reasons for working from home given by employees were work-related, and few employees cited factors relating to caring needs. Another indication that caring responsibilities are not the principle cause of the growth in telework can be seen in the gender balance. Men are more likely to work from home than women, and while there has been an upward trend in teleworking for both sexes the increase has been greater for men than for women.

Besides mobile working, a further development in working styles has been highlighted by an ongoing Internet survey of telecommuting (Lyons et al, 2006). This found that working from home for *part* of the day was much more common than the traditional concept of teleworking as working from home for a whole day. Whilst 6% of the sample had done at least one day of homeworking in the reference week, 14% had undertaken at least one day where they mixed work at home (for a minimum of 30 minutes) with work in the workplace. The authors suggest that such high propensities to work from home for some of the day, indicate a considerable potential for higher levels of teleworking if conditions favoured it – for example, in response to worsening congestion or congestion charging.

9. Key factors to be considered in assessing the environmental and social impact of teleworking

On the basis of the evidence considered for this review, an impact assessment of telecommuting should give consideration to the following factors.

Energy use

- Reduction in fuel use as a result of reduction in commuter car travel
- Increase in fuel as a result of any additional commuter car travel that can be directly related to telecommuting – i.e. journeys that would normally have been incorporated into the commute
- Increase/decrease in use of fuel for work-related trips as a consequence of operating from a home base
- Reduction in use of heat, light and electricity at the workplace
- Increase in use of heat, light and electricity in the home
- Decrease in embodied energy related to buildings and equipment at the workplace
- Increase in embodied energy related to buildings and equipment in the home.

Benefits/costs to the employer

- Better employee performance
- Reduced absenteeism
- Savings from better recruitment and retention
- Savings from reduced building space and equipment
- Savings from reduced car parking requirement
- Additional costs involved in providing support for teleworkers – e.g. support staff, training additional ICT investment
- Potential costs related to breaches of security (a common concern of employers)
- Potential costs related to breaches of trust/abuse of teleworking (also a common concern)
- Improved environmental performance of organisation.

Benefits/costs to the employee

- Improvements to quality of life
- Improvements to work-life balance
- Improvements to personal performance at work
- Effects on health related to levels of work stress, personal stress, exercise, and diet
- Improvements in domestic harmony (not universal)
- Savings from reduced commuting costs
- Reduced stress from greater personal control over use of time
- Negative effects linked to increase in working hours
- Negative effects associated with greater isolation
- Effects on career development (perceived as positive by most but negative by a significant minority in SusTel surveys)
- Greater community involvement.

Benefits for local communities

- Greater spending on local services
- Better social capital through greater involvement of teleworkers in community activities
- Environmental gains from air quality and traffic reduction.

ANNEX 3: Interview Transcripts and Comments

Dave Dunbar, Head of BT Workstyle

BT has around 105,000 employees, of whom around 70% work remotely to some extent. Just under 14,000 are contracted homeworkers; 40,000 are mobile and nomadic workers who regularly access whilst on the move, and there are 30,000 engineers who work “on the road”.

The programme has been running over the last six years or so. Homeworkers are provided with a PC or laptop, printer, home office furniture, stationery deliveries, and ESDN/area cell. They are also given a token access card so that they can log on anywhere. In the last couple of years the technology available for use in homes has improved a lot, particularly speed increases, leading to massive improvements in stability.

Conference technology is used a lot, although video conferencing is not so popular due to time lag and thoughts of cameras in bedrooms! But audio conferencing is very popular; it can be arranged very quickly. We use ‘Teamphone’ for audio and document sharing so that everyone can look at a document at the same time – this is simple and reliable. Instant Messenger is also used a lot as well.

We’re keen to increase flexible working – motive is predominantly cost control. £500m less is spent on BT property since the approach was introduced; also productivity increases, and absenteeism falls (down 63%). More use is made of office space (through measures such as desk-sharing) or it is ‘planned out’ – in London two years ago 10 out of 16 BT buildings were closed. The main BT centre now has 1600 workstations, with 8000 people using them daily – they offer “walk-up” computing using remote access processes. We estimate that flexible working has reduced the office footprint by 30% - beyond that it is an exercise in reducing the overall number of buildings.

