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**GAINING THE AIR QUALITY AND  
CLIMATE BENEFIT FROM  
TELEWORK**

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The idea for *Gaining the Air Quality and Climate Benefit for Telework* came out of an earlier project in which the Electronic Industries Alliance (EIA) and the World Resources Institute (WRI) partnered to publish *Taking a Byte Out of Carbon: Electronics Innovation for Climate Protection*. The report shows how electronics and communication products such as sensors and bandwidth can be used to reduce greenhouse gases. Based on that work, EIA and WRI decided to look in depth at one application—telecommuting.

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## **EXECUTIVE SUMMARY**

Electronics and telecommunications companies have pioneered telework programs that allow people to connect by phone, email, video, or web conferencing. While increasing the pace and reducing the cost of getting work done, telework programs can also be designed to replace some commutes and business trips and to reduce energy use in buildings. This guide introduces assessment tools to help companies gain the additional benefit of improving air quality and protecting the climate from their telework programs. Telework is defined in the guide as using information and communications technology to work at home a few days a week, engage in full-time virtual work, and to participate in meetings remotely.

Companies may want to factor the air pollution and climate protection benefit into telework programs for four reasons: 1) Help meet community needs to reduce traffic congestion; 2) get ahead of the curve in learning to account for emissions of greenhouse gases; 3) gain a competitive edge by providing new products and reducing costs; and 4) respond to interest among employees. The big opportunities for reduced emissions are likely to come in telework programs that aim to achieve business goals ranging from increased productivity, new markets, and business continuity in emergencies to lower real estate costs and success in recruiting and retaining skilled staff.

To develop and evaluate the effectiveness of telework in reducing emissions from transport and energy use in buildings—two significant sources of air pollution and greenhouse gases, companies will need to track changes in emissions. Many companies already collect some of the data needed. Reporting guidance, protocols and software tools are increasingly available to use these data and collect and organize additional data. For example, the Telework Impact Estimation Tool, developed by the Consortium on Green Design and Manufacturing at the University of California in Berkeley, allows companies to estimate and compare the benefits and costs of telework and non-telework scenarios. It covers not only transportation but also energy used to light, heat, and cool buildings and run equipment.

## 1. INTRODUCTION

Through telework (Box), people connect by phone or video or over the web instead of commuting or taking a business trip. Companies adopt telework to increase the pace and lower the cost of getting work done. They use it to continue operating during emergencies and to recruit and retain employees by giving them more flexibility in when and where they work. While meeting business needs, telework can also improve air quality and protect the climate. This guide, developed with companies from the electronics and telecommunications sector, describes opportunities to gain the environmental benefit of telework and introduces assessment tools that are available to account for changes in emissions.

Air pollutants emitted by commuting traffic contribute to respiratory disease. Emissions from cars and planes contribute to the greenhouse gases that change the climate. When used to replace some travel to and for work, telework avoids these emissions and can help improve regional air quality and protect the climate.

Electronics and telecommunications companies have an interest in promoting telework. They have pioneered new patterns of telework. (Appendix A summarizes a survey of telework practices among members of the Electronic Industries Alliance.) Sector companies make the products that support telework. They have issued statements highlighting the use of their equipment to reduce emissions and improve energy efficiency. Two examples of these statements are:

- *Environmental Charter*: North American telecommunications companies agree to use telecommunications technologies such as video conferencing, teleconferencing, telecommuting and electronic mail to reduce employee vehicle miles and emissions, office space requirements, and energy and paper consumption.<sup>1</sup>
- *Principles on Global Climate Change*: The Electronic Industries Alliance, an association of several thousand companies, note in this statement that “Electronic products in the home, office, and workplace can help manage heating, cooling and lighting more efficiently; information technology and telecommunications equipment can help reduce energy consumption by promoting telecommuting . . .”<sup>2</sup>

Telecommuting evolved in the 1970s as the practice of working at home or in a center a day or so a week to avoid traffic congestion. It assumed workers going back and forth to a central office. Telecommuting began to broaden into telework in the 1990s to meet both business and individual needs. Using rapidly developing information technology and the Internet, companies began to organize teams located in different places and shifted to around-the-clock schedules, often to compete globally. In dual-income families, workers used telework to work around family schedules while other employees used it to balance work with other priorities.<sup>3</sup>

Company experiences as well as regular surveys are beginning to provide more in depth understanding of evolving telework practice in the United States. At AT&T, about 33% of managers teleworked at least once a week by 2002, up from 8% in 1992. The company expects to save \$150 million from telework in 2003 through increased productivity, reduced costs for real

### What is Telework?

In this guide, telework means using information and communications technology to:

- work at home a day or two a week instead of commuting to a central office (often called telecommuting);
- become a full-time virtual worker;

It also includes remote participation in meetings to replace some business travel, for example by video or web conferencing.

estate, and enhanced retention and recruitment of employees.<sup>4</sup> The 2001 Telework America Survey found that about one-fifth of the adult workforce works at least part of the time from home, in a telework center or satellite office, on the road, or combines some of these approaches.<sup>5</sup>

This guide addresses five questions about gaining the air quality and climate protection benefit as patterns of where and how people work change.

- Why factor the air quality and climate benefit into telework?
- How does telework reduce emissions?
- What are the business opportunities to add the air quality and climate protection benefit?
- What assessment tools are available to help evaluate telework's impacts and track results?
- What information that a company already has may be useful in getting started?

