Networking for Sustainability: The Network Offset Effect

Executive Summary

This white paper introduces the network offset effect to describe the positive sustainability value creation that takes place when activities that have a high environmental impact can be replaced with low-carbon alternatives that use the networks of information and communication technology (ICT) providers. The network offset effect holds the potential to deliver efficiencies to everything from Smart Workplaces, Smart Data Centers, Smart Transportation and Logistics, Smart Grids and Smart Buildings.

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Part One: The Search for Viable Solutions

Introduction

Reducing greenhouse gas (GHG) emissions means eliminating or curtailing activities that burn fossil fuels and send carbon dioxide equivalent (CO_2e)[1] emissions into the atmosphere. This means using less petroleum to fuel our cars, trucks, trains, boats and airplanes and less coal, oil and natural gas to fire the generating plants that produce electricity to run the machines, equipment and infrastructure of our economy, and to provide light, heating and cooling to our buildings and homes.

AT&T believes business and society can reduce environmental impacts, including realizing measurable GHG reductions through the use of network-delivered applications and services.

This white paper introduces the network offset effect to describe the positive sustainability value creation that takes place when activities that have a high environmental impact can be replaced with low-carbon alternatives that use the networks of information and communication technology (ICT) providers. The network offset effect holds the potential to deliver efficiencies to everything from Smart Workplaces, Smart Data Centers, Smart Transportation and Logistics, Smart Grids and Smart Buildings.

In the area of Smart Workplaces, for example, the network offset effect is implemented by enabling remote work or telecommuting, whereby once-centralized information resources are virtualized through broadband connections and collaborative tools that can be accessed by employees without regard to their physical location. The result is a workplace environment that can reduce the need for commuting and unnecessary travel, with the potential to deliver an additive and cumulative reduction in CO_2e emissions. What's more, by space-sharing (part-time telecommuters) and space-shedding (full-time telecommuters), a business may also be able to reduce office space and associated heating, cooling and lighting requirements, thereby further reducing emissions and reducing costs.

Smart Transportation also illustrates the potential for the network offset effect to deliver significant CO_2e reductions by enabling fleet management solutions that use telecom wireless and satellite communications to automate vehicle route planning. Such efficiency gains translate to fleet-wide performance improvements, reduced energy waste due to idling reduction and the elimination of CO_2e emissions by improving maintenance and optimizing miles traveled, which ultimately permits removing unnecessary vehicles from the road.

Bringing the country's electricity generation, transmission and distribution grid into the digital age, an effort frequently referred to as the Smart Grid, likewise has the ability to harness the network offset effect to significantly impact power consumption and resulting CO_2e emissions from literally millions of energy-intensive devices, such as home appliances. Equipping devices with remote sensors that support two-way communications connects them with utility operators over intelligent networks for remote monitoring and power demand management.

Cloud computing services also may leverage the network offset effect to the extent less intensely utilized individual dedicated servers are replaced by a more intensely utilized cloud computing infrastructure. Not only does this change eliminate or reduce the need to power lower utilized servers and their associated data storage equipment, but it also reduces cooling and real estate infrastructure. As a result, e-mail, Web hosting and other applications can be centralized to provide ubiquitous access for a multitude of users and devices over the network.

As its starting point, this paper builds on key findings from the watershed Global eSustainability Initiative(GeSI) report "SMART 2020: Enabling the Low Carbon Economy in the Information Age," which posited that ICT-enabled solutions have the potential to significantly reduce annual CO_2e emissions by up to 15 percent worldwide and up to 22 percent in the U.S. by 2020.[2]

By interpreting how the network offset effect can be applied to AT&T's own situation and business, the goal of this white paper is to help AT&T customers better understand how they can harness the power of ICT to reduce their own CO_2e emissions more profitably.

White Paper Top Line Highlights

- With estimates of potential reduction of global gross domestic product (GDP) of 20 percent or more, the problem of minimizing environmental impact from fossil fuel emissions has risen to the top of the global public policy agenda
- Businesses across many industries have started to embrace low-carbon solutions in their business models and are increasingly turning to ICT solutions to help them address escalating costs of power consumption and address climate change
- The objective of this white paper is to provide further data and support the growing role of ICT in delivering solutions that help businesses simultaneously achieve three critical outcomes: more efficient energy consumption, reduced global GHG emissions and lower cost
- Building upon the recommendations contained in the GeSI SMART 2020 report, this paper examines specific areas where AT&T products and services have the potential to harness the network offset effect to help improve energy efficiency and mitigate environmental impact by reducing CO_2e emissions
- This paper introduces the network offset effect for carbon mitigation to describe the positive outcome in sustainability value creation that occurs when collaborative networks are used to eliminate, reduce or simply make more efficient high-carbon activities, processes, connections or transactions
- Reducing CO_2e emissions means eliminating or curtailing activities that burn fossil fuels and send CO_2e into the atmosphere. To lower GHG emissions, it is necessary to change how we produce and consume energy

- Changing how energy is produced is beyond the scope of this paper. On the other hand, production is a slow route, but changing consumption is often readily achievable, cost effective and produces meaningful results. ICT-related tactics for changing consumption fall into four broad categories
  - Moving work to people rather than people to work
  - Connecting rather than traveling
  - Managing business remotely and in real-time
  - Improving transportation and distribution system efficiencies
- The CO_2e reduction potential of ICT industry solutions is examined across four key usage areas
  - Smart Workplaces
  - Smart Data Centers
  - Smart Transportation
  - Smart Electric Grids
- Each of the four primary ICT usage areas is accompanied by descriptions of AT&T products and solutions available today that can help customers reduce CO_2e emissions and become more efficient, productive and sustainable
- The report provides a more detailed analysis of several solution areas falling under the travel replacement category – teleconferencing and telecommuting – that represent “low hanging fruit” for early widespread corporate energy efficiency gains leading to both CO_2e emission and cost reductions
- A hypothetical scenario which assumed certain in-service numbers, percentage usage and travel avoidance enabled by a subset of AT&T’s teleconferencing and telecommuting services revealed one year CO_2e savings of 1.34 million metric tons – equivalent to eliminating over 255,000 passenger vehicles or the electricity required to power more than 170,000 homes for a year
- Case study examples, accompanied by proposed measurement models and formulas, are provided to illustrate the benefits of moving work to people, rather than people to work, while delivering significant and relatively straightforward documentation of CO_2e reduction
- Further development of verifiable data across the full spectrum of solution areas is identified as a critical next step for establishing a larger role for ICT in reducing CO_2e emissions that will require the creation of new models and methodologies for establishing baseline data and measurement criteria
- The paper concludes with a call to action, including AT&T’s commitment to help further develop the measurement tools and methodologies required to better quantify and realize the energy efficiencies, cost savings and emission reduction potential of ICT products across the full range of customer solution areas

Minimizing Environmental Impact

As the world transitions to a low-carbon economy, the search for viable solutions to control GHG emissions and reduce the carbon footprint of industries, businesses and individual consumers has risen to the top of the global public policy and business agenda.

At the December 2009, U.N. Framework Convention on Climate Change in Copenhagen, Denmark, the European Union agreed in advance to accept a CO_2e reduction target of 80-95 percent less than 1990 levels.[3] In October 2009, U.S. President Obama issued an executive order covering federal energy usage that calls for meaningful cuts in CO_2e emissions by 2020 across all federal agencies and details a green procurement policy that covers 95 percent of new federal acquisitions and contracts[4] – representing a significant opportunity for businesses looking to help government agencies meet new procurement requirements – while building on the President’s stated goal to reduce U.S. emissions 83% by 2050.[5]

Whether or not, as a business leader, you embrace the issue of climate change, the solutions discussed here-in also deliver real business value.

The Search for ICT Solutions

Against this backdrop, ICT companies participated in a groundbreaking study developed by The Climate Group in partnership with the GeSI: “SMART 2020: Enabling the Low Carbon Economy in the Information Age.” AT&T and other U.S. GeSI members then worked to create a U.S. view of the study, released in November, 2008 (2008 U.S. Addendum). The Smart 2020 reports focused on how ICT can play a crucial role in fighting climate change. It concluded that while alternative fuels and various cap and trade or cap and storage regulatory approaches for the largest carbon emitters hold long-term promise, some of the most effective solutions for industry are already available for implementation today. The reports estimated that ICT-enabled solutions could cut annual CO_2e emissions by up to 15 percent worldwide and up to 22 percent in the U.S. by 2020. The resulting annual energy expense savings in the U.S. alone could amount to as much as $240 billion.[6]

Rapid advances in ICT hold enormous potential for the future by enabling smart networks that can deliver environmental savings both quickly and cost effectively. Some of the best examples come from the simple fact that the energy required for communication (moving photons) is much less than the energy required to physically move people and things (moving atoms).

To lower CO_2e emissions, it is necessary to change how we produce and consume energy. Changing production is a slow route, but changing consumption can be faster and is often less expensive. For business, some of the lowest hanging fruit is paying attention to what is moved around the planet. Moving information through fiber, wires and airwaves is much less energy-intensive than moving people to permit the exchange of information. For example, moving work to people, as is the case for telecommuting and video conferencing, can be much more efficient than moving people to work, particularly when long distances are involved or when groups are brought together from multiple locations to attend meetings.

