Progress to 2025 — 10x Goal Update

May 2019
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Climate change is one of the world’s most pressing challenges. At AT&T, we believe that our technology solutions can play an important role in addressing the problem. That’s why we set our 10x carbon reduction goal, demonstrating our ambition to reduce our own greenhouse gas (GHG) emissions footprint while using the power of our technology to enable GHG emissions reductions that are 10 times greater than our own by 2025.

Overview

Since setting our net positive goal in late 2015, we have established a methodology to define the scope of the goal and measure our impact. We are working with our customers and Carbon Trust, a leading climate change non-government organization, to quantify how AT&T technology is enabling GHG emissions reductions, and we are documenting and sharing these customer success stories in our 10x Case Study Series.

This document provides a summary of our progress and examples of the overall net positive impact that our technology is enabling. We will provide additional updates with more real-world examples and data-driven results every 2 years.

Progress timeline, 2015–2018

At the end of 2018, we calculate that we enabled GHG savings approximately 2 times the GHG footprint of our operations. We are using this estimate to understand the current state and progress against our larger goal.
We measured our impact by examining how AT&T technology solutions can enable lower GHG emissions in 8 impact areas and compared those emissions to our own footprint. At the close of 2018, we calculate that our technology solutions enabled GHG reductions of 17.1 million metric tons of CO$_2$e, which is equivalent to over 1.9 billion gallons of gasoline. In 2018, our GHG carbon footprint was approximately 7.7 million metric tons of CO$_2$e, putting our current 10x factor at approximately 2.2x.

AT&T 10x: Our current progress and path forward

2018 values (in metric tons of CO$_2$e)

**AT&T-enabled GHG reductions**

- Modern Workplace **13.78M**
- Transportation **2.31M**
- Healthcare **697K**
- Smart Cities & Building **129K**
- Industrial **112K**
- Energy **61.1K**
- Consumer/Retail **12.6K**
- Food, Beverage & Agriculture **5.6K**

**AT&T GHG footprint**

- Scope 1 **1M**
- Scope 2 **6.7M**

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1 Per the [10x Methodology](#), we define our 10x footprint as Scope 1 and 2 emissions as defined by the [Greenhouse Gas (GHG) Protocol Corporate Standard](#).

2 The ratio comparing the AT&T GHG footprint to AT&T technology-enabled GHG reductions.

3 AT&T Technology-enabled carbon reduction (17.1) divided by AT&T Scope 1 and 2 (7.7) = 2.2.

4 All equivalencies in this document are estimated using the methodology outlined by the U.S. Environmental Protection Agency, [Greenhouse Gas Equivalency Calculator](#). (Note, the average eGRID electricity factors have been used rather than the marginal AVERT electricity factors, this being a more conservative estimate of the savings).
Goal outlook

AT&T remains committed to addressing climate change, and we are confident that we can meet our 10x goal by our target year of 2025. We are pleased with the current progress and encouraged by the actions we are taking to reduce our footprint and increase carbon-reducing technology solutions. We see these specific trends playing a key role in our progress towards 10x:

Managing AT&T’s GHG footprint

Electricity efficiency is critical:
• We will continue to focus on energy efficiency efforts in our buildings and network.
• We will leverage AT&T technology to identify improvement opportunities.

Recent renewable energy commitments:
• In 2018, we committed to delivering up to 820 megawatts of clean wind energy to the American power grid.
• We expect these systems to come online in 2019, reducing our footprint.
• We expect to pursue more large scale renewable energy projects in the future.

Enabling GHG reduction

Established technologies currently have largest impact:
• Modern Workplace technologies are currently the largest reduction source because they are mature and have a relatively high adoption rate.
• We expect this usage to continue, but we anticipate other areas will grow at a much faster rate.

Current IoT solutions taking hold in the marketplace:
• We have identified existing real-world Internet of Things solutions that enable GHG reductions, but we recognize that these are nascent and adoption is still growing.
• We will continue to evaluate marketplace solutions and quantify their carbon impact.

New technology advancements show promise in emissions-intensive industries:
• We expect technology advancements in areas such as 5G and IoT to have game-changing impacts for customers.
• We believe these technologies can drive GHG reductions in high-emissions industries such as energy, industrial/manufacturing, and transportation.