## **2. WHY FACTOR THE AIR QUALITY AND CLIMATE PROTECTION BENEFIT INTO TELEWORK?**

A company may choose to include the air quality and climate protection benefit in telework for several reasons. Many companies operate in regions where tackling traffic and air pollution are high on the agenda. For these companies, state or local measures aimed at reducing congestion and air pollution are the trigger. At the same time, awareness and concern about climate change continues to grow.<sup>6</sup> The Electronic Industries Alliance's Principles state: "We believe it makes sense for countries, governments, industries, and individuals throughout the world to adopt reasonable, common sense measures to reduce emissions of 'greenhouse gases' in a manner that is consistent with promoting economic growth."<sup>7</sup> Some companies may decide to get ahead of the curve in learning how to reduce greenhouse gases or to gain a competitive edge by using their products to protect the atmosphere. Individuals in a company may champion the use of telework to achieve both business and environmental goals.

***Meet community needs to reduce traffic and pollution.*** About 133 million people live in areas of the United States that do not meet national ambient standards for air quality.<sup>8</sup> Companies operating in regions jammed with traffic and facing air pollution alerts need to find ways to help address these challenges. Recognizing changing work patterns, the state of Washington encourages the use of telework to influence demand for transportation.<sup>9</sup> The Northern Virginia Technology Council takes the lead in a program spurring use of telework by companies to address that region's transportation problems.<sup>10</sup>

***Get ahead of the curve in finding ways to reduce greenhouse gases.*** Proposals to address global warming are gaining momentum. More than half the states have already developed action plans or strategies to reduce greenhouse gas emissions and Congress continues to debate action.<sup>11</sup> Telework provides one entry point for examining a company's greenhouse gas emission profile and identifying ways to reduce emissions related to transportation and energy use. As an increasing number of states and cities set greenhouse gas reduction targets and emissions trading opportunities increase<sup>12</sup>, experience in reducing greenhouse gases is likely to become increasingly important for companies.

***Gain a competitive advantage.*** Michael Porter, a leading authority on competitive strategy, stresses that in modern competition, social and economic issues must be integrated.<sup>13</sup> As many electronics and telecommunications companies recognize, providing less polluting and more efficient mobility through telework offers a double opportunity. Companies can use the

equipment to reduce their own costs and emissions. At the same time, they can build the market for the company's products. Several telecom companies have demonstrated the potential for electronic mobility by first reporting about their own company initiatives and then sharing information widely. BT (British Telecom) had 6000 registered teleworkers working from home or on the road in 2002. The company's program is designed to demonstrate that telework can work and thus encourage other companies to adopt it. BT's Workstyle unit sells its expertise on telework to customers.<sup>14</sup>

***Respond to interest among employees.*** Teleworkers want information about the relationship of telework and pollution, a state study found.<sup>15</sup> Polls also reflect broad public concern about global warming.<sup>16</sup> Interest in tracking emission changes related to telework may emerge among employees who want to include the air quality and climate factor in making choices about where to work. Based on that understanding, business can also work with local communities to help others find ways to reduce energy use and emissions.

### **3. HOW DOES TELEWORK REDUCE EMISSIONS?**

Telework can address two important sources of air pollutants and greenhouse gas emissions--transport and buildings. It can lower the number of miles traveled by employees and reduce the amount of energy used for offices.

#### ***3.1 Avoiding the commute***

Emissions from traffic play an important role in both air pollution and climate change. The number of cars on U.S. roads has grown twice as fast as the U.S. population.<sup>17</sup> Commuting accounts for about a quarter of miles driven annually in the United States. In most states, drivers make three-fourths of these trips to and from work alone in a vehicle.<sup>18</sup> In addition to stress, lost productivity, and traffic congestion, commuting also results in emissions that change the climate and pollute the air.<sup>19</sup> Commuting vehicles emit carbon dioxide and carbon monoxide as well as the nitrogen oxides and volatile organic compounds that combine to form ozone. Cars and trucks emit almost a third of air pollution in the United States.<sup>20</sup> Electronic technology enables vehicles to use fuel more efficiently. However, this efficiency has gone into increasing vehicle size, weight, and power.<sup>21</sup> As a result, emissions have increased as buyers opted for heavier vehicles in the past decade.<sup>22</sup>

Cities and companies find that telework initiatives aimed at avoiding commuting trips can reduce emissions. The city of Phoenix eliminates 1.3 million commuter vehicle miles and avoids more than 47,000 pounds of air pollutant emissions each day through telework.<sup>23</sup> AT&T estimates its teleworkers have increased their commuting miles avoided from 87 million miles in 1999 to 154 million in 2002.<sup>24</sup> A broad review of aggregate time series data found that telecommuting does reduce overall passenger vehicle-miles traveled.<sup>25</sup> However, a review of measurement issues and sources concludes that, while government and trade association telecommuting surveys are providing more data, none are yet entirely satisfactory. Also, the lack of an agreed definition continues to make tracking difficult beyond company and municipal programs.<sup>26</sup>

#### ***3.2 Avoiding some business trips***

Business accounts for nearly a quarter of all trips people make to a place at least 100 miles away in the United States. Business travel shifts rapidly to air for trips over 500 miles.<sup>27</sup> Since many electronics, computer and telecommunications companies operate globally, business travel by air

is likely to be a significant source of emissions. As an organization working internationally, the World Resources Institute found that air travel ranked right after office use of electricity when it prepared a baseline of emission sources.<sup>28</sup>

Aircraft emit the greenhouse gases carbon dioxide and methane. These gases mix through the global atmosphere. Aircraft also emit nitrogen dioxide, nitric oxide, and sulfur oxides that can have regional effects. Although passenger levels were down after the terrorist attacks of September 11, total emissions from aircraft have long increased as demand for air travel has outpaced efficiency gains through improved aircraft technology and operations.<sup>29</sup>

Few companies yet track the change in emissions related to reductions in business travel, but reductions in travel costs are one indication of the extent that audio, web, and video conferencing can replace some business travel. The Swedish telecom company Telia saved \$300,000 over two years by substituting audioconferencing for three of its four quarterly meetings of top managers. The savings came from reduced costs for travel, hotel, and working time. In addition, others in the company followed management's lead in increasing use of audioconferencing, which helped cut trips by air 20 percent.<sup>30</sup> Security concerns are also encouraging substitution of telework for business trips. A Washington law firm paid \$10,000 to install its videoconferencing system, which cost \$85 an hour to use. It cut travel costs 60 percent or about \$250,000 in under six months. Black & Decker uses the collaborative web technology WebEx. After September 11th, the company's use doubled and then tripled. It costs about \$100 a month plus 5 cents a minute and has cut travel costs significantly.<sup>31</sup>