Equally important is the role of smart networks in providing faster access to better information, which enables smarter decisions to be made regarding the use of resources in general and energy more specifically. Remote sensors that support Smart Grid solutions, for example, will be critical in enabling more efficient electricity distribution and consumption. Mobility products that support vehicle routing, tracking and monitoring help improve fleet utilization and transportation logistics. Likewise, products that once consumed significant amounts of energy for manufacturing, packaging, transport and storage are being dematerialized for distribution and consumption over smart networks, avoiding the need to create physical product entirely, ranging from music downloads to eBooks, magazines, newspapers and movies.

According to GeSI estimates, ICT has the potential to enable CO_2e emission reductions five times larger than the CO_2e emissions generated by ICT use.[7] And, while the ICT industry has long recognized the value of its products and services in delivering increased energy efficiency and productivity gains, it has only just begun to develop the tools and methodologies needed to track and verify those gains in terms of CO_2e emission reduction to help customers make smarter sustainability choices and investments and better prepare them for any future carbon offset, cap and trade or regulatory scenarios.

Becoming More Sustainable, Profitably

For businesses, the deployment of new applications and services over smart networks means sustainability gains can not only be achieved more cost effectively today but can actually be harnessed to drive future growth and profitability through improved performance and reduced energy costs. What's more, achieving energy efficiency can deliver financial returns that often far outweigh the initial investment and are not only good for the environment but good for the economy. According to a recent study by McKinsey, "Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?", a $520 billion U.S. investment in energy efficiency could result in savings of up to $1.2 trillion by 2020, decreasing energy consumption by 23 percent and eliminating up to 1.1 billion tons of GHG annually.[8]

Faced with the increasing cost of energy and the potential business impact of climate change, businesses across a broad swath of industries are increasingly looking at ways to introduce low-carbon solutions into their business models, particularly when the cost of mitigating carbon emissions can be turned into an opportunity for savings that can boost their bottom lines. According to a recent Economist Intelligence Unit survey on workplace sustainability initiatives around the world (co-sponsored by AT&T and Cisco), of 345 top-level executives polled, 18 percent said their companies already have a carbon-reduction strategy in place and another 39 percent said they are in the process of developing one.[9]

And despite the uncertainties presented by a challenged economy, business leaders indicate a willingness to embrace technology solutions to help them meet the climate change challenge. IDC reports that when asked in a recent survey: "How important a role do you think information technology (IT) will play in your organization's efforts to reduce its environmental impact?", roughly two-thirds of global CEO respondents agreed that IT's role was "important to very important."[10]

AT&T's ICT Solutions

As a business networking leader, AT&T delivers products and services that align business needs – to be more energy efficient – with environmental needs – to explore and develop new and inventive approaches that will help address rising energy costs and carbon emissions. They have the potential not only to increase the performance of companies and improve productivity and efficiencies but can also help them fully harness the network offset effect to realize the triple bottom-line benefit of creating more sustainable ecological, social and financial outcomes.

This paper builds upon the recommendations contained in SMART 2020 and examines specific areas where AT&T products and services have the potential to harness the network offset effect to help reduce CO_2e emissions.

How Collaborative Networks and Sustainability Create Value

In 1993, network pioneer Robert Metcalfe described the "network effect" to explain how the addition of each new user or device on a communications network resulted in an exponential increase in its value. Widely referred to as "Metcalfe's Law,"[11] the network effect has evolved through subsequent iterations and interpretations to demonstrate how various measures of value on a communications network can grow at a rate faster than the linear growth in the number of users or devices connected.

This white paper introduces the network offset effect for carbon mitigation to describe a similar positive outcome in sustainability value creation that can be both additive and cumulative from collaborative networks that have the ability to eliminate, reduce or simply make more efficient high-carbon activities, processes, connections or transactions that can be automated, virtualized or replaced with low-carbon alternatives that use the networks of ICT providers. The network offset effect has the potential for delivering efficiencies to everything from Smart Workplaces to Smart Data Centers, Smart Transportation and Logistics, Smart Grids and Smart Buildings.

Through further study and validation, AT&T believes the network offset effect can be leveraged as a powerful tool to help business and society achieve measurable CO_2e reductions through the use of network-delivered applications and services that can be harnessed to drive change in business processes and individual behavior.

The AT&T Global Network

AT&T has one of the world's most advanced and powerful global backbone networks that enables users to do more, more effectively and often more efficiently while reducing their carbon footprint. It delivers information and intelligence to support efficient transactions in near real-time at the point of need. It helps move work to people, rather than people to work. And it allows people to connect rather than travel.

And, as one of the leading providers of global networking to the world's largest multinational corporations, AT&T can use its scale to help reduce customers' infrastructure needs – physical plant and real estate, redundant labor, and associated energy and emissions – enabling them to buy only what is needed, thus potentially lowering the cost of doing business as well as reducing their carbon footprint and waste.

Realizing ICT's potential to mitigate environmental impact from CO_2e emissions is dependent on key enablers across the full range of computer hardware, software and networking technologies as well as significant changes to business processes and individual behavior.

From the network technology perspective, two fundamental enablers necessary to maximize the potential for delivering energy-efficiency improvements and associated CO_2e reductions are: 1) widespread adoption of broadband access; and 2) an intelligent IP-based network. AT&T delivers both wireless and wireline broadband access and is continually expanding its coverage while upgrading bandwidth and performance to meet the increasing connection requirements of new applications. The AT&T global network integrates broadband access with IP networking technology, sophisticated network management and cyber security options to deliver an intelligent network that is capable of supporting a wide array of current and future services.

There's no doubt that today's increasingly diverse and demanding IP applications place new demands on delivering optimal network performance. AT&T's intelligent network provides customers with choices for IP traffic handling to support a rapid, cost-effective introduction of new applications with the assurance they will operate as intended. Furthermore, AT&T provides security options to reduce the risk of unauthorized access to systems and information. An intelligent network also makes it easier and more cost effective to introduce new innovations, while reducing the connection management burden placed on edge devices and their associated services.

Part Two: The Network Effect in Smart Workplaces

Smart Workplaces

Decreasing energy-intensive travel through telecommuting, teleconferencing and other collaborative workspace services.

According to the GeSI report, by allowing employees to work from the most optimal location and meet virtually, rather than in person, businesses could reduce total U.S. CO_2e emissions attributed to air and road travel by an estimated 5-9 percent. In addition, travel substitution could save U.S. business $20 billion to $40 billion in reduced fuel consumption.[12]

In fact, a recent independent study of telecommuting found that while 40 percent of U.S. workers have jobs that would allow them to telecommute, less than 4 percent actually work from home.[13] The study further noted that 40 percent of the work force, representing 33 million Americans, could collectively reduce GHG emissions by up to 107 million tons a year and save almost $43 billion of gasoline each year.[14]

The Economist Intelligence Unit survey on workplace sustainability initiatives around the world found that 43 percent of respondents surveyed cited increased use of virtual meetings as their biggest contribution thus far in reducing their carbon footprint.[15] According to a recent American Consumer Institute study, if video conferencing were to be substituted for just 10 percent of business air travel in the U.S., carbon emissions would be reduced by some 35 million tons annually, which is the equivalent annual energy savings required to provide electricity to more than 4.1 million homes.[16] And globally, the World Wildlife Fund (WWF) estimates that telecommuting and virtual meetings could eliminate 1 billion tons of workplace emissions annually by the year 2030.[17]

While many organizations have partially established the infrastructure needed to support telecommuting, including migrating enterprise applications and administrative functions to remotely accessible interfaces, a more thorough approach would take into consideration the full complement of enterprise and home office resource, application and access requirements along with the necessary data, voice and technical services needed to deliver a robust remote access experience. In the meantime, many organizations are examining extending the benefits of telework to their entire organization to support business continuity in the event of a widespread pandemic or other natural or manmade disaster, as well as realizing enhanced productivity gains from extending the work environment.

AT&T Solutions for Smart Workplaces

AT&T Telepresence Solution

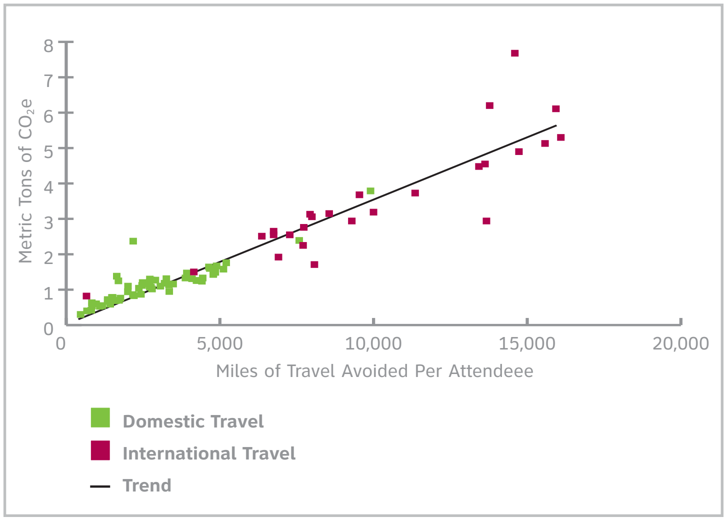
The AT&T Telepresence Solution combines innovative video, audio and interactive elements to create a unique, virtual presence over the network giving users an "in-person experience." Using telelpresence equipment from various vendors, the AT&T Business Exchange, AT&T's Multi-Protocol Label Switching-enabled global IP Network and VPN capabilities, and specialized management software, telepresence creates new ways for companies to collaborate and conduct global business internally, across supply chains and across industries. It delivers actual-size images via full, high definition (HD) video and spatial audio within a specially designed environment creating the experience of being in the same room with remote participants, whether they are down the street or around the world, while retaining the high level of network security provided by a VPN network.