Fleet efficiency:
• Our mobile fleet of vehicles is our largest Scope 1 emission source.
• We will continue investing in fuel-efficient vehicles and technology solutions to reduce emissions.

How 10x is influencing our business

The 10x goal is providing us with insight that can influence how we run our operations and engage our customers. For instance, our 10x goal provides motivation for us to reduce our own emissions, and that has played a role in our commitments to the large-scale wind purchases that we announced in 2018.
For our customers, the development of our 10x case studies has shed light on the wide array of applications that can be used to reduce costs and emissions. We are using these real-world stories to engage our customers in new conversations about ways we can work together to improve their business while reducing their environmental impact. The 10x goal and case studies turn the abstract idea of technology-enabled GHG reduction into a practical discussion about new technology solutions, and that’s good for our customers, AT&T and the environment.

I. Climate change and the 10x goal

AT&T recognizes that GHG emissions are accelerating climate change, presenting significant threats to the global community. We understand the need to avoid the worst impacts of climate change by limiting carbon emissions to keep global temperature increases below 1.5 degrees Celsius, as articulated in the Paris Climate Agreement and supported by research published recently by the IPCC and the U.S. federal government.

The urgency of this crisis demands immediate action, and AT&T has developed a holistic climate change strategy that includes adaptation as well as mitigation. We are reducing our GHG emissions through extensive energy efficiency efforts and large-scale renewable energy purchases, and we are preparing for climate impacts through our Climate Change Resiliency Project. In addition, we are a founding member of the Climate Leadership Council, an international policy institute founded in collaboration with business, opinion and environmental leaders to promote a carbon dividends framework as the most cost-effective, equitable and politically-viable climate solution.

By 2025, AT&T will enable carbon savings 10x the GHG footprint of our operations by enhancing the efficiency of our network and delivering sustainable customer solutions.

A key component of our climate change strategy is an initiative focused not just on our own company but also on the customers we serve. That initiative is our 10x goal, our commitment to use the power of our technology to generate customer emissions reductions 10x greater than our own carbon footprint by 2025.

We will provide updates every 2 years to show our progress toward this goal. This document — as part of our 2018 Corporate Responsibility Report — is intended to show the progress we have made since setting the goal in November 2015. Our next update will accompany the 2020 Corporate Responsibility Report.

II. GHG impact methodology

When we set the 10x goal in 2015, there was no standard methodology to measure how technology solutions could help reduce GHG emissions. We worked with Carbon Trust and BSR, 2 leading non-government organizations with extensive experience in this area, to build a guidebook for measuring

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5 IPCC, 2018: Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty, ipcc.ch/sr15/

progress against our 10x goal. Released in June 2017, the methodology document is available on the 10x website.

We are also a founding member of the Net Positive Project, a collaborative effort looking to spur “net positive” efforts like our 10x goal that put back more into society, the environment and the global economy than they take out. Together with this group, we are working to create credible, common approaches to measuring “net positive” and to encourage other companies to pursue a net positive impact.

III. Identifying GHG abatement impact areas

We have aligned our work with industries and technology solutions that offer the greatest potential to reduce GHG emissions. Again, we engaged BSR and Carbon Trust to help identify areas that have high potential for AT&T technology-enabled GHG emissions reductions and evaluated these existing frameworks to help prioritize our efforts:

- GeSI Mobile Carbon Impact Study
- GeSI SMARTer2030
- The 3% Solution (WWF/CDP)
- Sustainable Development Goals
- GRI & CDP, as mapped by SDG Global Compass
- Science Based Targets initiative
- AT&T Customer Focus Areas

Using these resources as a guide, we have focused our work on key impact areas that we believe can help achieve the most carbon and cost reductions for our customers. Some of the technologies used in these areas are just starting to gain market traction and have relatively small GHG impacts at this time, while other established technology solutions such as remote working platforms have already gained a foothold and are already reducing GHG emissions at scale. While we recognize that these areas may evolve over time as new technologies develop, our 8 impact areas are:

- Modern Workplace
- Transportation
- Healthcare
- Consumer/ Retail
- Smart Cities and Buildings
- Energy
- Industrial
- Food, Beverage & Agriculture
IV. Impact area summaries

In each of these impact areas, we are working to identify and quantify how AT&T technology solutions enable GHG emission reductions. The sections below provide a summary of each impact area, including:

- An overview of the impact area
- Our perspective on the current state and future potential of each impact area
- A highlighted solution that is enabled by AT&T and its estimated annual GHG reduction impact in terms of gallons of gasoline. Note that these examples do not represent all the solutions we have evaluated to estimate our impact. A full list is available in Appendix 1.