Some companies are beginning to look more broadly at the value of travel of all kinds, whether for face-to-face or remote meetings. Electronic travel—by email, teleconferencing, or videoconferencing—then becomes part of a larger effort to get the most value out of relationships and the time of employees by selecting the mode of communication most appropriate to the task.<sup>32</sup> Some forms of teleconferencing, particularly video, continue to face barriers in reliability, ease of use, and cost. Training and support services similar to those available for travel are still at an early stage. Understanding of the kinds of meetings for which teleconferencing works most effectively is just beginning to emerge. Organizations are learning that remote connection works particularly well for routine, short meetings and often for training, for example, while face-to-face communication is particularly important for early brainstorming on a project and for key negotiations.<sup>33</sup>

The first studies that will combine examination of how people choose to use the real transportation network and the virtual telecommunications network are just beginning. Based on earlier studies, a leading researcher suggests that the net outcome is likely to be faster growth in telecommunications than in travel (with an increasing share of interactions falling to telecommunications) but with continued growth in travel in absolute terms.<sup>34</sup> While at a societal level, virtual and real travel may be complementary, company and regional programs can be designed to substitute telework for some commuting and travel and thus, at a minimum, reduce the rate of increase in travel and the related emissions.

### ***3.3 Using less energy to heat, cool, and light buildings and operate equipment***

Commercial and residential buildings use energy to heat, cool, and light offices and to run equipment. Office buildings account for nearly a fifth of all commercial energy consumption and nearly three-fourths of that is used for lighting, heating, cooling, and powering office equipment.<sup>35</sup> If the amount of office space is reduced, emissions from electricity use are likely to



be lowered as well. The net savings depend on the changes in use of space and equipment at both the office and the telework location.

Reconfiguring office space is often a part of telework programs designed to introduce new modes of working that depend on communications technology. In addition, telework allows companies more flexibility in responding to changes in the market. Space can be rapidly reduced or rapidly increased. IBM trained 17 percent of its employees to work independently of the office and reduced its occupancy costs from \$15,900 to \$9,800 per person through the 1990s.<sup>36</sup> Sun Microsystems now averages 1.8 users per office because as many as a third of its workers are usually out of the office working elsewhere. They may be engaged in training, conferences, customer visits, or team meetings.<sup>37</sup> When ConneXT needed to expand its workforce in an expensive real estate market, it designed a floor that housed four times as many people as other floors but provided flexible space, advanced technology, and a spectacular view.<sup>38</sup> Half of the dozen companies with formal telework programs responding to the Electronic Industries Alliance survey said that they used their telework programs to reduce the amount of space needed for offices.

More information is needed about the effect of telework on home energy use. Total energy use in U.S. homes is rising as the average size--up a third since the 1970s--increases.<sup>39</sup> Space conditioning, lighting, and refrigeration are the major contributors to the increase in energy use.<sup>40</sup> A Telework America survey found that home-based teleworkers most frequently use a spare bedroom for their workspace. On average, teleworker homes were 500 square feet larger than non-teleworker homes.<sup>41</sup> Because some energy is always being used at home regardless of teleworking, one analyst estimated that the incremental increase in use of energy at home would be less than a third of what that person would use in a traditional office.<sup>42</sup>

Although the total use of energy by electronics equipment is still small,<sup>43</sup> telework is likely to increase the use of equipment. One way to keep emissions down is to use the shift as an opportunity to increase the efficiency of using current equipment or to purchase more efficient computers, printers, and other equipment—including lighting and conditioning--both at the office and at home. Companies such as AT&T and IBM noted in the Electronic Industries Alliance survey that they supply Energy Star equipment to teleworkers. Sun Microsystems installed highly energy efficient systems in its unassigned workspaces and satellite offices. As a result, even though the occupancy of the new space is higher than in regular space (where some offices are usually vacant), the use of energy was not expected to be higher.<sup>44</sup>

As technology and work practices continue to evolve, they are likely to provide new ways of increasing energy efficiency and reducing emissions.

#### **4. WHAT ARE THE BUSINESS OPPORTUNITIES TO GAIN THE ADDED BENEFIT?**

Early telecommuting programs were often established specifically to respond to requirements to reduce traffic and the related air pollution. This was a major factor for seven of the dozen companies that reported in the Electronic Industries Alliance survey that they established formal telework programs in the early 1990s. In contrast, for five companies establishing programs more recently, it played no role. Nor was it a major factor for companies planning to expand their telework programs.

The big opportunities to achieve environmental gains are likely to come in adding the air quality and climate protection benefit to telework programs that are established to address business goals.

Environmental managers looking for opportunities may find them in working with managers of business units that want to use a network organization model or in joining property and human resource managers in reducing space and related energy costs and enhancing employee ability to balance work with other parts of life. An increasing number of examples demonstrate the potential.