AT&T uses telepresence in its own business to conduct meetings and to improve the ability of employees to work anywhere, anytime. In fact, in addition to improved productivity, AT&T conservatively estimates that its own use of AT&T Telepresence Solution will allow AT&T to reduce CO_2e emissions by approximately 31,000 metric tons over the next six years – an amount that is roughly equal to the emissions generated by 5,732 passenger vehicles for a year.[18]

Telepresence Carbon Reduction Model

To further explore the network offset effect potential for telepresence, AT&T worked with an independent research firm[19] to develop a model for calculating CO_2e reductions based on several typical telepresence meeting travel-avoidance scenarios.[20] The model calculates the CO_2e emissions that would result from air and ground transportation for a meeting attendee and subtracts the CO_2e emissions produced by the telepresence component of the meeting (the network and hardware required in the conference rooms). The Cisco 3200 system was the basis of the study.

Carbon Emissions Avoided



Assumptions for the model include:

- Domestic round-trip travel from Newark, N.J.; Dallas and Los Angeles and international round trips based out of Newark and New York City
- Data encompasses 62 domestic city pairs and 25 international city pairs
- A plot of metric tons of CO_2e saved is given based upon one person using the video conferencing facility
- Calculations with embedded carbon from the Cisco system are included

The carbon emitted per mile varies quite a bit for different flights, but a relationship is apparent – longer flights avoided save more carbon and, assuming the lowest carbon seats, the relation is close to linear. Even for short trips, the savings are significant, and they add up quickly as more people attend the meeting remotely.

For example, the graph above illustrates total carbon emissions avoided based on total miles of travel avoided, ranging from a low .3 metric tons for round-trip travel between Los Angeles and Las Vegas to a high 7.68 metric tons for round-trip travel between New York's JFK International Airport and New Delhi.

The Case for Telepresence in Advertising

As the account lead, the last thing DDB advertising agency CEO Tim Rodgers wanted to worry about when preparing a new "Stretch" creative campaign to support AT&T's business-to-business marketing was having to sell his agency on presenting its new creative concepts over a video teleconference call.

Finding it difficult to clear everyone's calendar to schedule an in-person meeting, Bill Archer, AT&T Business Solutions' chief marketing officer, suggested the DDB creative team, based out of Chicago and St. Louis, forgo a February visit to Bedminster, N.J., and instead conduct the meeting via the AT&T Telepresence Solution.

"Initially, I was dead set against it," said Rodgers. "In our business, we feel that it is a sign of respect to go visit someone and show them the work in person. And this being a creative business, we feel that if we can charm our clients with our mystical magic, it will make all the difference in whether they become true believers in the advertising."

Reacting to that first telepresence meeting, Rodgers remarked, "Telepresence worked great and the meeting went way better than we could have possibly hoped. The amount of extra time we gained to work on the campaign, not to mention the good night's sleep we enjoyed by not traveling, clearly resulted in a better meeting all around."

However, making matters more difficult for DDB, the "Stretch" campaign also needed to be segmented to specifically address the needs of multiple divisions within AT&T's business marketing organization that had previously used their own, separate campaigns. This meant DDB also had to sell its advertising creative to and receive the buy-in and approval of a much broader group of marketers.

"Different parts of the organization also needed to believe in the campaign, so the challenge was to convince everyone to agree from the start that this was the right way to go," said Rodgers. "It was critical to get in front of these different clients and have them feel like they were part of the idea instead of 'Here it is, hope you like it.' And, since they're in different locations, we would've had to take our show on the road, which simply wouldn't have been feasible given budget, calendar and time constraints."

The initial telepresence meeting, which linked together the DDB account team in Chicago with its AT&T counterparts in Bedminster and Dallas, was followed by two successive telepresence meetings as the campaign was further developed and presented to a broader number of AT&T marketing clients. All told, the DDB team conducted eight telepresence meetings with its AT&T Business Solutions clients as the marketing program progressed through the summer months. Those eight meetings replaced 52 round-trip airline flights, saving more than $32,000 in travel costs and reducing CO_2e emissions by an estimated 26.2 metric tons.[21]

In the meantime, Rodgers now considers himself a telepresence tele-evangelist who believes the many benefits offered by the technology clearly outweigh the value of face-to-face meetings in many situations.

"Though somewhat counterintuitive, you come to realize that you actually get people more focused using telepresence than in a normal meeting because the technology makes you more self-aware than an in-person meeting," said Rodgers. "And, you can read the room as well or better than in a live meeting: You become more aware of a fidget, a furrowed brow or even the sneak peak at the BlackBerry. Once we got past the guilt feeling like we should have been on a plane going to see the client, we couldn't imagine having had to do it any other way."

Asia Pacific Meeting Case
Twice each year, AT&T Asia Pacific Group meets with approximately 20 of its regional and global customers who make up its advisory council to discuss a wide range of issues from service quality and support to new products and investment plans for emerging markets. Previous regional advisory council meetings have been held in Beijing; Hanoi, Vietnam; Hong Kong; New Delhi; and Singapore with customers generally devoting three to four full days including travel time.

For its semi-annual June 2009 meeting, AT&T decided to use telepresence technology to link together 21 customers from 15 companies along with 15 AT&T managers in 10 locations: Dallas, Chicago and New Jersey in the U.S., together with London; Sydney, Australia; Singapore; Hong Kong; Shanghai, China; and Mumbai and Bangalore, India.

By conducting the meeting via telepresence, AT&T and the RAC customer participants achieved savings of more than $100,000 in travel and associated per-diem costs and a reduction of 62 metric tons of CO_2e emissions.[22]

In addition to the cost savings achieved by meeting this way, AT&T was able to be more productive and improve its employees' work-life balance by eliminating the need to travel as well as reduce the impact on the environment.

Will Thomas, customer chairman of the AT&T Asia Pacific RAC, said that the experience had clearly demonstrated how effectively group meetings could be conducted remotely via tools and services that enable a truly lifelike, in-person virtual experience.

"These meetings are all about open, honest exchanges of views and opinions from both sides," Thomas said. "AT&T not only managed to achieve our key meeting objectives in about four hours, AT&T also had the chance to thoroughly test the technology by involving so many people in multiple locations."

Telecommuting

Calculating the Environmental Benefits of Telecommuting
Given that transportation represents approximately 26 percent of CO_2e emissions worldwide[23], telecommuting is potentially the most promising opportunity for businesses to capture significant CO_2e reduction benefits in the near term. To illustrate the potential carbon dioxide emission benefits of telecommuting, AT&T developed a hypothetical case to illustrate how the emissions from commuting, central office space and the user's home workstation are calculated.

A survey by the Bureau of Transportation Statistics found the average one-way commute in the U.S. is 15.3 miles.[24] About 92 percent of commuters used a personal or company car, and the average American car has a fuel economy of about 20 mpg.[25] The average commuter uses about 1.4 gallons of gasoline in his or her commute (this does not include public transit). Burning a gallon of gasoline produces about 19.3 pounds of carbon dioxide, so the average round-trip commute results in the emission of about 27 pounds of carbon dioxide.[26, 27]

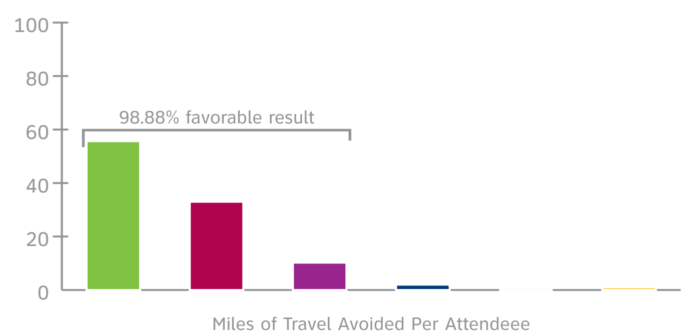
A telecommuter using, for example, a desktop with a higher bandwidth service produces about 2.65 pounds of carbon dioxide a day, so such a telecommuter would save more than 23 pounds in carbon dioxide emissions per day.[28] If enough employees telecommute, it may be possible to consolidate building locations. Not using a building can represent a large carbon savings. Using Department of Energy and Environmental Protection Agency (EPA) data, it is possible to calculate the average carbon dioxide emissions for average office buildings in various parts of the country. For example, while a typical office facility in Seattle produces annual CO_2e emissions of approximately 2,397 metric tons, a similar facility in Chicago produces 2,858 metric tons of annual CO_2e emissions.[29, 30]

As the above scenario demonstrates, telecommuting represents perhaps the most promising opportunity for businesses to capture significant CO_2e reduction benefits in the near term and with a relatively minor investment in technology equipment and infrastructure that is either already in place or is readily accessible for immediate deployment. In addition, the calculations for capturing the initial carbon benefits of eliminating commuting travel miles are relatively straightforward and verifiable.[31] Beyond these technology requirements, of course, successful telecommuting programs also depend on investments in optimizing business processes and harmonizing workplace behavior to overcome potential cultural and managerial barriers.

Telecommuting at AT&T
An AT&T telecommuting survey, based on responses from more than 9,000 full- and part-time employees and their supervisors participating in the company's telecommuting program, concluded that productivity increases, often dramatically, by enabling employees to perform work away from their central work location. Completed in August, 2009, the survey indicated that among telecommuting supervisors, more than 98 percent indicated that telecommuting has had either a positive or neutral impact on employee productivity. This view was shared by employees themselves, with more than 96 percent indicating that they agree or strongly agree that they are more productive on the days when they telecommute.

Productivity Impact

How has telecommuting impacted your employees' productivity?