<table>
<thead>
<tr>
<th>Overview</th>
<th>AT&amp;T's role and perspective</th>
<th>Highlight and impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>- The way we work has changed radically over the last few decades, fueled by the power of computers and mobile connectivity.</td>
<td>• AT&amp;T has long been a leading provider of mobile work tools and virtual collaboration technology.</td>
<td></td>
</tr>
<tr>
<td>- This transition has made it possible for employees to work remotely, reducing fuel usage. It has also enabled employers to reduce the electricity need for office space lighting, heating and cooling.</td>
<td>• We implement flexible work programs for our own employees and we provide these services for many of our customers.</td>
<td>Desk-based video conferencing utilizes AT&amp;T voice and data connectivity to avoid traveling for a meeting. Whether across town or around the globe, this technology helps accelerate business while reducing travel.</td>
</tr>
<tr>
<td>• Wireless and wired connectivity can allow for access to information, more efficient use of time, and a lower environmental footprint by reducing fuel needed for travel and lower electricity usage in the workplace.</td>
<td>• Because this technology is so well established, this represents our largest source of technology-enabled carbon reduction in 2018.</td>
<td></td>
</tr>
<tr>
<td>• Because this technology is so well established, this represents our largest source of technology-enabled carbon reduction in 2018.</td>
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</tbody>
</table>
## Transportation

<table>
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<th>Overview</th>
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<tr>
<td>• In 2016, 28% of U.S. GHG emissions came from transportation, making it one of the largest sources of GHG emissions.</td>
<td>• AT&amp;T-enabled wireless fleet management technology can allow fleet managers to use data to more efficiently deploy and route vehicles to help reduce delivery and idle time, improve mileage and reduce fuel costs.</td>
<td>RM2 shipping pallets are lighter and more durable than traditional wooden pallets, reducing fuel use and emissions. Integrating AT&amp;T connectivity enables customers to track location and condition of the shipment and reduce the risk of loss, lowering the per-trip cost.</td>
</tr>
<tr>
<td>• Alternative fuel and electric vehicles reduce tailpipe emissions, but traditional fuel vehicles still are most vehicles on the road.</td>
<td>• Asset management technologies can help maintain visibility and control of assets while avoiding transportation trips and loss.</td>
<td></td>
</tr>
<tr>
<td>• Asset tracking, route optimization, idling reduction, and fuel-efficient driving behavior are critical to emissions reduction.</td>
<td>• This helps reduce fuel usage and associated GHG emissions by optimizing how we move people and things from point A to B.</td>
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## Healthcare

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| • If the U.S. healthcare system were a separate country, its $3.3 trillion GDP would make it the fifth-largest economy in the world. It is also the world’s seventh-largest producer of carbon dioxide. 9  
• The U.S. healthcare system emitted 655 million metric tons of carbon dioxide in 2011, which accounted for around 10% of all the CO₂ generated in the United States that year. 10 | • Connected technology solutions can help create expanded access to medical and health services, offer insight into medical conditions, and help people with disabilities overcome accessibility challenges.  
• Using solutions such as remote patient monitoring, patients can reduce the number of trips to see a medical provider, saving time and reducing fuel usage.  
• Smart building technologies can help hospitals and other medical facilities reduce the electricity needed to provide their services. | Remote patient monitoring allows health providers to gather patient health information without a patient having to travel, reducing travel-related emissions. |