- ***Increase productivity.*** Telework is one way to increase the pace of developing and delivering products whether by avoiding time lost to emergencies or airport delays or adding hours not spent commuting. Surveys consistently show that working at home can increase productivity by allowing workers to avoid distractions as well as replace some commuting time with working time. An extra hour a day can add six weeks a year.<sup>45</sup> Over 70 percent of the participants in a Telework America Survey reported increased productivity with another 20 percent saying productivity stayed the same.<sup>46</sup>
- ***Build new markets.*** Telework uses the products of electronics and telecommunications firms. As noted earlier, telecommunications companies market broadband technology for telework as well as their own expertise in setting up and operating telework programs. Some companies have documented the potential of their equipment to replace travel and thus reducing emissions. Kodak calculated that if a customer used its digital video camera to teleconference through a home or office computer instead of flying to a meeting 600 miles away, the teleconference option would have less than *one* percent of the global warming potential.<sup>47</sup> Over 250 companies have contacted Oracle Netherlands to learn about its integrated use of information technology that enables three-quarters of its employees to telework and at the same time improve their communication.<sup>48</sup>
- ***Operate in emergencies.*** Many companies are developing plans to ensure continued operation in emergencies. Telework can be one tool in these plans. It has already been used to keep companies going after earthquakes, hurricanes, floods and blizzards.<sup>49</sup> After the terrorist attacks of September 11th, businesses such as American Express increased their use of telework to maintain operations despite damage to their offices.<sup>50</sup> Hundreds of the employees at Merrill Lynch & Co. forced to relocate after the World Trade Center attacks now telecommute.<sup>51</sup> Other companies have chosen to avoid delays in travel resulting from increased security by using of video conferencing.<sup>52</sup> Several companies arranged for workers to telework after being exposed to severe acute respiratory syndrome (SARS).<sup>53</sup>
- ***Redesign office space while reducing real estate costs.*** Companies use telework in several ways that can reduce real estate costs and the related energy use and emissions. In some cases telework is part of a shift to new work patterns. Sun Microsystems has reduced use of space by designing unassigned workspace to replace individual office space for teleworkers. First Choice Health Network, Inc. in Seattle found it was cheaper to support employees working from home rather than move to a larger space. By taking this approach, the company reduced commuting and avoided the energy and material intensity of construction and maintenance of the additional space.<sup>54</sup>
- ***Recruit and retain the people with needed skills.*** A telework program can tap into new pools of workers, including those with disabilities or those who live in rural areas, and thus provide a larger workforce without adding commuters and air pollution to a region. In Washington, a company located units in towns outside Seattle. The units transfer data electronically. Workers looking for jobs also say telework is a factor. A career website survey found 84 percent of the respondents said the ability to work from home was important when looking

for a new job.<sup>55</sup> Telework also helps retain workers. Two-thirds of AT&T teleworkers who received a competing job offer say that the ability to telework was a factor in turning down the offer.<sup>56</sup> Telework may also be offered as an incentive in hiring employees who want to avoid moving. A Telework America survey found that nearly one-fifth of teleworkers had supervisors in another state.<sup>57</sup> The level of emissions from travel by remote staff, of course, depends on whether they commute to a local office and on how many trips they make to distant company offices.

- **Reduce travel costs.** Many companies use video and web conferencing to reduce travel costs. The Royal Bank of Scotland encourages its staff to consider video conferencing by asking for a statement on its travel request forms explaining why a videoconference cannot substitute for a face-to-face meeting requiring travel. It estimates that it hosts 450 videoconferences a month. The table-top equipment is widely used by all levels in the company, usually after initial face-to-face meetings. In the United States, Deltek Systems Inc saved \$150,000 in travel costs in six months by using technology that allows collaboration over the web for training and staff meetings. IBM now does most of its training remotely which both reduces miles and avoids the costs of travel.<sup>58</sup>

Telework programs initiated to meet a broad range of business challenges offer the promise of protecting air quality and the environment. To calculate changes in emissions, new assessment tools are now available.

## 5. WHAT TOOLS ARE AVAILABLE TO ASSESS THE IMPACT OF TELEWORK ON EMISSIONS?

Once the opportunities to use telework have been identified, a company or other organization can use software tools to make quick estimates or look in more depth at the potential impacts on air quality and the climate of different approaches to telework. This section discusses these tools and the emerging guidance for organizing and reporting emissions as part of a broader practice of corporate reporting on sustainability. The next section outlines the information a company needs—or may already have—to track the benefit. Further resources are listed in Appendix B.

### 5.1 Making quick estimates

A number of web calculators provide estimates of emissions relevant to telework from transport and energy use associated with offices and homes. Two examples of the increasing number available are:

- **SafeClimate.Net** at <http://www.safeclimate.net> offers tools to calculate carbon footprints from both transport and energy use. It asks the user—either a business or individual-- to supply the distance traveled by car and plane and to provide amounts of energy used from utility bills or other sources. It also considers paper use.
- The **Telework Webguide** at <http://www.att.com/telework> provides a CO2 Emissions Calculator. Users can enter the miles of their commute and efficiency of fuel use of their automobile and obtain pounds of carbon dioxide emissions per year for telecommuting one, two, three, or four days or full-time.

## 5.2 Taking an in-depth look at telework costs and benefits

Tools that allow a much more detailed assessment of the air quality and climate impacts of telework are just becoming available.

**E-COMMUTair (The Telework Impact Estimation Tool )** offers business and government managers and teleworkers themselves a web-based tool to estimate and compare the benefits and costs of telework and non-telework scenarios or to evaluate ongoing telework programs. *TIET* allows the user to identify the key variables that determine both the cost and level of 11 types of emissions (including methane, carbon monoxide, carbon dioxide, hydrocarbons, nitrogen oxides, and sulfur dioxide). *TIET* covers use of transport; use of electronic equipment; and lighting, heating, and cooling of office space. It calculates:

- emissions of carbon and air pollutants from burning fuel for transport and electricity generation (grams per 7-day week );
- use of fuel (gallons per week) and energy (KW hour per 7-day week);
- costs of fuel and of energy (dollars per 7-day week).

The tool takes into account factors such as the sources of heating and cooling, the number of hours and amount of space used at home and in the office, and the number of hours electronic equipment is in active, low power, or charge mode. Users can print a copy of their costs and emissions from the teleworking and non-teleworking scenarios.