Very positive impact	55.67%
Positive impact	33.00%
No change	10.22%
Negative impact	.80%
Very negative impact	0.00%
I don't know	.32%

The increase in productivity, according to survey respondents, is attributed to fewer office interruptions and distractions, less socializing, and less time spent in non work-related activities such as commuting to the job or traveling from building to building for meetings. In addition, more than 85 percent of respondents rated telecommuting as either important or very important to their overall job satisfaction.

The AT&T telecommuting program is also delivering significant reductions in CO_2e emissions. The AT&T telecommuter population surveyed avoided 142 million commute miles per year, with annual fuel savings of approximately 7 million gallons and a net reduction in CO_2e emissions of 61,637 metric tons per year.[32] With an average round-trip commute time per employee of 113 minutes, respondents cited "work-life balance" as the No. 1 reason why they telecommute. The time that employees would have spent commuting to and from work can be used instead as personal or family time and, as indicated by 96 percent of respondents, also represented time that was given back to the company as additional productive time.

In addition to a telecommuter population that, at this writing, totaled approximately 10,000 employees, the company has enabled 130,000 employees with mobile and remote access technologies that allow them to telework from a variety of locations. AT&T defines telecommuting as a formal work arrangement in which people work from home at least one day each week.

Telecommuting Quality of Life Benefits

In addition to the body of research attesting to the productivity gains afforded by the many variants of telework and telecommuting, there is also growing recognition for the positive impact on personal productivity and quality of life issues that are enhanced by eliminating wasted travel time for comparable types of work and increasing access to work.[33]

What's more, numerous studies over the years, including a recently released Cisco report based on 2,000 company employees who telecommute, have helped build a strong case for the ancillary benefits of telecommuting, including improvements in job satisfaction, reductions in employee turnover and the intangible benefits of improved work-family balance.[34]

AT&T Remote Access Services

Reducing GHG emissions associated with unnecessary workplace travel is aided by remote access solutions that extend the boundaries of fixed workplace environments. To achieve location independence, workers need secure broadband access.

AT&T Remote Access Services provide workers with the flexibility to access corporate information applications on the fly, whether telecommuting, working from home, while traveling or perhaps even as extended members of corporate work groups. Providing an experience and performance similar to what they would achieve directly on the corporate network, AT&T Remote Access Services provide users with access to their corporate applications through a single, simple, reliable logon while working remotely from locations throughout most of the world. AT&T remote access solutions include the following services.

- AT&T Global Network Client – a virtual private network (VPN) client that provides seamless and reliable remote access to enterprise infrastructure and internet resources
- AT&T VPN Tunneling Service (AVTS) – enables customers to extend reliable remote access and site-to-site capabilities to branch offices and remote workers through dedicated connections to the AT&T Global Network or Internet
- Laptop Connect – provides reliable, easy to use, one-click mobile access via broadband cards to AT&T enterprise infrastructure and Internet applications via the AT&T Global Network Client
- AT&T Network-Based IP VPN Remote Access Service (ANIRA) – provides business customers with a single solution for connecting their personal computers or local area networks (LAN) remotely to secure corporate resources as well as the public Internet

Other AT&T Collaboration Solutions

Unified Communications

AT&T provides a number of unified communications (UC) solutions that help AT&T customers become more efficient while reducing energy costs, enabling them to improve their business outcomes in a more sustainable manner. Through UC solutions, customers can lower organizational costs associated with travel, facilities, power and cooling, while also realizing savings from replacement of inefficient equipment and consolidation of redundant solutions.

AT&T Connect®

AT&T Connect combines voice, Web and video conferencing in a single integrated solution that provides company-wide conferencing and collaboration capabilities for communicating in meetings with colleagues, customers and partners from multiple locations. In addition to eliminating unnecessary travel, AT&T Connect can also lower conferencing costs, improve business decision-making and competitive response, and significantly improve employee work/life balance.

Part Three: The Network Effect at Work with Smart Data Centers, Smart Transportation and Smart Grids

Smart Data Centers

Providing efficient, centralized data management, Internet communications and software service that streamlines computing resources and reduces or eliminates their associated power usage and real estate requirements.

According to a recent data center study released by the U.S. EPA, by 2020, data centers could surpass the airline industry as a top GHG polluter.[35] The GeSI report estimates that the number of data center servers will grow at a 9 percent annual rate worldwide to reach 122 million in 2020, up from 18 million in 2002, helping grow IT sector emissions at a 5.7 percent compound annual rate, while driving the sector's overall contribution to global CO_2e emissions from 1.3 percent of the world's total today to 2.8 percent by 2020.[36]

Current utilization rates for data center servers, storage and other assets are as low as 6 percent, and facilities utilization rates average less than 60 percent, according to the GeSI report.[37] The key to realizing increased IT and data center efficiency potentially resides with current trends toward the adoption of hosted services (outsourcing and cloud computing), server and storage virtualization, and low-energy cooling as a means to replace less-efficient data centers and application services, deliver business continuity and address demand elasticity.

Virtualization optimizes the use of physical computing and networking hardware through software that improves utilization, reduces cost and saves energy. According to a recent Forrester Research survey, nearly half of U.S. enterprises have implemented some form of server virtualization to address utilization rates and drive efficiencies from a more consolidated server population.[38]

The basic idea behind virtualization is to transfer and consolidate processes into a "centralized" server or hosted server environment that consists of physical infrastructure that is shared through secure virtual partitioning and that can be run more efficiently than the customer's existing data center. What's more, hosted service environments are often much more likely to incorporate upgraded technology faster than would be the case with a customer-provisioned data center, thereby yielding even greater efficiencies.

While increased efficiencies can be shown to exist in many cases, the critical point in determining environmental impact is the net reduction in carbon emissions rather than energy savings. Depending on the location of the server, carbon dioxide emissions can range from a low of 0.03 pounds CO_2e/kilowatt hour (kWh) in Idaho to a high of 2.15 pounds CO_2e/kWh in Wyoming with a U.S. average of about 1.34 pounds CO_2e/kWh.[39] Understanding the locations of the servers being taken off line and the hosting servers is critical in determining the carbon emission savings that result.

AT&T Solutions for Smart Data Centers

AT&T helps businesses build and operate their IT infrastructure more efficiently by employing virtualization technology both in AT&T data centers and at customer locations. The AT&T Global Network, which incorporates layered network-based protection, allows customers to bridge these environments together, providing flexibility in where and how to deploy IT capacity to meet evolving business demands.

Hosted solutions let customers tap into AT&T's multi-tenant service platforms, which provide each customer with a logically partitioned slice of the underlying shared physical assets. Leveraging virtualization and multi-tenancy, customers can "right size" their consumption of network, processing and storage resources, often with less cost and waste than the previously underutilized, dedicated infrastructure.

AT&T Hosting and Application Services

In addition to dedicated hosting services, AT&T provides a range of utility- and cloud-based solutions that give businesses greater flexibility, speed and control over their IT infrastructure and allow them to better match capacity with application demand. These services include the following.

- AT&T Synaptic Hosting℠ – a fully managed, utility-based solution that provides configurable capacity as well as near real-time bursting to accommodate variable demand or peaks in user traffic
- AT&T Compute as a Service℠ – a virtualized computing environment that lets customers directly control their IT resources and pay for consumption on an hourly basis
- AT&T Storage as a Service℠ – an elastic, virtualized data storage that automatically scales up or down to whatever size the customer may need, and is billed based on the amount of storage used

Managed Hosting Services

AT&T's comprehensive suite of Managed Hosting Services allows customers to tailor their IT configuration and scale across AT&T support teams, operational toolsets, service platforms and data centers.

- Server Management – many of AT&T's hosted solutions include the latest energy-efficient servers that typically deliver more processing power per watt
- Server Virtualization – allows customers to consolidate physical servers with the potential to reduce their associated power, cooling and space requirements
- Integrated Client Networking – a utility-based networking solution that includes a full set of advanced network features packaged on a per-port basis
- Managed Storage – hosted servers that can connect to partitioned disk resources provisioned on multi-tenant storage area network (SAN) and network attached storage (NAS) platforms

- Data Backup Services – efficiently back up data residing on hosted servers to common tape and disk platforms as an alternative to using dedicated backup infrastructure

Co-Location Services
Even customers who deploy and manage their own IT infrastructure within AT&T data centers can realize energy savings when compared with running that same equipment in their own data center. These savings result from the reduced overhead associated with running cooling systems as well as core power infrastructure such as transformers, switch gear, uninterruptible power supplies, power distribution units and other components.

AT&T Internet Data Centers are 28 percent more efficient than the industry average, made possible by best practices in cooling system design, advanced airflow, high-efficiency lighting, data center automation and more.[40] Additionally, AT&T is a contributing member in the Green Grid, a global consortium dedicated to advancing energy efficiency in data centers and business computing ecosystems.

Smart Transportation and Logistics

Rationalizing transportation and distribution systems using next-generation dispatching and route planning software combined with wireless and satellite-based communications for fleet-wide performance improvements, leading to a reduction in energy waste and CO_2e emissions by reducing idle time, total miles driven and removing unnecessary vehicles from the road.