The main obstacles are not technology, which is very reliable now so long as it is planned out properly. (With wireless technology, whereas there has previously been distrust there is decreasing scepticism about it now – breaking into wireless networks is very hard.)

It is the cultural obstacles that are biggest – you need:

- The organisation to have vision and leadership
- To persuade people that it’s OK to remote work and that they won’t lose out
- To change the culture in middle management in particular so that you don’t have to see everyone around you in order to manage effectively

We found that some homeworkers were terrified to go to the toilet for the first six months, fearful of missing calls, and a feeling of guilt.

Lots of local pilots can actually prove a barrier to effective adoption of homeworking – you have to see it as a full-scale issue over time, and the supply chain has to be right. The biggest risk is finding that small-scale attempts don’t really work and the whole concept then falls into disrepute.

For data security, if you've got a good security process it can actually be more secure working outside the office than in. BT takes an 'onion layer' approach with different levels of security depending on what is being accessed and where. On a personal level, lockable cabinets are provided, and people carry around little paper as remote access technology is so prevalent; almost everything is on the web. People are also provided with contact details so that they don't have to give out their home phone or address.

For the future, freeing people from the desk is the aim. The next level is to do with convergence of technologies such as wireless, bluetooth, GPRS etc, and increasing the range of places to use the technology from. BT also estimates that the company is now generating 54,000 tonnes less CO2 per year.

Richard Swann, Infrastructure Manager at the Institute of Directors

The IoD has around 275 staff, of whom 35 have the capability to work flexibly rather than permanently. The concept was introduced as a trial in November 2006, and it went 'live' in January 2007. Initially users were provided with a PC and their own broadband line partly for security purposes. They are now allowed to use their own equipment – just have to log on using a secure webpage.

The managing director of the IoD is keen to promote it from an environmental point of view, (although there hasn't been any attempt so far to quantify the benefits). The organisation is keen to make it easier for those who are parents and to encourage a better work/life balance as well. Flexible working is mostly used by individuals speaking to outside contacts, so it's mainly telephone or email – conference technology hasn't been used so far.

Security and technology were the biggest issues at first – looked at systems such as Citrix but found it too expensive for the user level. Instead we have used an AEP box which has solved most of the problems on security and prevents a virus from getting in from the outside. Additional licences can be bought to upgrade it, so it can grow as the business changes. We don't want to make it too complicated for the end user. Haven't reduced office space yet – but sure that would come further down the line. If sales people were to flexibly work en masse, this would push it forward.

Barriers have been behavioural rather than technological such as how much managers are prepared to let staff work unsupervised (although haven't come across anyone yet who would say don't do it). Can tell how many people are logged on for if need be; increased broadband speed makes life much easier.

Two big advantages of teleworking:

- it allows people to work much more independently
- disaster recovery/business continuity: if people can't get into London for whatever reason, the organisation can still carry on functioning easily.

The intention has been to make it as simple as possible, and the feedback has been very positive so far.

Barry Goldberg, director of Swansea University's Health Informatics Department

The department has been teleworking since it came into existence in 1990. The median number of people has been around 7; everyone has a notional desk as well as the capacity to telework. Some people come in to the office most of the time; others never do.

All of the department staff are on project work, generally at a fairly senior level. Some of the staff are based in other organisations, including two in the NHS. People will have a laptop that they can get into it via a VPN – and also have a Mytel teleworker phone. We audio conference constantly and we video conference a lot as well. Shared files are utilised, so we can work on documents together. The team runs its own email and telephone exchange.

The technology was pretty awful until recently – Office products couldn't handle slow links and UNIX couldn't handle emails; didn't have integrated conferencing either. Broadband has made a lot of difference, and Mytel is used which supports teleworking over broadband. Now everything works in concert: "It's working like a dream." There are no technological barriers now – it's more cultural ones and the personality of individuals. Some people don't like isolation and miss the contact you get in the office, although younger staff tend to treat it as normal.