Designed by the Consortium on Green Design and Manufacturing at the University of California at Berkeley, the decision support system can be found under software tools at <http://cgdm.berkeley.edu/telework>.<sup>59</sup>

Taking yet a broader approach is the **sustainable teleworking partnership**. Seven business and research institutions from Denmark, Germany, Italy, the Netherlands, and the United Kingdom are engaged in a two-year project looking at the economic, environmental, and social impacts of teleworking. By mid-2003, the project had completed a concept paper, a pilot survey, 30 case studies, and a self-assessment tool.

The partnership's initial paper, available at <http://www.sustel.org>, describes 14 key sustainability elements related to telework. The economic elements include added value (productivity, performance, labor, space, equipment and infrastructure, and support costs); human capital, employment, personal wealth, and resilience. Social elements are inclusion, quality of life (work-life balance, working hours, and connectedness), health, and community. Environmental elements are transport, air quality (inside as well as outside), consumption of energy and materials, the built environment, and safety.<sup>60</sup> The partners in this project have also developed a tool that allows an organization to assess a telework program's economic, social, and environmental dimensions. They expect to prepare guidance and policy proposals to help businesses and other organizations maximize the benefits of telework initiatives.

## 5.3 Tracking telework's air quality and climate benefit

Managers in companies that are already tracking and reporting their air emissions or plan to start, for example, to participate in emissions trading markets,<sup>61</sup> will want to build experience in

accounting for emissions. Three related sets of guidance demonstrate how emissions from telework fit into the developing approaches for company or organization-wide reporting of emissions.

The *Global Reporting Initiative (GRI)* ([www.globalreporting.org](http://www.globalreporting.org)) published revised Sustainability Reporting Guidelines in 2002. These guidelines provide a framework for reporting on the economic, social, and environmental impact of organization activity. Factors related to telework appear in the environmental section. They include:

- greenhouse gas emissions;
- other emissions to air;
- distance traveled by type of transport for business travel and for staff commutes.

A draft Energy Consumption Protocol provides more detailed guidance on ways to report energy use. The multi-stakeholder GRI has become an independent institution to support implementation and further development of the Guidelines.

The *Greenhouse Gas Protocol* ([www.ghgprotocol.org](http://www.ghgprotocol.org)) provides more specific guidance for reporting on greenhouse gas emissions. It can be used with the GRI Guidelines. The World Business Council and the World Resources Institute lead this open process that is designed to develop and promote detailed, internationally accepted greenhouse gas accounting and reporting standards for companies. So far, the guidance covers

- direct emissions such as those from production of electricity and travel in company vehicles (relevant to a telework program only if the program affects company-owned production of electricity—for air conditioning, for example, or changes in travel in company-owned vehicles) (scope 1);
- indirect emissions such as those from use of purchased electricity (relevant only if a telework program changes amounts of office space or types of equipment in ways that affect amounts of energy use) (scope 2);

It also includes

- indirect greenhouse gas emissions (scope 3). This scope applies to employee business travel in non-company owned vehicles and employee commuting and is the most likely scope for use in accounting for telework for most companies.

The *Telework Impact Estimation Tool* described in section 5.2 is being developed so that it is consistent with the GHG Protocol's approach to accounting for emissions from projects. A Road Test Draft of the Project Quantification Standard under the GHG Protocol is available at <http://www.ghgprotocol.org>. Under this approach, emissions are calculated relative to what the emissions would have been without the project.

Companies estimating emissions from telework programs as well as office managers looking for a step-by-step guide to estimating and reducing carbon dioxide emissions can use *Working 9 to 5 on Climate Change: An Office Guide*. (See [www.safeclimate.net](http://www.safeclimate.net)) The World Resources Institute prepared this practical guidance for non-manufacturing sites based on WRI's experience in tracking its own emissions, which are mainly from electricity use and travel, the key elements affected by telework. The *Office Guide* shows how to use the approach of the Greenhouse Gas

Protocol to track and reduce emissions from use of energy and transport through a hypothetical example. It also provides links to the tools developed for the Greenhouse Gas Protocol.

## 6. WHAT INFORMATION DOES A COMPANY NEED—OR ALREADY HAVE?

Tracking emissions seldom means starting from scratch. Companies often have some of the information needed to track telework's effect on emissions related to miles commuted or traveled and energy used in buildings and for equipment. This section connects the web tools and guidance for corporate reporting described in section 5 with the kinds of information that companies may already have. It also points out some of the issues that arise in more detailed tracking of emissions.

### 1.1 Miles and emissions avoided by telecommuting

To obtain the emissions avoided by telecommuting requires information about

- commute miles avoided;
- number of days per week or month the person telecommutes;
- mode of travel (including type of vehicle and number of people if by car);
- emission factor for mode of travel.

Emission factors are available for travel by car from at <http://www.epa.gov/autoemissions>. The *Telework Impact Estimation Tool* and *Working 9 to 5 on Climate Change* provide estimation factors and approaches for tracking miles avoided by other modes of travel.

The Electronic Industries Alliance survey of company telework practices found that half of the dozen responding companies track reduction in commuting trips in some way. Practices include:

- **Statistical survey of telecommuting.** AT&T obtains data through an annual statistical survey of its employees. It finds this approach provides the most useful information at least cost to employees and to the company. One advantage is that it covers informal as well as formal teleworkers and thus provides a broader picture of practices and the related barriers and benefits.<sup>62</sup>
- **Surveys of commuting patterns.** Some companies collect data on commuting practices by surveying their employees regularly. Sun Microsystems surveys modes of commuting used by its employees for a week each year.<sup>63</sup> The World Resources Institute also annually surveys its staff about commuting practices and updates the database, as *Working 9 to 5 on Climate Change* describes.
- **Telecommuting agreements.** Companies that use formal teleworking agreements are likely to include information about the frequency of and location of telecommuting. If these data are accessible in a database, this may be a source.
- **Commuter choice database.** Companies with programs to promote trip reduction often include telecommuting as one alternative to track in a database along with ride sharing, public transit, biking, and walking. Intel tracks telecommuters through its Rideshare database. It uses the company's phone book to generate and update personal profile information including location of home and work. The database helps employees locate car pools but can also be used to calculate commute miles avoided by telecommuters. The system can regularly email

employees requests to record their telecommuting frequency and then automatically calculate the miles saved.<sup>64</sup>

## **6.2 Miles and emissions avoided by replacing business travel with telework**

Tracking the miles and emissions avoided by replacing business travel with telework requires the same basic information used to track telecommuting:

- the miles avoided;
- the mode of travel that would have been used;
- emission factors for modes of travel.