### Consumer/Retail

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| • Brick and mortar retail stores and warehouses represent 87% of retail sales, and with it, a substantial environmental impact due to electricity and water use.  
• Online shopping has more than doubled its share of retail sales from 2007–2017.  
• Online shopping brings the potential benefit of lower energy usage at stores and reduced emissions from consumers travelling to stores, but also introduces potential GHG emissions increases from delivery and data center operations. | • AT&T has teamed up with a wide range of retail companies to cultivate a connected, efficient retail experience, keeping stores running efficiently and reducing energy and water usage.  
• We are also working with retail and logistics experts to integrate technology solutions with the potential to optimize the delivery process for online purchases.  
• Connected coolers with smart analytics can help optimize inventory and replenishment, reducing trips and preventing waste in retail and grocery stores. | HydroPoint® smart irrigation controllers use AT&T Internet of Things (IoT) to optimize landscape irrigation and reduce water usage. Because water treatment and pumping use so much energy, saving water also effectively reduces community GHG emissions. |

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12 Ibid
## Smart Cities and Buildings

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</table>
| • Cities consume approximately 75% of global energy.<sup>13</sup> Buildings account for up to 70% of energy use in major cities — and 30% of greenhouse gas emissions globally.<sup>14</sup>  
• The United Nations estimates that 68% of the world population will live in urban areas by 2050.<sup>15</sup>  
• Rethinking how we build and maintain our cities and buildings can impact our success in dealing with GHG emissions and climate change. | AT&T is providing the next-generation wireless networks and services to help cities realize many potential environmental benefits of smart cities, including:  
• Increased energy efficiency  
• Improved water conservation from reducing pipe leaks and water waste  
• Reduced carbon emissions and improved air quality  
• Tools to increase the visibility of building equipment to help reduce energy and carbon footprint. | By integrating AT&T Internet of Things connectivity, Redaptive can implement energy-efficient building equipment upgrades that can reduce energy costs and GHG emissions for its customers with no upfront capital investment and immediate financial returns. |

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13 Energy. UN Habitat, unhabitat.org/urban-themes/energy/
## Energy

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<td>• In 2017, the U.S. Energy Information Administration estimated that emissions of carbon dioxide ($CO_2$) by the U.S. electric power sector were about 34% of the total U.S. energy-related $CO_2$ emissions. (^{16})  &lt;br&gt;• The burning of coal, natural gas and oil for electricity and heat is the largest single source of global greenhouse gas emissions. (^{17})</td>
<td>• AT&amp;T works closely with our utility and oil &amp; gas customers to help them operate more efficiently and safely.  &lt;br&gt;• Technology is giving utilities greater autonomy and more choices in the way they source, use and store electricity. Smart storage systems also help speed up the transition to renewables.  &lt;br&gt;• The electric power system is evolving from a unilateral system to an integrated networked ecosystem and we believe that AT&amp;T’s expertise in highly secure connectivity will be an important enabler for the energy of the future.</td>
<td>Connected residential electricity meters can help reduce electricity usage and the associated GHG emissions because they provide timely information to consumers about their usage, empowering them to adjust lighting and heating/cooling to reduce that usage. Connected meters also collect usage data remotely, reducing the need for truck dispatches and associated travel-related emissions.</td>
</tr>
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### Industrial Overview

**AT&T’s role and perspective**

- AT&T-enabled IIoT allows businesses and cities to harness data to predict, learn and make near real-time decisions to optimize their operations.
- These solutions can make best use of assets, enable preventative maintenance, reduce electricity use, save fuel by avoiding unnecessary trips, and reduce associated GHG emissions.
- AT&T believes IIoT will grow to be a major contributor to energy efficiency-related carbon reductions.

**Highlight and impact**

- **Lineage Logistics**, a leading food cold storage operator, engaged a software and engineering company focused on reducing waste called industrial.io to optimize energy at its warehouses.
- AT&T IoT connectivity enables Lineage to create heat maps, alerts and reports that empower it to actively manage its cooling operations and reduce energy cost and GHG emissions.