We don't hold secure data. We did go through a stage of being heavily hacked into but the investment we made against hacking has paid off and we have been clean for four years.

Environmental benefits were not a factor in doing it, but people can work whilst living out in rural areas more easily because they don't have to commute in regularly, so I have a high-quality workforce that I might not otherwise have.

Annette Keane, KPMG

Works at home two days a week; she is a "flexible working champion" for KPMG in the UK to help drive the concept forward within the company.

Has a laptop and mobile provided, and KPMG will pay for broadband if need be; could have other pieces of office equipment such as a printer or fax machine if they were needed. People assess the home 'office' and provide what is needed (e.g. a computer chair has now been provided). The company has an internal website dedicated to flexible working.

I am far more organised now – not trying to 'catch up' all the time when in the office. Output has increased – I can do at home in 5 hours what it would take me around 9 to do in the office. My work/life balance is much better (sees much more of her young son).

Use audio conference technology to deal with issues quicker. No problems with isolation – I'm in London regularly so it doesn't have that much effect. Technically there have been no problems at all. Security is not an issue – when I log onto KPMG server at home it's the same as at the desk in the office.

Lives near to Colchester – office is off Fleet Street, so door-to-door commuting is about two hours each way. A few extra journeys are generated at home, such as taking son to nursery and back and occasional other trips, but these are fairly minimal.

Environmental benefits – might do journeys near to home by foot whereas previously I would have driven due to tiredness and time pressures. Also, make more effort with cooking to use fresh ingredients and don't buy so many ready-meals.

Contribution from Stinne Madsen stinne.madsen@significanz.com

1. Establishing the field: The scope of this contribution will be the bulk of people who hold positions that make it feasible to work remotely and who have the dispositions to perform effectively in a teleworking environment. Their actual work product still needs to be delivered with same effective, creative, qualitative and innovative sense as when it was carried out at the office.

- a) The first movers, who represent perhaps 5% of the total amount of people whose work is suitable for teleworking, are already established and we can learn from their experiences when establishing more widespread practices.
- b) There are approximately 20% of potential candidates, who from an outside viewpoint might be able to telework, but for other reasons should not be considered. This might be because they professionally thrive with more social interaction, because they do not have access to a quiet, focused space to set-up a telework station, or even because other family members have already claimed the work space.
- c) Therefore, we will focus on the remaining 75% that can be considered potential teleworkers whose positions and organisations can accommodate a more flexible work environment. They could work remotely at least 1 day a week, and up to full time. We are not addressing those employees who are working on an outsourced assignment. They could be working from a home office space, or from a shared office space designed for individuals working remotely (telegroup).

2. Is teleworking a good idea? - It depends: The widespread adoption of new communications and technology has rapidly enabled the possibilities of creating teleworking environments. There is a commercial rationale that makes teleworking more attractive for companies. Or is it just an additional "perk" to offer employees. These factors include anything from keeping real estate expenditures down, to the globalization of companies and talent, to the need to be closer to customers rather than colleagues.

However, too often this arrangement is entered blindly, by companies as a way to reduce costs, and by individuals as a consequence wanting to follow in the footsteps of their colleagues to follow in the footsteps of the first movers and have the independence and "freedom" to work remotely (Maslow). But they often fail to identify the price and the consequence of this "freedom" for the individuals, their managers, and the organisation as a whole. Organisations need to plan for the incremental changes that teleworking requires. This preparation will ultimately determine whether they fall victim to the pitfalls

or whether they will reap the benefits. We have had a century of studying styles of leadership, management and communication based on the assumption that people were working side-by-side. The nature of employment is not fundamentally changing. People are still employed, collecting a salary in exchange for their talent.

Is it a good idea? It depends. Companies and individuals need to be able to keep the end results in mind, and to recognize that this is a strategic decision. This new “contract” needs to be entered into consciously, establishing the proper conditions in the organisational structure and work processes. Within the last 25 years, more of the business studies and literature have identified the new management styles needed in today’s work environment: a) setting a common direction and clear objectives; b) setting goals and following up with effective performance management routines; c) then coaching people towards achieving these goals.