*Working 9 to 5 on Climate Change* describes how to calculate emissions from all modes of travel—in this case, travel avoided—and provides emission factors, which are updated at [www.safeclimate.net](http://www.safeclimate.net). The guide notes that fuel use gives more accurate information for calculating emissions than using the distance traveled.

It also points out that emissions from air travel vary with the length of the flight since more emissions are associated with take off and landing. Thus, it provides separate emission factors for short, medium, and long trips by air.

Five companies responding to the Electronic Industries Alliance survey reported programs to substitute telework for some business travel. However, no companies said they tracked the travel miles or emissions avoided or the change in total miles traveled on a regular basis. One way of doing this is to include the miles traveled in travel authorization forms. The World Resources Institute added a line to its forms asking for this information (and provided a link to calculate it) if the travel is not booked through the regular travel agency, which otherwise provides the data. As some organizations begin to replace “travel” policies with “meeting” policies and use a single system to “order” meetings—whatever the combination of virtual or physical,<sup>65</sup> they may be able to use a single approach to track emissions related to virtual and real travel.

In substituting electronic conferencing for business travel, two basic questions arise in how to count trips avoided by virtual communication.

- ***Which remote meetings count as replacing business travel?*** Not every audio, web, or video conference will replace a trip. One approach is to choose a percentage of remote conferences that will be assumed to replace travel, based on company experience. The Royal Bank of Scotland decided to assume that 60 percent of videoconferences replaced travel.<sup>66</sup>
- ***How many people would have traveled for a meeting in the absence of the remote conference?*** A calendar for use of central video conferencing equipment may provide an opportunity to record the number and types of trips avoided by telework. This can be decided separately for each meeting. Did a person present on a particular point but probably would not have traveled to a meeting at another location? A default assumption may also be useful. The Royal Bank of Scotland assumes that only one person for a typical four-person conference would otherwise travel.

### ***6.3 Energy and emissions avoided by changes in use of office space and equipment***

Telework programs change the amount and type of energy used in office buildings and homes for lighting, heating, cooling, and equipment. Telework may be a factor in increasing electricity use. When replacing business travel with video conferencing, companies should also look at the electricity use associated with use of the equipment, for example. One study found that the length of time the equipment was used—or not turned off—made a significant difference in emissions avoided.<sup>67</sup> Frequently, however, energy use will be reduced through redesign of office space and technology.

Especially when real estate cost reductions have been a factor in establishing telework, companies are likely to have some information on changes in energy use. Five companies in the Electronic Industries Alliance survey reported having data on the amount of space used for offices with and without telework. Otherwise, utility bills and company surveys can be used to obtain these data.

- ***Electricity bills.*** Utility bills provide information on amounts of electricity used both in the office and at home.
- ***Company surveys.*** AT&T's annual statistical survey includes questions on home energy use.

The *Telework Impact Estimation Tool* allows companies to examine how telework programs change electricity use for lighting, heating, cooling, and equipment at home and in the office. By using this tool and sharing the resulting information, organizations can develop more accurate information about the conditions that reduce energy use and tailor telework programs to achieve reductions.

*Working 9 to 5 on Climate Change* suggests that companies obtain emission factors directly from their electric company to increase the level of accuracy. The E-GRID database provides emission factors for U.S. power plants at <http://www.epa.gov/airmarkets/egrid/>. Emission factors are also available for states and regions, though they are less accurate.

Ten of the companies responding to the Electronic Industries Alliance survey had some of the data needed to track the air quality and climate benefit of telework. Software tools can now easily translate energy and fuel data, the type companies are mostly likely to collect, into information about emissions.

### ***6.4 Keeping the costs of tracking down and promoting trust***

As companies gain experience with the technical aspects of assessment and tracking tools, two other factors will be important. One is how to keep the cost low to both individual employees and the company. New assessment tools can reduce the costs. The other issue is how to protect privacy and promote trust when tracking emissions from commuting and travel and energy use in the office and at home—practices that involve personal choice. The appropriate approaches are likely to vary with the company. An anonymous statistical survey of all workers rather than just tracking the location of teleworkers may enhance—rather than undermine--both the informality and trust that underlie management based on performance.<sup>68</sup>



## **7. LOOKING AHEAD**

The communication network--phone, video, and web--is becoming the primary way many companies organize work. Telecommuting may remain a separate program in some companies. In others, telework will be both formal and informal. Regardless of how telework develops, tools to calculate the associated emissions begin to be available. With testing, the assessment tools can be improved to keep costs of using them low and encourage use in ways that demonstrate trust and provide privacy.

The data collected will help companies and individuals examine emissions related to commuting, business travel, and energy use in buildings. These data can be used to encourage patterns of telework that meet key business needs—increased productivity, operation in emergencies, enhanced recruiting and retention of people, and lower real estate costs--and gain an added benefit for the environment.

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**Appendix A:  
SURVEY OF TELEWORK PROGRAMS IN ELECTRONICS COMPANIES**

To develop a baseline of formal telework programs at member companies, the Environmental Issues Council of the Electronic Industries Alliance emailed a survey to about 200 member companies twice in the summer of 2000. Twenty-two of the companies responded.