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Food, Beverage & Agriculture

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<tbody>
<tr>
<td>Agriculture accounted for 9% of total U.S. GHG emissions in 2016, per the EPA. Management of agricultural soils accounts for over half of the emissions from the agriculture economic sector. The GHG implications from growing, transporting, storing and disposing of food are substantial and present an opportunity for resource efficiency and emissions reductions.</td>
<td>By working with farmers to improve how they grow food through efficient fertilizer usage, fuel usage and irrigation practices, AT&amp;T believes that IoT can be a key enabler to reducing the environmental impact of feeding our population. By integrating sensors and connectivity into the water distribution and irrigation systems, technology can help identify and reduce wasted water and the carbon emissions related to the treatment and pumping of water. AT&amp;T Asset Management solutions can be integrated with food distribution and waste systems to reduce inefficiencies.</td>
<td>Grind2Energy™ has created an industrial food grinder that turns food waste into a nutrient-rich slurry that anaerobic digesters can turn into biogas and fertilizer. They turned to AT&amp;T to integrate IoT connectivity and robust reporting, helping to increase scalability and increase the market competitiveness of the system.</td>
</tr>
</tbody>
</table>

V. Raising awareness

One of the main objectives of the 10x goal is to raise awareness of existing and developing technology solutions that have the potential to reduce GHG emissions. To make meaningful progress toward a low-carbon economy, we need scale across all impact areas. To that end, we have made a concerted effort to join with our customers to raise the visibility of these solutions. Through our 10x Case Study series, we hope to stimulate more awareness and interest in solutions with the aim of increasing adoption and, as a result, reducing GHG emissions at greater scale.

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Appendix 1: Summary of AT&T-enabled technology solutions and emissions abatement factors

This table summarizes the types of AT&T-enabled solutions that have been included in this year’s 10x impact estimate. The table is grouped by impact area and identifies the solutions that have been included in the analysis, the estimated GHG abatement factor for each solution, and the source for each abatement factor. Where available, we have used the AT&T 10x case study to estimate the potential to reduce emissions in each impact area. For those solutions where we do not have a 10x case study, we have calculated the GHG abatement factor using research from credible sources and publicly available data. We intend to continue this series of case studies as new technology solutions are developed.

This list represents the existing research that we have used to date and is not intended to show the complete impact.

<table>
<thead>
<tr>
<th>Impact area</th>
<th>Solution</th>
<th>Abatement factor (kg CO₂e/unit/time)</th>
<th>Source/References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer/Retail</td>
<td>Smart Landscape Irrigation</td>
<td>800 kg CO₂e/site using smart irrigation/year</td>
<td>AT&amp;T 10x case study: <a href="#">Lowe’s Uses HydroPoint and AT&amp;T to Reduce Water Consumption and Carbon Footprint</a></td>
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<td>Ofgem study: <a href="#">GB-wide smart meter roll out for the domestic sector</a></td>
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<td></td>
<td>EIA: <a href="#">average electricity consumption per US household</a></td>
</tr>
<tr>
<td>Energy</td>
<td>Residential Smart Meters</td>
<td>142 kg CO₂e/connected residential smart meter/year</td>
<td>AT&amp;T 10x case study: <a href="#">Emerson’s Grind2Energy integrates AT&amp;T IoT to turn food waste into clean energy</a></td>
</tr>
<tr>
<td></td>
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<td></td>
<td><a href="#">GB-wide smart meter roll out for the domestic sector</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><a href="#">average electricity consumption per US household</a></td>
</tr>
<tr>
<td>Food, Beverage &amp; Agriculture</td>
<td>Food Waste to Energy</td>
<td>84,000 kg CO₂e/site using Grind2Energy/year</td>
<td>AT&amp;T 10x case study: <a href="#">Emerson’s Grind2Energy integrates AT&amp;T IoT to turn food waste into clean energy</a></td>
</tr>
<tr>
<td>Healthcare</td>
<td>Remote Patient Monitoring</td>
<td>871 kg CO₂e/connected remote monitoring device/year</td>
<td>See Appendix 2 below.</td>
</tr>
<tr>
<td>Industrial</td>
<td>Cold Storage Energy Efficiency</td>
<td>1,400,000 kg CO₂e/cold storage facility/year</td>
<td>AT&amp;T 10x case study: <a href="#">Lineage Logistics &amp; Industrial.io: Energy Efficient Frozen Food</a></td>
</tr>
<tr>
<td>Impact area</td>
<td>Solution</td>
<td>Abatement factor (kg CO$_2$e/unit/time)</td>
<td>Source/References</td>
</tr>
<tr>
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<td>---------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Modern Workplace</strong></td>
<td>Video Conferencing - TelePresence Rooms</td>
<td>101,000 kg CO$_2$e /TelePresence room /year</td>
<td>Case study in SMARTER2020 report, The Telepresence Revolution, CDP and Verdantix</td>
</tr>
<tr>
<td></td>
<td>Video Conferencing - Desk Based</td>
<td>4,300 kg CO$_2$e /video conference seat/year</td>
<td>See Appendix 2 below.</td>
</tr>
<tr>
<td></td>
<td>Cloud Connectivity</td>
<td>13,683 kg CO$_2$e /highly secure connection to cloud service providers/year</td>
<td>Average server power, PUE factors — various sources. Greenpeace Clicking Clean report — energy mix for electricity used by cloud providers</td>
</tr>
<tr>
<td></td>
<td>Telecommuting/Remote Working</td>
<td>637 kg CO$_2$e /residential internet connection/year</td>
<td>See Appendix 2 below.</td>
</tr>
<tr>
<td><strong>Smart Cities and Buildings</strong></td>
<td>Efficient Building Equipment Funding</td>
<td>154,000 kg CO$_2$e /site using Efficiency-as-a-Service/year</td>
<td>AT&amp;T 10x case study: AT&amp;T and Redaptive® Help Overcome Obstacles to Energy Efficiency in Buildings</td>
</tr>
<tr>
<td></td>
<td>Buildings</td>
<td>13,600 kg CO$_2$e /connected building management system/year</td>
<td>AT&amp;T 10x case study: Using the Internet of Things to reduce facility costs and emissions</td>
</tr>
<tr>
<td></td>
<td>Smart Parking</td>
<td>271 kg CO$_2$e /parking service connection /year</td>
<td>SFMTA study: SFpark Pilot Project Evaluation</td>
</tr>
<tr>
<td></td>
<td>Smart Street Lighting</td>
<td>49 kg CO$_2$e /LED street light connection/year</td>
<td>Intel: Smart Street Lights for Brighter Savings and Opportunities</td>
</tr>
</tbody>
</table>
## Table: Avoided emissions calculations for AT&T 10x top 4 categories