Globally, transport accounts for 26 percent of all CO_2e emissions stemming from human activity, with the U.S. singled out as the largest contributor to global CO_2e emissions from transportation on both an absolute and per-capita basis.[41] Traffic congestion costs Americans $200 billion in annual lost economic productivity and wastes 2.3 billion gallons of fuel.[42] What's more, research shows that more than 50 percent of trucks traveling U.S. roads operate less than half full.[43]

Smarter transportation reduces fuel consumption through automated route planning and/or increased efficiency of the vehicle through the reduction of idle time, better management of miles driven, adherence to speed rules, monitoring of vehicle acceleration, etc. The resulting efficiency gains can deliver fleet-wide performance improvements that can lead to reduced energy waste and CO_2e emissions. Routing is accomplished by giving the driver a wireless network connection and using a GPS system to track vehicle position. Increased fuel efficiency requires some instrumentation on the vehicle and a wireless network connection to a control facility.

According the GeSI report, ICT-enabled improvements in commercial logistics that optimize road transport could reduce emissions by 15-28 percent by 2020 in the U.S. and deliver gross savings of $65 billion to $115 billion annually to the economy from reduced fuel consumption.[44]

Fleet management solutions are increasingly being deployed in order to comply with the growing number of state and municipal regulations enforcing vehicle idle time reduction. Meanwhile, in Europe, which has already implemented a stronger regulatory regime, the number of fleet management systems deployed in commercial fleets reached 1.3 million by the end of 2008 with an annual growth rate of 23.8 percent.[45]

In a May, 2009, Aberdeen research survey of 200 service and manufacturing professionals, 64 percent of respondents reported they were implementing location intelligence and fleet management solutions in order to improve routing and reduce fuel costs. According to the survey, since implementing their solutions, firms reported slashing nearly 22 percent in fuel costs while reducing operating costs an average 21 percent and improving workforce productivity by 23 percent.[46]

AT&T Solutions for Smart Transportation and Logistics

AT&T offers leading fleet management solutions from its third-party solution providers. These vehicle-based products combine the latest advances in GPS, wireless and Web technologies to make mobile workforce and fleet management an affordable reality.

AT&T's technician vehicles are equipped with similar GPS capabilities, which provide increased visibility into business operations and allow the company to uncover opportunities to improve efficiency and reduce costs. For AT&T, these products provide the following.

- Better management of miles driven per day by technicians
- Improved processes in place for vehicle returns to the work center
- Improved inventory management
- Reduced travel time and costs with real-time dispatching

AT&T's fleet management solutions include:

TeleNav Vehicle Tracker™ from AT&T
TeleNav Vehicle Tracker is a GPS tracking and management solution that is hard-wired or embedded onto a vehicle supported by TeleNav's password-protected, Web-based management console. Managers can log onto the site and view the location of each vehicle in their fleet to afford better management of miles driven per day.

Xora® GPS TimeTrack® In-Vehicle from AT&T
Xora GPS is an affordable, powerful solution that provides real-time visibility into the locations and activities of mobile workers. Using any PC connected to the Internet and a standard Web browser, office managers or staff can track the locations of mobile workers carrying a supported AT&T mobile phone.

Trimble® GeoManager℠ from AT&T
Trimble GeoManager is an end-to-end mobile resource management solution for managing mobile workforce productivity, vehicles and other assets in the field.

WebTech Wireless™ Quadrant™ from AT&T
WebTech Wireless Quadrant is a powerful Web-based location and telematics solution that provides fleet managers with real-time and historical GPS-based information for efficient fleet management, including vehicle and driver performance, comprehensive mapping capabilities and an in-depth suite of configurable reports.

Transport Case

A large U.S.-based transport company operating 2,700 long-haul trucks installed WebTech Wireless Quadrant telematics units operating over GPS and the AT&T wireless network to provide real-time tracking and monitoring of vehicle idle time with a goal of reducing fuel costs. Based on initial results from an on-road trial of six tractor-trailers using the WebTech Wireless Quadrant system, the company realized idle time reductions ranging from 10-20 percent, with an average monthly reduction of 40 hours idle time per truck. With plans under way for fleet-wide installation of the telematics units, the company projects anticipated fuel savings to reach $5 million accompanied by an abatement of 20,000 metric tons of CO_2e emissions on an annualized basis.[47]

Smart Electric Grids and Smart Buildings

Bringing two-way "Smart Grid" communications and monitoring capabilities that enable electric utilities to route power in more efficient ways, including remote energy management and control of appliances and other networked devices, support for bi-directional power sharing for new alternative energy sources and, through smart metering, more efficient energy use in residential and commercial buildings.

"Even as our economy has been transformed by new forms of technology, our electric grid looks largely the same as it did half a century ago," said President Barack Obama during a March 19, 2009, visit to an electric car factory in Orange County, CA.[48]

Second only to deforestation, emissions from power generation globally account for 24 percent of total man-made CO_2e emissions. Losses from transmission and distribution are estimated to account for 8-15 percent of all power generation.[49] Smart grid technology, which consists of software and hardware that enables more efficient power transmission, distribution and management, reduces the need for excess capacity, supports real-time, two-way communication and information exchange between suppliers and customers, and optimizes supply and demand through better monitoring and data capture.

The introduction of advanced home meters will allow customers to monitor real-time usage to take advantage of off-peak savings, while suppliers can better manage usage during power spikes and avoid costly service interruptions. Smart Grid can also support the integration of renewable power sources. According to the GeSI report, smart grid technology has the potential to reduce carbon emission by up to 2.03 gigatons by 2020[50], cut U.S. electrical power generation sector emissions by as much as 14 percent by 2020, saving $15 billion to $35 billion in energy and fuel costs.[51]

AT&T Solutions for Smart Electric Grids and Smart Buildings

AT&T offers a wide range of Smart Grid and strategic mobility products and services to the utility industry, including wireless solutions for field service workers, and a two-way wireless, real-time communication network for monitors, sensors and controllers on the electric grid to improve reliability. A key component in Smart Grid development is smart metering, which connects residential meters directly with the utility enabling two-way machine-to-machine (M2M) communication. AT&T, utilizing SmartSynch's smart grid technology, has developed a smart metering solution that connects residential meters over the AT&T wireless network. In addition, smart metering mitigates the need for building or maintaining a separate utility-based communications network.

AT&T helps enable smart grids by providing the same broadband and wireless communication technology used to connect people with their world every day. Smart grids depend on two-way communications between virtually all devices producing, distributing and consuming electricity. AT&T has teamed up with other companies to provide this two-way connectivity.

- Itron OpenWay® Solution – allows utilities to read electric meters remotely, helping ensure more accurate billing and efficient use of energy
- SmartSynch Solution® – relying on AT&T's wireless network, uses point-to-point configuration – AT&T provides a direct link from smart meter to utility using a SIM card in every smart meter, just like a cell phone
- Cooper Power Systems – offers fault detectors and capacitor bank monitors certified on the AT&T wireless network to provide near real-time performance measurements and trouble notification to utilities, thus improving the reliability of the electricity distribution grid

Part Four: Conclusions for Promoting ICT Solutions

This white paper evolved through AT&T's active participation in the GeSI, an effort to foster open cooperation across international boundaries to improve sustainability in AT&T's own industry and to promote ICT solutions as a way for others to decrease carbon emissions.

ICT – the full suite of hardware, software and broadband technologies that can increase the energy efficiency of society – has enormous potential to transition us to a cleaner, more efficient economy. AT&T believes that investment in the ICT sector can strengthen the global economy while making the world more energy independent. That's why AT&T continues to reach out and build relationships with stakeholders to turn possibilities into realities.

In this report, AT&T has identified several initial areas that can be considered "the low hanging fruit" for targeting CO_2e reductions that fall under the category "Smarter Workplaces" and center around travel replacement. Teleconferencing and telecommuting both represent areas that are ripe for implementation today that illustrate the benefits of moving work to people, rather than people to work, and can deliver significant and relatively straightforward documentation of CO_2e reduction.

Similarly, the carbon reduction benefits afforded by fleet management solutions in the Smart Transportation category are equally straightforward measures based on improved fuel economy, a decrease in total miles driven and reductions in fleet size.

AT&T also identified other emerging opportunities where AT&T's products and solutions can harness the network offset effect for CO_2e reduction aligned with the GeSI findings in the areas of Smart Data Centers and Smart Electric Grids. In both areas, while it was possible to identify substantial energy savings when examining a specific usage case, AT&T concluded more work needs to be done in developing measurement models that take into account differences between facility, application and equipment usage for a given activity or business process that could be applied more uniformly in calculating CO_2e reduction benefits.

Equally important, AT&T realized that any measurement of CO_2e reduction must first be accompanied by accurate baseline data to develop clear and verifiable before and after documentation.

To further explore the network offset effect potential for the most strategic products and services that enable travel reduction, AT&T worked with an independent research firm[52] to develop a model for calculating expected CO_2e reductions based on a hypothetical scenario. This included both internal and external usage associated with AT&T Telepresence Solution, AT&T Connect and VPN remote access solutions. While other product areas were initially examined, AT&T determined to conduct a more detailed analysis of teleconferencing and telecommuting applications, which represented the "low hanging fruit" for early widespread corporate CO_2e reduction and provided the most immediately accessible data for quantification.

Further development of verifiable data across other application areas is planned for the future. However, this area was deemed a critical initial target for demonstrating the potential for environmental impact and significant CO_2e reductions made possible by network-enabled applications and services that limit travel and the movement of people.