**1. Companies with formal programs**

As Table 1 shows, 12 companies reported that they had set up formal telework programs between 1990 and 2000. The companies are Apple, AT&T, Compaq (now part of HP ), HP, IBM, Intel, Lockheed-Martin, Motorola, Nortel Networks, Radio Shack, Sun Microsystems, and Texas Instruments. Five of these companies reported formal programs that use telework to substitute for some business travel: AT&T, Compaq, IBM, Nortel Networks, and Texas Instruments. Two-thirds of the companies with telework programs expected to develop their programs further.

Respondents from ten companies (AIWA America, Canon, Corning, Fujifilm, GE, Harris, JVC, Panasonic, Thomson Consumer Electronics, and Yamaha) said that they found no formal human resources management policy on telework. However, several noted that their company frequently used telework to meet specific business needs such as lack of office space or an employee’s personal situation. All but one company that has a formal telework program cited developing uniform personnel practices for a widespread informal practice as at least a minor reason for establishing the program.

**Table 1: Electronics companies that established formal programs during the 1990s**

<b>Company</b>	<b>Year established</b>	<b>Was goal to encourage telework or to standardize informal practice?</b>	<b>Does company have plans to expand program?</b>	<b>Does company also have formal telework program to replace some travel? If so, year established.</b>
<b>Motorola</b>	1990	Encourage	Yes	No
<b>AT&amp;T</b>	1992	Encourage but also clarifies policy	Several divisions have shifted to telework since 2000	Formal in 1999; informal earlier
<b>Compaq</b>	1992	Clarify policy	Yes	1992
<b>Apple</b>	1993	Encourage	No	No
<b>HP</b>	1993	Encourage	Yes	No
<b>IBM</b>	Mid-90s	Encourage	Incremental	Mid-90s
<b>Texas Instruments</b>	1995	Encourage	No	1995
<b>Intel</b>	Gradual	Encourage	<b>Will open centers as needed</b>	No
<b>Nortel Networks</b>	1997	Encourage	Yes	1997
<b>Radio Shack</b>	1997	Clarify policy	No	No
<b>Lockheed-Martin</b>	1999	Clarify policy	No	No
<b>Sun Microsystems</b>	2000	Clarify policy	Yes	No

## 2. Reasons for establishing formal telecommuting programs

In 2000, the most important business drivers for telework were recruiting and retaining employees and improving employee quality of life. Table 2 shows that 11 companies ranked attracting and keeping employees as very important. Nine also rated improving workers' lives at the top. Increasing productivity was a strong secondary motive for three-fourths of the companies—ranking as important for nine companies and very important for three. While cutting real estate costs was very important for five companies and important for one, it played a minor or no role for the other six. Maintaining business continuity, which has recently received more attention, was not a major factor.

For companies located in areas with heavy traffic and air pollution problems, reducing congestion and pollution were the original reasons for establishing programs. These factors played a very important or important role for seven companies but no role for most of the others. Reducing greenhouse gases was important for three companies and a minor factor for another two.

**Table 2 Importance of motivating factors in establishing telecommuting programs**

<b>Factor</b>	<b>Very important</b>	<b>Important</b>	<b>Minor</b>	<b>Not a factor</b>
<b>Recruit, retain people</b>	11 companies	1 company	None	None
<b>Improve productivity</b>	3 companies	9 companies	None	None
<b>Improve employee quality of life</b>	9 companies	2 companies	1 company	None
<b>Establish uniform practices</b>	None	8 companies	3 companies	1 company
<b>Reduce congestion</b>	3 companies	4 companies	1 company	4 companies
<b>Reduce air pollution</b>	3 companies	4 companies	none	5 companies
<b>Reduce real estate costs</b>	5 companies	1 company	3 companies	3 companies
<b>Reduce greenhouse gases</b>	None	3 companies	2 companies	5 companies (+2 no response)
<b>Avoid absenteeism</b>	None	2 companies	7 companies	3 companies

## 3. Practices in tracking telework programs in 2000

Companies take a range of approaches to collecting data on the numbers of people participating in their programs and on the changes in use of transport and buildings that result. As Table 3 shows, three of the 12 companies do not track the number of telecommuters. Those that do some tracking use two types of definitions. Some use the number of days a week telecommuted. Others distinguish those employees by whether or not they have assigned company office space.

**Table 3 Approaches to tracking the number of telecommuters**

<b>Company</b>	<b>Track telecommuters</b>	<b>Definition</b>	<b>Method</b>	<b>Number</b>
<b>Apple</b>	Yes	2 or more days a week	Confirming surveys twice a year	350 in U.S.
<b>AT&amp;T</b>	Yes	Prefer definition of 1 or more days a week; also track full-time virtual workers	Annual statistical survey	1 in 2 once or more a month; 1 in 4 once or more a week, 10% full-time; in 2002, 17% full-time virtual and 40% telework some of time.
<b>Compaq</b>	Yes	Home-based full-time; office-based part-time	No response	About 7000 total
<b>HP</b>	No			
<b>Intel</b>	At individual site only	Track number of drivers and miles avoided		No company wide numbers
<b>IBM</b>	Only mobile workers	No assigned office space		58,000 in 1999
<b>Lockheed-Martin</b>	No			
<b>Motorola</b>	Yes	Work from home at least 8 hours a week	No description	No number given
<b>Nortel Networks</b>	Yes	No office space, home office wired	No description	6000
<b>Sun Microsystems</b>	Yes	Developing tracking system	Annual survey of commuting modes; plan new data collection as new system adopted	At pilot stage
<b>Radio Shack</b>	Yes	Staff at call center		35
<b>Texas Instruments</b>	No			

Table 4 shows that ten companies responded that they had some data on transport and building use related to telecommuting. None reported collecting data on vehicle miles avoided by substituting telework for business travel.