<table>
<thead>
<tr>
<th>Impact area</th>
<th>Solution</th>
<th>Abatement factor (kg CO(_2)e/unit/time)</th>
<th>Source/References</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transportation</strong></td>
<td><strong>Connected Shipping Pallet</strong></td>
<td>71.6 kg CO(_2)e/composite pallet/pallet lifetime</td>
<td>AT&amp;T 10x case study: <a href="att.com/10x">Unlocking the Potential of Connected, Reusable Pallets</a></td>
</tr>
<tr>
<td></td>
<td><strong>Electric Vehicle Charging</strong></td>
<td>1,630 kg CO(_2)e/connected charging stations/year</td>
<td><a href="att.com/10x">Number of charging points and number of electric vehicles</a>, <a href="att.com/10x">Electric car energy use</a></td>
</tr>
<tr>
<td></td>
<td><strong>Fleet Management</strong></td>
<td>612 kg CO(_2)e/connected vehicle/year</td>
<td>See Appendix 2 below.</td>
</tr>
</tbody>
</table>

### Appendix 2: Avoided emissions calculations for AT&T 10x top 4 categories

Carbon Trust has calculated the avoided emissions enabled by AT&T that are included in this summary report. These calculations represent the estimated GHG emissions that have been avoided by AT&T customers using AT&T’s products and services. Carbon Trust used the research referenced in this document and the details in the 10x case studies ([att.com/10x](att.com/10x)) to make these calculations.

These include avoided emissions, which have been calculated for the case studies published on AT&T’s website ([att.com/10x](att.com/10x)), and for a range of cases enabled by AT&T products and services.

The list of cases that have been considered are listed in Appendix 1. Of these, 4 categories make up more than 95% of the total avoided emissions: telecommuting; video conferencing (desk-based); fleet management; and remote patient monitoring. The assumptions, data and calculations for these 4 cases are described in this appendix.

The overall methodology that was used is described in the methodology document published on our website ([att.com/10x](att.com/10x)).