In this hypothetical scenario which assumed certain in-service numbers, percentage usage, and travel avoidance of a subset of AT&T's teleconferencing and telecommuting services (AT&T Telepresence Solution, AT&T Connect and VPN remote access solutions) the one year carbon emission savings is estimated at 1.34 million metric tons of CO_2e offset. That is the equivalent to removing the emissions from over 255,000 typical passenger vehicles for a year, or the equivalent electricity required to power more than 170,000 homes for a year.[53]

The assumptions behind the hypothesis are as follows:

AT&T Telepresence Solution (ATS)

If one assumes a growth of 525 ATS rooms[54] within a one-year period, and that each room is utilized for 8 meetings per month at an average of 2 hours per meeting, with 1.4 trips avoided per meeting and a 1,093 average round-trip flight, the travel avoidance enabled by use of telepresence could potentially yield slightly over 2,500 metric tons of CO_2e saved.[55]

AT&T Connect

If one assumes approximately a 130K growth in AT&T Connect seats[56] within a one-year period, and utilizing the average CO_2e emissions saved per Web minute (0.8 kg) based on customer survey data, the travel avoidance enabled by use of AT&T Connect could potentially yield over 120,000 metric tons of CO_2e saved.[57]

VPN Remote Access

If one assumes an annual growth of 1.5 million VPN connections[58] (defined as the number of times a VPN user connects), and that 50% of VPN users are also telecommuters, with an average of 2 telework days per month and an average commute of 30 miles roundtrip, the travel avoidance enabled by use of VPN for remote access could potentially yield 1.21 million metric tons of CO_2e saved.[59]

While AT&T has also begun to implement baseline data collection for some of its own business processes, including for Internet Data Centers and hosting facilities, clearly more work needs to be done – at both the product, company and industry levels – to create baseline data from real-world customer usage scenarios that can be aggregated, analyzed and applied to document these additional promising areas for CO_2e reduction.

The result would be a set of standard benchmarks that could be applied with confidence along with the tools and methodologies needed to provide the rigorous documentation needed to deliver verifiable outcomes that customers and their stakeholders demand.

AT&T's commitment to help establish these industry benchmarks starts now. From this point forward, AT&T will endeavor to harness the power of its ICT products and solutions not only to help customers achieve the business efficiencies and velocity they have come to expect from AT&T Business Solutions but to help them realize their full CO_2e reduction potential as well. As such, AT&T is undertaking efforts to provide customers with tools that will demonstrate the environmental impact of AT&T's products and services – beginning with those that enable travel reduction – and AT&T will be working with others to identify usage scenarios and to better aggregate customer data for further quantification of the CO_2e emission savings enabled by AT&T ICT products and services.

AT&T's Commitment to Enable Effective and Sustainable Solutions

Today, ICT products and services have the potential to help create a more sustainable future, enabling people and businesses to make more energy-efficient choices and reduce their own environmental impact, in the following ways.

- Moving work to people rather than people to work
- Connecting rather than traveling
- Managing business remotely and in real-time
- Improving transportation and distribution systems

AT&T is also working to better quantify the energy efficiencies, costs savings and emission reductions that its products and services can provide customers. This will help us continue to educate customers on how they can use AT&T's products and services to be more efficient, productive and sustainable.

AT&T is committed to developing and launching tools for its customers to use in quantifying carbon emission savings from utilization of AT&T's "sustainable" products and services. AT&T is also committed to working with others to further validate the principle of the network effect as applied to environmental sustainability and to perform research that will provide additional quantification of the impact of AT&T's ICT solutions.

Developed in 2008, AT&T's internal energy policy was established to guide energy management actions and drive efficient, cost-effective and environmentally responsible use of energy in AT&T's operations. AT&T's policy is focused on developing technologies and approaches that help AT&T and its customers reduce environmental impact as well. It also established a cross-functional Energy Council to identify key areas of opportunity, including the following.

- Integrating best practices into AT&T's buildings
- Optimizing energy efficiency in the selection of equipment
- Improving the fuel efficiency and emissions profile of AT&T's fleet
- Evaluating alternative energy sources
- Supporting employees and customers in an energy-efficient behavior

Strengthening Connections

Making connections is AT&T's business. Positively impacting the communities and the environment in which AT&T operates, while helping customers do the same, is AT&T's responsibility and opportunity as a good corporate citizen.

Every day, AT&T works to connect people with their world, everywhere they live and work – no matter their unique communications needs. This means connecting people to information, entertainment and other people. It means connecting businesses to customers, data and other businesses.

AT&T works hard to ensure these connections are reliable, mobile and seamless. And, AT&T constantly searches for new ways to help the world communicate more efficiently, sustainably and safely.

AT&T's Commitment

AT&T efficiently connects people and businesses virtually everywhere with innovative and sustainable products and services. From minimizing its environmental impact to investing in sustainable technologies, AT&T is doing its part to help protect and sustain the environment.

Notes

1. CO_2e – Carbon Dioxide Equivalence – is used interchangeably with CO_2 throughout this paper. CO_2e is a quantity that describes, for a given Greenhouse Gas, the amount of CO_2 that would have the same global warming potential, when measured over a specified timescale.

2. Global e-Sustainability Initiative, "*SMART 2020: Enabling the Low Carbon Economy in the Information Age (United States Report Addendum)*," November, 2008, http://www.gesi.org/

3. European Union press release, "Environment Council: Commission welcomes Council conclusions on the EU position for the Copenhagen Climate Change Conference," October 21, 2009, http://europa.eu/rapid/pressReleasesAction.do?reference=IP/09/1561&format=HTML&aged=0&language=EN&guiLanguage=en

4. InformationWeek Government, "Obama Orders Federal IT To Get Greener," by J. Nicholas Hoover, October 6, 2009, http://www.informationweek.com/news/government/policy/showArticle.jhtml?articleID=220301302

5. The White House, office of the press secretary, press release, "President to Attend Copenhagen Climate Talks," November 25, 2009, http://www.whitehouse.gov/the-press-office/president-attend-copenhagen-climate-talks

6. Global e-Sustainability Initiative, "*SMART 2020: Enabling the Low Carbon Economy in the Information Age (United States Report Addendum)*," November, 2008, http://www.gesi.org/

7. Global e-Sustainability Initiative (*United States Report Addendum*), Op. cit.

8. McKinsey & Company, Op. cit.

9. Economist Intelligence Unit, "Managing the Company's Carbon Footprint: the Emerging Role of IT," February 2008, http://www.chamber.org.hk/info/eiu/ThoughtLeadership/Carbon.pdf

10. IDC, "The Green IT Message: Balancing Sustainability With Profitability," September 2008

11. "Metcalfe's Law" is referenced in this paper to describe the "network-effect" of value creation on a communications network. Since its original conception, Metcalfe's Law, and its assertion that value can grow *exponentially* on a network proportional to the square of the size of the network, has been the subject of much debate as regards to the *proportionality* of that growth. Our use of the term "network effect" is based on the generally accepted principle that the value of a communications network can grow at a rate faster than the linear growth in the number of users or devices connected which, for example, contrasts with the rate of growth in value ascribed to a simple broadcast network (see: "Sarnoff's Law"). For a more thorough explanation of Metcalfe's Law and subsequent definition of the network effect, see: A. Odlyzko and B. Tilly, "A Refutation of Metcalfe's Law and a Better Estimate for the Value of Networks and Interconnections, " March 2, 2005, www.dtc.umn.edu/~odlyzko/doc/metcalfe.pdf

12. Global e-Sustainability Initiative (*United States Report Addendum*), Op. cit.

13. K. Lister and T. Harnish, research study reported in "Undress For Success: The Naked Truth About Making Money at Home," John Wiley & Sons (New York), March 2009

14. Ibid.

15. Economist Intelligence Unit, Op. cit.

16. American Consumer Institute (ACI), “Broadband Services: Economic and Environmental Benefits,” October 2007, http://www.theamericanconsumer.org/2007/10/31/broadband-services-economic-and-environmental-benefits/

17. WWF, “From Work Place to Any Place,” March 2009, http://www.worldwildlife.org/who/media/press/2009/WWFBinaryitem11939.pdf

18. Calculations based on Cisco IBSG analysis, 2008. GHG equivalencies based on calculations using U.S. Environment Protection Agency Greenhouse Gas Equivalencies Calculator

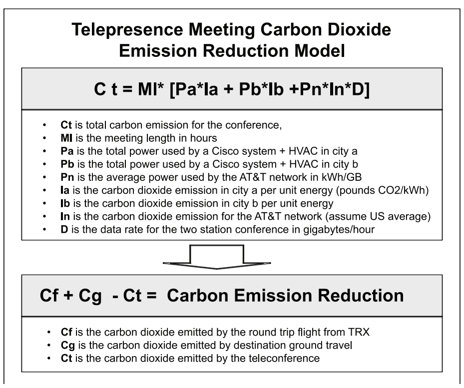
19. The Telepresence carbon reduction model was developed for AT&T by Omenti Research. Omenti Research was founded by Steve Crandall, who holds a Ph.D. in experimental particle physics from the State University of New York (SUNY) at Stony Brook and worked at Bell Labs and AT&T Research in applied physics, digital music and broadband network research. He currently is a founding partner at Omenti Research where he specializes in applied physics, energy and global warming issues.