**Table 4 Types of data collected on changes in transport and in use of buildings**

Company	Changes in vehicle miles	Mode of transport	Changes in amount of space	Changes in cost of construction, and/or maintenance
Apple		Yes		
AT&T	Yes	Yes	Yes	
Compaq			Yes	Yes
HP			Yes	Yes
IBM		For mobile workers	Yes	
Intel	Yes	Yes		
Motorola	Yes	Yes		
Nortel Networks			Yes	Yes
Radio Shack			Yes	Yes
Sun Microsystems	Could calculate	Yes	Yes	Yes

#### 4. Scale and benefits from example programs

Table 5 shows cost and productivity savings and miles or emissions avoided from four example programs.

**Table 5 Scale and benefits of four example telework programs**

Company	Scale	Productivity gains	Reduced real estate costs	Reduction in pollution, energy use
AT&T	10% virtual, 1 in 4 once or more a wk, 1 in 2 once or more a month; for 2002, 17% full-time virtual, 40% telework part of time	Six weeks a year One more hour a day equals \$100million yr. (also \$15 million in employee retention for 2003)	\$25 million a year; (for 2003 expect \$35 million)	Avoided 87 million miles commuted in yr.; (for 2002, 154 million miles avoided)
Compaq	7000, covers teleworking both full and part-time	15 to 25%		
IBM	58,000 mobile workers		Reduced costs of space per employee by half	Contributed to 4% a year drop in energy use
Nortel Networks	6000 worldwide, half full and half 1 to 2 days a wk.	25%	\$8 million yr.	16 million pounds air pollutants avoided in yr.



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**Sources:** Data were mainly reported in the EIA survey during 2000 but are supplemented by other sources.

AT&T: ITAC, Romm, Roitz et al.

Compaq: ITAC

IBM: Romm, IBM environmental reports

Nortel Networks: HOMEbase: Nortel Networks Telecommuting Program

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## Appendix B WEB RESOURCES

### 1. Air quality and climate protection

<http://www.epa.gov/airtrends> Introduces six principal air pollutants and also discusses toxic air pollution, acid rain, stratospheric ozone, and visibility. Provides air quality and emissions data including trends.

<http://epa.gov/globalwarming> Describes climate problem, emissions, and impacts; outlines actions, provides information by geographic region and tailored to particular interests (from health professional to outdoor enthusiast to small business) as well as links to publications and tools.

<http://www.usgcrp.gov> U.S. Global Change Research Program documents the science of climate change. Includes links to the National Assessment of the Potential Consequences of Climate Variability and Change in the United States.

<http://www.ipcc.ch> Provides links to the publications of the Intergovernmental Panel on Climate Change and national monitoring reports.

<http://earthtrends.wri.org>. Includes searchable database of time series data for emissions of carbon dioxide by country and region of the world, maps of per capita emissions and articles on climate change. See also <http://www.wri.org/climate>.

### 2. Telework

<http://att.com/telework>. Includes pieces on getting started on telework for employees, managers, and companies as well as a library of articles describing experience with telework.

<http://www.workingfromanywhere.org> The International Telework Association and Council site includes resources such as Telework America reports, a newsletter with company case studies, and links to federal, state, and local telework programs. Also see <http://www.telcoa.org>.

<http://www.sustel.org> Provides findings from a collaboration of seven business and university partners funded by the European Union. The 2002-2004 project is developing tools and guidance materials to help organizations evaluate and optimize the sustainability of teleworking initiatives.

### 3. Transport

<http://www.bts.gov> The Bureau of Transportation Statistics provides data on transport and related greenhouse gas and air pollutant emissions.

<http://www.epa.gov/otaq> National information on commuter choice programs including a business benefits calculator at <http://www.commuterchoice.gov>.

<http://www.globaltelematics.com> Analysis by John S. Niles of relationship between telecommunications and travel.

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<http://www.its.ucdavis.edu/telecom> Lists publications prepared by the Telecommunications and Travel Behavior Research Program under the Institute of Transportation Studies at the University of California at Davis. Directed by Patricia Mokhtarian, the program has performed extensive research on telework for more than a decade.

<http://www.yosemite.epa.gov/globalwarming/nsf/content/ActionsTransporation.html> Action opportunities and includes link to fuel economy site.

<http://www.travelmatters.org>. Site developed by the Center for Neighborhood Technology for the Transportation Research Board. Includes regional and national emission calculators and maps related to transport and climate change.

#### **4. Energy efficiency in building and equipment**

<http://www.eia.doe.gov/emeu/efficiency/contents.html> The U.S. Department of Energy provides extensive information on efficiency in buildings and equipment.

<http://www.energystar.gov> Information about saving energy at the office and at home. Also see <http://www.computerpowersaver.com> for calculator that estimates energy and cost savings from using power management for computer monitors.

<http://enduse.lbl.gov/n4e> Lawrence Berkeley National Laboratory site provides analysis of electricity use by office equipment.

<http://www.cool-companies.com>. Includes report on Energy and the Internet. Lists companies with climate commitments.

<http://www.aceee.org> Consumer resources include guide to home energy savings and greener cars site.

#### **5. Assessment tools and guidance**

<http://www.safeclimate.net> Calculator for individual and business carbon footprints from transport and energy use.

<http://cgdm.berkeley.edu/telework>. Software to calculate costs and emissions using telework and non-telework scenarios that include use of transport, electronic equipment, lighting, heating, and cooling.

<http://www.globalreporting.org> Broad guidelines for corporate reporting on economic, social, and environmental impact of organization's activity include commuting and business travel in environmental section. Also more detailed protocol for reporting on energy consumption.

<http://www.ghgprotocol.org> Detailed guidance and tools for reporting on greenhouse gas emissions.

Also see calculators at <http://att.com/telework>, <http://www.travelmatters.org>, <http://www.commuterchoice.gov>, and sustainability assessment tool at <http://www.sustel.org>.