### Telecommuting

**Solution and mechanism for avoided emissions**

Telecommuting is when people work from home, rather than travelling to a place of work (office). The avoided emissions are directly related to the reduction in travelling. The premise is that people are able...
to work from home by having a broadband connection without which it would not be practical to work from home.

Assumptions and calculation method

The calculation uses an average commuting distance, a number of days per week worked from home for telecommuters, and number of working weeks per year to calculate total miles per year saved by an average telecommuter. It is assumed that the commuting would have been by car, thus the mileage figure can be converted into CO₂e savings per telecommuter by applying appropriate miles/gallon and tCO₂e/gallon factors. Then this is expressed as CO₂e saving per broadband connection by multiplying by the number of telecommuters and dividing by the total US broadband connections.

Data and data sources

<table>
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<th>Data value</th>
<th>Units</th>
<th>Source/References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average commuting distance</td>
<td>29.8</td>
<td>miles per day</td>
<td>Calculated from: Source: US Department of Transportation, Bureau of Transportation Statistics, Omnibus Household Survey. [bts.gov/archive/publications/omnistats/volume_03_issue_04/index Figure two](bts.gov/archive/publications/omnistats/volume_03_issue_04/index Figure two)</td>
</tr>
<tr>
<td># of days / week worked from home (for US telecommuters)</td>
<td>2.81</td>
<td>days</td>
<td><a href="news.gallup.com/reports/199961/7.aspx">news.gallup.com/reports/199961/7.aspx</a></td>
</tr>
<tr>
<td>Working weeks per year</td>
<td>47</td>
<td>weeks</td>
<td>Assumption</td>
</tr>
<tr>
<td>Avg. miles per gallon</td>
<td>17.9</td>
<td>miles / gallon</td>
<td><a href="bts.gov/content/motor-vehicle-fuel-consumption-and-travel">bts.gov/content/motor-vehicle-fuel-consumption-and-travel</a></td>
</tr>
<tr>
<td>Emission factor for gasoline</td>
<td>0.008887</td>
<td>metric tons CO₂ /gallon of gasoline</td>
<td><a href="epa.gov/cleanenergy/energy-resources/refs.html">epa.gov/cleanenergy/energy-resources/refs.html</a></td>
</tr>
</tbody>
</table>
## Results

- Avoided emissions factors calculated are:
  - Avoided emissions per telecommuter = 1.96 tCO₂e per telecommuter per year
  - Avoided emissions per broadband connection = 0.637 tCO₂e per connection per year

## Video conferencing (desk based)

### Solution and mechanism for avoided emissions

Desk-based video conferencing allows remote collaboration, avoiding the need for physical travel to meetings. Thus, this avoids the emissions associated with the travel. AT&T provides the video conferencing capability.

### Assumptions and calculation method

The calculations were based on an annual figure of typical equivalent travel distance to physical meetings if these had taken place instead of video calls. This figure was calculated from data collected by a provider of video conferencing, based on analysis of use of a managed video conferencing service over the period of a year. These calculations are based on data from an internal study - hereafter called the “video conferencing study” - that considered the number of people involved in the video conferences, and their locations. A “meeting avoidance factor” was applied to the travel distance figure. This factor represents the percentage of video conferences that would have been replaced by a physical meeting. The factor used was 32%, thus approximately 1 in 3 video conferences would have had a physical meeting.
The resulting avoided travel distance was converted to avoided carbon emissions, by applying appropriate emission factors. It was assumed that 4% of the travel distance was by car, and 96% was by air. (The percentage figures come from the video conferencing study).