20. Calculations were based on the following assumptions:

- pounds of CO_2e from TRX calculator for the round trip. The lowest carbon seat available is used. Carbon forcing due to atmospheric effects are included.
- pounds of CO_2e per kilowatt-hour of electricity produced in the departure state
- pounds of CO_2e per kilowatt-hour of electricity produced in the destination state or country
- pounds of CO_2e for the videoconference as per formula Ct
- pounds of CO_2e saved Cf + Cg – Ct
- pounds of CO_2e saved Cf + Cg – Ct if the forced carbon value is used

The following data was included in the calculation:

- meeting length in hours
- power consumption of the Cisco 3200 room including HVAC in kilowatt-hours
- kilowatt hours required to move one gigabyte of data on the AT&T network
- data rate used for the conference in megabits per second
- U.S. average pounds of CO_2e required to produce 1 kilowatt-hour of electricity (assumed to be the energy intensity for the AT&T network)
- pounds of CO_2e from destination ground travel (assumes 20 pounds: 20 miles at about 20 mpg burns one gallon of gasoline which is 19.3 pounds CO_2, round up to 20 pounds)
- kilowatt hours per Cisco station for the meeting
- kilowatt hours for video conference data during the meeting
- pounds of CO_2e embedded in the production and disposal of the Cisco station per hour
- pounds of CO_2e embedded in the production and disposal of the Cisco station for the meeting



The assumptions for this model are:

- Cisco CTS 3200 conferencing systems are used in each location
- The AT&T network is used
- All carbon emissions are CO_2e where possible
- The flight eliminated would have been the lowest carbon seat available between the two locations as calculated by the Travel Analytics Airline Carbon Emissions Calculator. The simple CO_2 emission result is used rather than the forced carbon number.
- The physical trip to and from the destination airport to the meeting location is included in the travel
- It is assumed that the trip to and from the departure airport is similar to the trip to and from the local office with the CTS 3200
- The carbon production for staying in a hotel (if necessary) is similar to that for the employee staying at home
- The meeting length is three hours

Teleconferencing specific energy consumption includes:

- Cisco 3200 system: 3214 watts (source: Cisco)
- HVAC for the room: 1071 watts (~1/3 of the power dissipated by the equipment is removed by AC)
- Total room is 4285 watts
- The AT&T network requires 654 kilowatt hours/terabyte of traffic. (this includes all energy costs). The part of the network used for this purpose may well use less energy, but we are conservative and use the average figure

Additional notes on embedded carbon calculation:

Cisco calculates embedded carbon costs for their equipment using a model that examines the carbon emissions associated the manufacturing and ultimate disposal of hardware (cost of goods sold) based on GDP ($2267 GDP per metric ton of carbon dioxide). This assumes a six year life and a retirement cost of 50 percent of the construction and installation. In this case, Cisco bases its calculation on 54 percent of the hourly operational carbon dioxide production using 0.62 kg/kWh for the average U.S. carbon intensity. The Cisco usage model calculates the number of hours the system will be used in its lifetime and uses a proprietary number representing cost of goods sold. This number works out to about 3.15 pounds of carbon dioxide per-station per-hour.

21. Carbon calculations were derived by Cisco's IBSG, which uses the TRX Airline Carbon Emissions Calculator (http://carbon.trx.com/Home.asp) for the impact of air travel avoidance, along with a standard calculation for the impact of ground transportation avoided to and from the meeting and airport, less the impact of energy usage for the Telepresence application and carbon start up and disposal. Note: Ground transportation to and from the Telepresence location and airport were assumed equivalent to participants' normal daily commutes, and thus, offset each other. The following charts summarize the calculations underlying the reported results:

AT&T Stretch Campaign Virtual TelePresence Meeting CO2e Benefits

Room hours	Meetings	Dates	Trips avoided	CO2e air travel avoidance (tonnes)	CO2e ground travel avoided at destination (tonnes)	CO2e ground travel avoided at origin (tonnes)	CO2e TP operation (tonnes) (1)	Embedded carbon (tonnes) (2)	Net carbon impact (tonnes)	Air travel savings ($ 000s)	Other travel savings ($ 000s)
3	Stretch 1	2/26/2009	5	1.5	0.1	0.0	0.016	0.008	1.56	1.9	1.1
3	Stretch 2	3/3/2009	5	1.5	0.1	0.0	0.016	0.008	1.56	1.9	1.1
3	Stretch 3	3/13/2009	6	1.7	0.1	0.0	0.016	0.008	1.84	1.9	1.1
3	Additional 1	2/26/2009	9	3.3	0.2	0.0	0.016	0.008	3.46	4.0	1.8
2	Additional 2	4/22/2009	6	4.2	0.1	0.0	0.011	0.006	4.34	2.1	1.4
2	Additional 3	5/6/2009	6	4.2	0.1	0.0	0.011	0.006	4.34	2.1	1.4
3	Additional 4	7/13/2009	8	4.8	0.1	0.0	0.016	0.008	4.91	2.8	1.8
3	Additional 5	8/12/2009	7	4.0	0.1	0.0	0.016	0.008	4.11	4.3	1.3
	s/t for Stretch		1 6	4.7	0.3	0.0	0.049	0.025	4.96	5.6	3.4
	s/t for Additional		3 6	20.5	0.6	0.1	0.071	0.037	21.16	15.2	7.6
	Total benefits		52	25.26	0.91	0.14	0.12	0.06	26.12	20.8	11.0

Units		
km	Ground travel distance at destination	100
%	% car in destination transport mix	90%
%	% train in destination transport mix	10%
t / Mm	Car CO2e emissions per 1,000 km	0.190
t / Mm	Train CO2e emissions per 1,000 km	0.038

ACTION: Waterfall chart

(1) Assumes an idle hour for an hour used
(2) Assumes 6 TelePresence locations total

22. Carbon calculations derived by Cisco's IBSG, Op. cit.

23. Global e-Sustainability Initiative, "*SMART 2020: Enabling the Low Carbon Economy in the Information Age*, " http://www.gesi.org/, June 2008

24. Research and Innovative Technology Administration (RITA), U.S. Department of Transportation http://www.bts.gov/publications/omnistats/volume_03_issue_04/

25. Research and Innovative Technology Administration (RITA), U.S. Department of Transportation 20 mpg is the rough average of fleet passenger car and light trucks, http://www.bts.gov/publications/national_transportation_statistics/html/table_04_23.html

26. Gasoline turns out to be a loose term (it is a complex mixture of hydrocarbons). It is common to use the assumption that it is mostly octane. Burning a molecule of (C8H18) gives 8 molecules of CO_2. The molecular weight of CO_2 is 44, octane is 114. So the ratio of the molecular weight of the CO_2 product from burning octane is 8*44/114 = 352/144. The weight of a gallon of gasoline is 6.25 pounds, so the weight of the CO_2 produced from a gallon of gas is 6.25 * 352/144 = 19.3 pounds. We use this measure as it is commonly used low (conservative) estimate. The World Resources Institute (http://www.ghgprotocol.org/), for example, uses an estimate of 19.564 pounds of CO_2 per gallon.

27. To calculate carbon dioxide emissions, the energy used to power a personal computer for an 8 hour day is multiplied by the local carbon intensity (pounds of carbon dioxide emissions per kWh) and added to the bandwidth used in an 8 hour day, times AT&T's energy use per GB of traffic, times the U.S. average carbon intensity.

Pounds of CO_2e (8-hour day):

	Average Data Rate		High Data Rate	
City	Desktop	Laptop	Desktop	Laptop
Los Angeles, CA	1.15	0.46	1.30	0.61
Bedminster, NJ	1.31	0.51	1.46	0.66
Atlanta, GA	2.36	0.83	2.51	0.98
Dallas, TX	2.51	0.87	2.65	1.02
Chicago, IL	2.03	0.73	2.18	0.88
Seattle, WA	0.57	0.29	0.72	0.44

28. See: table in footnote below (30) indicating estimates for pounds CO_2 per employee per day.

29. See: U.S. Environmental Protection Agency , "Carbon Emissions from Building Energy Use," http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager_carbon; the table illustrated is in pounds of CO_2/sq ft per year, so the emissions per employee are this number times sq ft/employee divided by 250 days per year. A hypothetical company that could eliminate, for example, a 500 worker facility would see significant carbon dioxide emission savings in a year.

30. AT&T assumed 200 sq ft of usable space per employee and a 250 working day year.

City	Pounds CO_2 per employee per day
Los Angeles, CA	16.0
Bedminster, NJ	19.2
Atlanta, GA	24.8
Dallas, TX	24.0
Chicago, Ill	25.6
Seattle, WA	16.0

City	Pounds/yr-employee	Pounds/yr facility
Los Angeles, CA	10,425	5,212,500
Bedminster, NJ	11,185	5,592,500
Atlanta, GA	12,323	6,161500
Dallas, TX	11,838	5,919,000
Chicago, IL	12,605	6,302,500
Seattle, WA	10,570	5,285,000

City	Metric tons/yr-employee	Metric tons/yr facility
Los Angeles, CA	4.73	2,364
Bedminster, NJ	5.07	2,536
Atlanta, GA	5.59	2,794
Dallas, TX	5.37	2,684
Chicago, IL	5.72	2,858
Seattle, WA	4.79	2,397

31. For the purpose of this example, we compared the energy and emissions profile for operating the typical home office PC setup. A more detailed calculation comparing telecommuting home office heating, lighting, computing/network power, non-commuting work-related vehicle use, etc. is required to accurately complete the CO_2E reduction scenario.

32. These Annual Projections are internally developed estimates based on the telecommuter's vehicle type, model year, commute miles, and number of telecommuting days. Fuel consumption and emissions data are based on Fuel Economy Guides from the U.S. Department of Energy and the Environmental Protection Agency (EPA).