Teleworking will reveal the existing flaws in current management styles. Now it is truly the time when these “new” management traits are essential, not just nice to have. Without these leadership and coaching skills, a manager’s last resort is to fall back into a controlling approach, micromanaging people, leading by example, and relying on more interpersonal dynamics (e.g. fear).

3. The issue of “trust” as aspirational rather than applied. The implications of teleworking means that the individual is self-managing their time and methods, and they are being measured based on their output and outcomes. Self-management can be defined as “The individual’s willingness and ability to assume responsibility for planning and carrying out one’s own work, within the existing and accepted employment framework between company and individual.”

What are the changes needed? Main recommendations:

1. There are certain assessments or actions that should be taken PRIOR to offering, or accepting, a tele-working option.
2. After accepting the teleworking option, continuously strengthen and develop the skills organisation’s policy, procedures and communication so that all employees, regardless of their location, are able to contribute equally.
3. The overriding need is to focus on the explicit, rather than the tacit. You need to provide the necessary and sufficient to secure the alignment of the output (not more, not less).
4. You cannot just reproduce the interpersonal context of working together and replicating behaviours. Behaviours need to be learned and demonstrated in a different way, so that it becomes part of the organisational fabric.
5. To reach alignment, this needs to be communicated consistently regardless of the individual messenger. Information needs to cascade throughout the organisation effectively, and not leave people “drowning in information, but thirsty for knowledge”. Different tools and methodologies are available to support this, but it will not happen by accident.

6. This applies in all dimensions. How the company is organised as such, the relationship between manager and employee, how teams work together and communicate, and how an individual makes sense of their own role and purpose.

7. Therefore, there are some areas for consideration for all companies, managers and individuals who are considering a teleworking dimension to their employment:

On an organisational level – Culture, Branding, Alignment - setting a common direction, including innovation and reaping the benefits of a diverse, multi-skilled workforce. These conversations cannot be taken lightly, and you cannot always substitute face-to-face communication. It is a process in which the shared understanding can be explored in understood in real-time.

On a managerial level

- Clearly defined roles, tasks and objectives
- Performance measurement and management system (what gets measured, gets done).
- Monitor, develop and retain people, meeting their needs and aspirations for both professional and personal development (Don't ask for A if you want B).
- Expectations for accessibility (24/7)

On an interpersonal/team level

- Revisit the process of communication. This ranges from anything from how decisions are reached (the process and design of making decisions, and how they are documented, understood and accepted). How you share knowledge, how to interpret "silence" and conflict handling.
- Organisations must be more conscious of how information is communicated (to know when teams should be together) and when face-to-face communication is necessary. This includes things like team kickoffs, for sensitive discussions, and team activities around alignment on behaviour, ethics, culture, and the "way things are done around here".

On an individual level

- Environment - do you have an appropriate space and self-knowledge? Are you aware of your own needs? Can you communicate them? Knowing learning styles, your need for face-to-face interaction,
- The grey zone between private and professional. This includes anything from blurring work hours, to the family decision of how your household operates.

Much in the same way that organisations should offer self-assessment tools to determine people's readiness to take an expatriate position or a promotion into a managerial role, there should be a set of self-assessment tools that individuals can use to determine if teleworking is a desirable situation.

Work-in-Progress

Companies need to set up the basic structures and put the right conditions in place. But this is still a work in progress and technological solutions are innovating all the time. There is a lag time in widespread adoption of new technology. Globally, more and more of the workforce is migrating to remote set-ups, so there is a harvesting of experiences to build good practices. Lessons can be cross-pollinated across industries and business

logics. The challenge is to customise practices to the specific culture of a particular organisational. Feedback should be regularly solicited from remote employees, to see what is working and what is not. (Retention should not be the only measure?) Do not reward for A, if what you want is B.

Other things to consider, include the non-exhaustive list of administrative and logistics surrounding teleworking?

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