Data and data sources

<table>
<thead>
<tr>
<th>Data item</th>
<th>Data value</th>
<th>Units</th>
<th>Source/References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual equivalent travel distance per managed video endpoint</td>
<td>73,860</td>
<td>Video-Miles / device / year</td>
<td>From video conferencing study</td>
</tr>
<tr>
<td>Meeting Avoidance Factor</td>
<td>32%</td>
<td>percentage</td>
<td>Cisco research</td>
</tr>
<tr>
<td>EF longhaul economy air travel per mile</td>
<td>0.1697</td>
<td>kg CO₂e / mile</td>
<td>Defra 2014 without RF + WTT</td>
</tr>
<tr>
<td>EF car (upper medium, petrol) per mile</td>
<td>0.43441</td>
<td>kg CO₂e / mile</td>
<td>Defra 2014</td>
</tr>
<tr>
<td>Ratio of car travel to air travel</td>
<td>4.0%</td>
<td>percentage</td>
<td>From video conferencing study</td>
</tr>
</tbody>
</table>

Note (for comparison): the calculations give a figure of 23,635 travel miles saved per year, which is equivalent to 4.6 return trips by air between New York and San Francisco.

Results

- Avoided emissions per video conferencing device = 4.3 tCO₂e per VC device per year

Fleet management

Solution and mechanism for avoided emissions

Fleet management and telematics covers a range of applications including satellite navigation, fleet tracking and dispatch, road tax collection, driver behavior monitoring and fuel management, among others. Mechanisms that cause abatement include targeted behavior improvement to improve fuel efficiency, satellite navigation to reduce journey distance and avoid congestion, and optimized route planning.
AT&T provides the connectivity to the vehicles enabling the real time collection of telematics data, which can be used to reduce fuel consumption.

Assumptions and calculation method

The key assumption is that fleet management enables fuel savings through a variety of mechanisms. There are numerous studies that demonstrate typical fuel savings of between 5% and 15%. A figure of 10% fuel saving was used.

To calculate the avoided emissions the average annual fuel consumption per customer vehicle was multiplied by the emission factor for gasoline to give the total average annual vehicle emissions. The avoided emissions are then calculated by applying the 10% saving factor.

Data and data sources

<table>
<thead>
<tr>
<th>Data item</th>
<th>Data value</th>
<th>Units</th>
<th>Source/References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average fuel consumed per vehicle per year</td>
<td>689.2</td>
<td>gallons</td>
<td>bts.gov/content/other-2-axle-4-tire-vehicle-fuel-consumption-and-travel</td>
</tr>
<tr>
<td>Emission Factor for gasoline</td>
<td>0.008887</td>
<td>metric tons CO₂/gallon of gasoline</td>
<td>epa.gov/cleanenergy/energy-resources/refs.html</td>
</tr>
<tr>
<td>Fuel Savings % for Fleet Management System</td>
<td>10%</td>
<td>percentage</td>
<td>energysavingtrust.org.uk/sites/default/files/Telematics.pdf</td>
</tr>
</tbody>
</table>

Results

- Avoided emissions per connected vehicle = 0.612 tCO₂e per vehicle per year

Remote patient monitoring

Solution and mechanism for avoided emissions

Remote patient monitoring allows health monitoring for patients at home. This can result in reduced visits to health centers and hospitals, resulting in reduced emissions for travel and for hospital stays.

AT&T provides the connectivity for the monitoring devices enabling the remote collection and monitoring of the data.
Assumptions and calculation method

The carbon savings are calculated assuming a reduced number of hospital stays. The number of hospital days avoided is calculated based on studies of hospital admissions and average number of day stays in hospital. This is then multiplied by an emission factor for hospital days.

There are also savings due to reduced travel, however these have not been included, and are expected to be small compared to the reduction in hospital emissions.

Data and data sources

<table>
<thead>
<tr>
<th>Data item</th>
<th>Data value</th>
<th>Units</th>
<th>Source/References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital admissions per year</td>
<td>1.5</td>
<td>admissions per year</td>
<td>health.org.uk/sites/default/files/QualityWatch_FocusOnHospitalAdmissionsFromCareHomes.pdf (p.24)</td>
</tr>
<tr>
<td>Average days stay in hospital</td>
<td>5.5</td>
<td>days per hospital stay</td>
<td>data.oecd.org/healthcare/length-of-hospital-stay.htm</td>
</tr>
<tr>
<td>Hospital emissions</td>
<td>106</td>
<td>kg CO$_2$e per day stay</td>
<td>sduhealth.org.uk/documents/publications/Bed_Days.pdf</td>
</tr>
</tbody>
</table>

Results

- Avoided emissions per connected remote monitoring device = 0.871 tCO$_2$e per device per year