33. The Information Technology & Innovation Foundation, "Improving Quality of Life Through Telecommuting," Cox Wendell, January 2009

34. Cisco press release, "Cisco Study Finds Telecommuting Significantly Increases Employee Productivity, Work-Life Flexibility and Job Satisfaction," June 2009, newsroom.cisco.com/dlls/2009/prod_062609.html

35. U.S. Environmental Protection Agency, "Report to Congress on Server and Data Center Energy Efficiency," Public Law 109-431 ENERGY STAR Program, August 2, 2007, http://www.energystar.gov/index.cfm?c=prod_development.server_efficiency_study

36. Global e-Sustainability Initiative (*United States Report Addendum*), Op. cit.

37. Global e-Sustainability Initiative (*United States Report Addendum*), Op. cit.

38. Forrester Research, "Road Map: How GeSI's "SMART" Report Broadens The IT Industry's Green Agenda For Vendor Strategy Professionals," August 2008. *www.forrester.com/go?docid=46761*

39. Energy Information Administration, U.S. Department of Energy, "Updated State-level Greenhouse Gas Emission Coefficients for Electricity Generation 1998-2000. April 2002, http://tonto.eia.doe.gov/ftproot/environment/e-supdoc-u.pdf; http://www.eia.doe.gov/

40. Measurement based on Uptime Institute EPA data reporting an industry average datacenter PUE of 2.5. The average PUE for AT&T Internet Data Centers is 1.8, representing 28% efficiency vs. the industry average based on comparison of our average power usage effectiveness (PUE) metric to member averages reported by Uptime Institute

41. Global e-Sustainability Initiative, "SMART 2020: Enabling the Low Carbon Economy in the Information Age, " June 2008, http://www.gesi.org/

42. Global e-Sustainability Initiative (United States Report Addendum), Op. cit.

43. U.S. Department of Transportation, Federal Highway Administration, FAF2 Freight Traffic Analysis, June 27, 2007

44. Global e-Sustainability Initiative (United States Report Addendum), Op. cit.

45. GeoConnexion, "European fleet management systems up in 2008," December 23, 2008, http://www.geoconnexion.com/geo_news_article/European-fleet-management-systems-up-in-2008/4923

46. Aberdeen Group, "Service Work Force and Fleet Management": May 2009

47. Savings calculations were based on an average decrease of 40 hours in idle time per truck per month, over 12 months, with 1.5 gallons of diesel fuel consumed per hour of idling, at $2.50 per gallon. The payback period was 8 months, after a one-time investment of $700 per truck for hardware, installation, and setup, as well as monthly fees of $45 per vehicle for data hosting and communications. Figures reported by WebTech Wireless Inc.

48. As quoted in The Los Angeles Times, " Obama unveils $2.4-billion grant program to aid electric cars," by Maeve Reston, March 20, 2009

49. Global e-Sustainability Initiative, Op. cit.

50. Global e-Sustainability Initiative, Op. cit.

51. Global e-Sustainability Initiative (United States Report Addendum), Op. cit.

52. Omenti Research, Op. cit.

53. U.S. Environmental Protection Agency Greenhouse Gas Equivalencies Calculator, http://www.epa.gov/cleanenergy/energy-resources/calculator.html

54. Calculations include existing base of rooms plus hypothetical growth.

55. Calculations were based on the following assumptions:

- average meeting length is 2 hours
- 1.4 trips are avoided per meeting *(the average of estimates from the IT departments of three non-AT&T telepresence users (private communications). This is consistent with 10 people at a meeting and 15% trip substitution noted by Cisco.)*
- each flight has a one way distance of 1093 miles *(domestic and international average for U.S. carriers. Bureau of Transportation Statistics Sept 2008 – August 2009 from: http://www.bts.gov/xml/air_traffic/src/index.xml)*
- each trip results in 1 gallon of gasoline being burned for ground transportation
- each meeting uses a pair of Cisco 3200 endpoints *(Cisco offers several endpoints ranging from the 1 seat 500, 2 seat 1000, 6 seat 3000 and 18 seat 3200. We chose the 3200 as we want to identify the most conservative case: e.g. the greatest endpoint power usage)*
- the average data rate per pair of endpoints is 20 megabits/s *(Cisco 3200 datasheet)*
- the AT&T network requires 654 watt-hrs of energy to transmit one gigabyte of data *(provided by AT&T)*
- the carbon intensity for electricity is the U.S. average of 1.34 pounds/kWh *(http://tonto.eia.doe.gov/ftproot/environment/e-supdoc-u.pdf, http://www.eia.doe.gov/)*

See earlier endnote with the Telepresence Meeting CO_2e Reduction Model.

To be conservative, the larger Cisco 3200 is used for calculating energy use. For a Cisco 3200 the average power use including HVAC is about 4.285 kW. Since the city pairs are not explicitly known, 1.34 pounds of CO_2e per kWh is assumed (the U.S. average), so a two hour meeting for the pair of stations produces about 11.5 pounds of CO_2e per hour.

CO_2e emitted by data transmission is 0.658 kWh/Gigabyte * 9.0 GB/hr * 1.34 pounds CO_2e/kWh or about 7.9 pounds CO_2e per hour

The characteristics of the individual flights are unknown, so the 1,093 mile domestic and international average for U.S. carriers is used, along with 0.44 pounds of CO_2e emitted per seat mile, or 962 pounds of CO_2 per flight. This is an average based on some TRAX flight estimates. To be conservative, radiative forcing caused by combustion at altitude is not included in these calculations. Adding this would increase the CO_2e emissions from the flight by a factor between 1.5 and 3.0.

The carbon emission reduction per meeting is now

Cr = Nnf * [Cf + Cg] - Ct
where Nnf is the average number of non-flyers per meeting (a 2 hour meeting is used for illustration)
so Cr = Nnf * [962 + 20] – [2 *[11.5] + 7.9]
or 1.4 * 982 – (23 + 7.9) ~ 1344 pounds of CO_2e saved per telepresence meeting.

At a high level, we can use some data for calls that go through the ATS Business Exchange Meet-Me Telepresence conferencing system. Real data for meetings in October, 2009 showed an average meeting length of 69 minutes and an average of 2.72 endpoints in a conference. Data from May-July, 2009 also showed an average of about 8 meetings per room per month. No data was available on displaced meetings or the nature of the trips. Since endpoint and network carbon emissions are small compared to trip displacement carbon emissions, the simple model noted above is used. Model refinement will occur as details of trip displacement become available.

The final model shows the carbon savings per meeting using the number of endpoints per meeting and assuming 1.4 flights are displaced per meeting. This is multiplied by the number of meetings per month and the number of endpoints (rooms) in the hypothetical projection.

Customer	km saved (plane)	km saved (train)	km travel saved (vehicle)	metric tons CO_2*	Minutes/month	MT CO_2/Yr per Min/Mo.	MT CO_2/Minute
1	141,142,500	–	2,540,565	17,416	1,129,140	0.0154	
2	41,200	–	92,700	23	10,300	0.0022	
3	90,972,000	1,364,580	4,093,740	11,766	1,819,440	0.0065	
4	7,687,955	115,041	345,123	1,603	247,400	0.0065	
5	2,100,000	31,500	94,500	272	42,000	0.0065	
				31,079.28	32,482.80	0.0096	0.00080

*From travel avoidance less metric tons generated by use of PC

56. Calculations include existing base plus hypothetical growth.

57. AT&T Connect uses a ROI tool built by Alinean that surveys customer usage and travel displacement. Travel is broken into airplane, train and automobile trips and the customer is asked to tally the mileage for each type of displaced trip. Conversion factors to calculate carbon dioxide emission reductions are used within the tool. For purposes of these calculations, surveys supplied by five AT&T customers were utilized, which showed an average of 0.8 kilograms of carbon dioxide displaced per minute of AT&T Connect use. Projected Web minutes (based on the hypothetical growth in seats) were multiplied by 0.8 kg to obtain the total carbon emission savings expected.

58. Calculations include existing base plus hypothetical growth.

59. Approach: Reviewed several VPN and VPN telecommuting studies to estimate the number of displaced trips per connection and the number of customers. Data used was from a 2008 study of 1,200 National Science Foundation workers, which was consistent with several other smaller studies. In the NSF study about 50 percent of midlevel workers do some telecommuting and about 30 percent telecommute a day a week. It appears that this 30% have about 50 commute-less days a year on average, or about 4 per month. An NSF IT worker noted their remote users are turning on their VPN for the whole day. *(http://www.teleworkexchange.com/nsfstudy/, http://www.telework.gov/Reports_and_Studies/Annual_Reports/2008teleworkreport.pdf)*

At 2.43 connections per month per user based on AT&T current data, and conservatively utilizing 2 commutes avoided per month, a connection saves 0.82 commutes. Model assumes 50% of VPN users are telecommuters averaging 2 teleworking days per month. Model multiplies hypothetical projections by commutes per month and the government average commute length of about 30 miles (http://www.bts.gov/publications/omnistats/volume_03_issue_04/), and the average vehicle mileage of 20 mpg *(20 mpg is the rough average of fleet passenger car and light trucks, http://www.bts.gov/publications/national_transportation_statistics/html/table_04_23.html)*, and 19.6 pounds of emitted CO_2 per gallon of burned gasoline are used.

The carbon emitted from work at home PC and network use is calculated. An upper bound estimate is about 200 watts, or 1.8 kWh in an eight hour day. The network contribution is negligible. This adds about 2.4 pounds of carbon dioxide emissions. The net savings for telecommuting is then calculated.

The formula is:
pounds of CO_2e saved per connection = carbon emitted per connection – home PC carbon per connection
where carbon emitted per connection is:
average commute in miles/average mpg * CO_2e/gallon of gasoline burned * commutes/connection
and home PC carbon emitted per connection is:
home PC power consumption * U.S. average electric carbon intensity * 8hrs/day

For more information contact an AT&T Representative or visit www.att.com/business.

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