Carbon Impact of the Future of Work

The Environmental Implications of Remote Working

vmware®

OFFICE OF THE CTO

Table of contents

Executive Summary

The year 2020 was a momentous one for all of us. We already knew that a digital foundation underpinned our daily lives, but overnight, the global pandemic made us rely on it more than ever before—for government, groceries, education, and work. We all shifted to some form of remote working, and the distributed workforce models that were once thought of as exploratory suddenly became mainstream. This transition has resulted in new opportunities—and new conundrums—for organizations of all sizes.

In 2020, we assessed—for the first time—the carbon impact of VMware employees working from home. For the Scope 3 Assessment of the Greenhouse Gas Protocol Corporate Accounting and Reporting Standard ("GHG Protocol"), companies normally track the carbon footprint of their employees' daily commute. In 2020, we expanded our Scope 3 assessment to better reflect our employees' remote work during the pandemic.

On the surface, having employees work from home seems to decrease the corporate carbon footprint. Fewer employees commuting to work means less fossil-fuel emissions, and fewer employees in the office means less on-site electrical usage. Nevertheless, remote workers have a carbon footprint, and we believe that our corporate footprint should account for the full range of carbon impacts resulting from remote work.

We were motivated by the opportunity to devise a custom methodology for home-office emissions. We wanted to truly understand the tradeoffs that a home office brings to employee commute emissions, and not simply ignore the environmental footprint of home offices. We also recognize that technology solutions companies such as VMware have a role to play in enabling digital workforces for all enterprises. This was a rare prospect: to not only advance our corporate footprint reporting, but also tie it to the carbon footprint reduction potential of our Anywhere Workspace[1] business. We believe that other companies can learn from our approach and leverage the methodology for collective community growth.

We're at the cusp of a paradigm shift in corporate carbon reporting. In fact, carbon reporting may soon become mandatory if financial regulators elect to include it in financial reports.[2,3] For the last 15 years or more, many professionals in carbon accounting[4] have worked to advance the standards and expand the voluntary reporting by corporations. For now, carbon accounting remains a niche field.

Change is on the way, however, and these changes bode well for the profession. The more transparent we are about what we've learned, the stronger environmental reporting will become across the sectors for all companies large and small.

---

[1] *https://www.vmware.com/solutions/anywhere-workspace.html*

[2] *https://www.sec.gov/news/public-statement/lee-climate-change-disclosures*

[3] *https://www.gov.uk/government/publications/environmental-reporting-guidelines-including-mandatory-greenhouse-gas-emissions-reporting-guidance*

[4] *The Next Frontier of Carbon Accounting: A Unified Approach for Unlocking Systemic Change. Rocky Mountain Institute, 2020. https://rmi.org/insight/the-next-frontier-ofcarbon-accounting/.*

"The Future of Work initiative brings together a set of policies, programs and adaptive culture to provide support for more than 33,000 personal innovation hubs around the world, highlighting VMware's vision of the Anywhere Workforce. It extends our EPIC2 values and advances our commitment to building a more diverse workforce, reducing our carbon footprint, and putting employee well-being first."

RICH LANG
SVP HUMAN RESOURCES

VMWARE REMOTE OFFICE SUPPORT

- Award winning digital workspace technology with VMware Workspace ONE

- Home-office setup reimbursement

- Best-in-class communication & collaboration tools

- Health & well-being programs

- On-demand virtual trainings

- 24/7 in-house support experts

Introduction

The global pandemic has reshaped the way we work. A year-long worldwide trend of employees working from home has catalyzed significant innovation in distributed work models. Now, employers need to focus on creating a conducive work environment at home—for continued productivity, innovation, and growth—while ensuring employee wellbeing and upholding company values.

In our effort to build a dynamic and global workforce, VMware has launched the Future of Work (FoW) initiative—a hybrid workforce model that offers all employees the flexibility and freedom to work from a VMware office, a home office, or other places that enable them to meet their professional and personal goals. Our offices will become Collaboration Hubs that are designed to help create synergies and collaboration amongst teams and co-workers, while providing employees with flexible working environments.

Benefits of Distributed Work

Source: https://careers.vmware.com/future-of-work
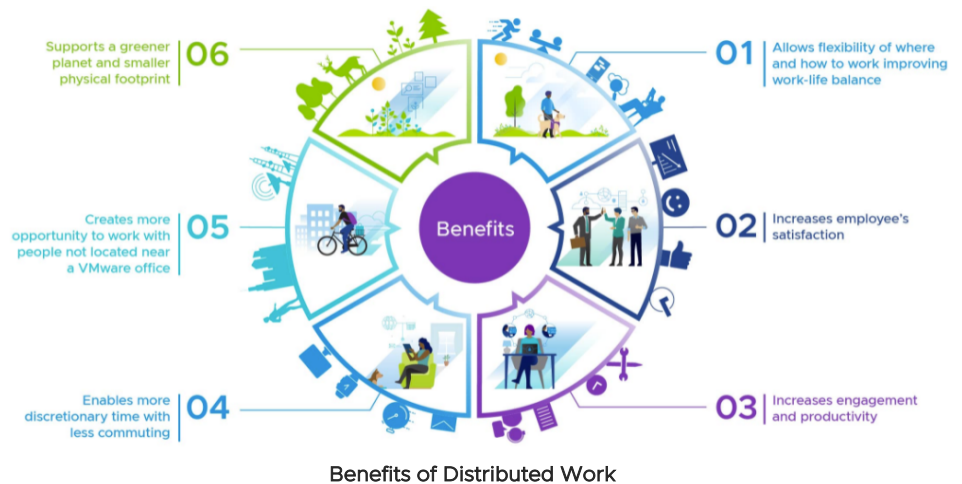
As most of our employees worked remotely during the pandemic, we assessed—for the first time—the carbon impact of the home offices of our more than 34,000 VMware employees around the world. As we move into our Future of Work model, we foresee that our custom home-office emissions methodology, in tandem with our employee commute impact assessment approach, will help us understand the region-specific trade-offs between remote and in-person working.

VMware's business is grounded in our ability to run, manage, connect, and protect any application on any cloud and any device. We have the solutions to help customers across the globe enable their employees to work remotely, maintain productivity, increase connectivity, and provide continuous, secure access to applications regardless of the technology they are using. We believe that our customers who are adopting distributed-workforce models can also leverage this methodology to assess their own remote working impact.

Our 2030 Agenda

VMware is committed to accelerating a more equitable, sustainable, and resilient digital future. We recognize that all aspects of our business have an impact on our environmental footprint—from the products we create to the people we employ. Our 2030 agenda reinforces our commitment to decarbonize our operations, supply chain, and digital infrastructure across our customer ecosystem.

vmware®

In fact, in 2018, we achieved carbon neutrality two years ahead of our stated goal, and we're now powering 100% of our operations with renewable energy. We have further accelerated our ambitions with a commitment to achieving net-zero emissions for our operations and supply chain by 2030. Our emissions reduction goals, approved by the Science Based Targets initiative (SBTi) in June 2020, reinforce our commitment, and provide the foundation for our journey to net zero emissions.

The aim for this white paper is to support decarbonization in our own operations and for our customers by driving awareness to the carbon impact of remote work.

Home-Office Emissions Methodology

As part of our 2020 greenhouse-gas inventory, we assessed—for the first time—the carbon impact of VMware employees working from home.[5] In line with our culture of innovation, we developed a custom methodology to account for regional variations in our globally distributed workforce.
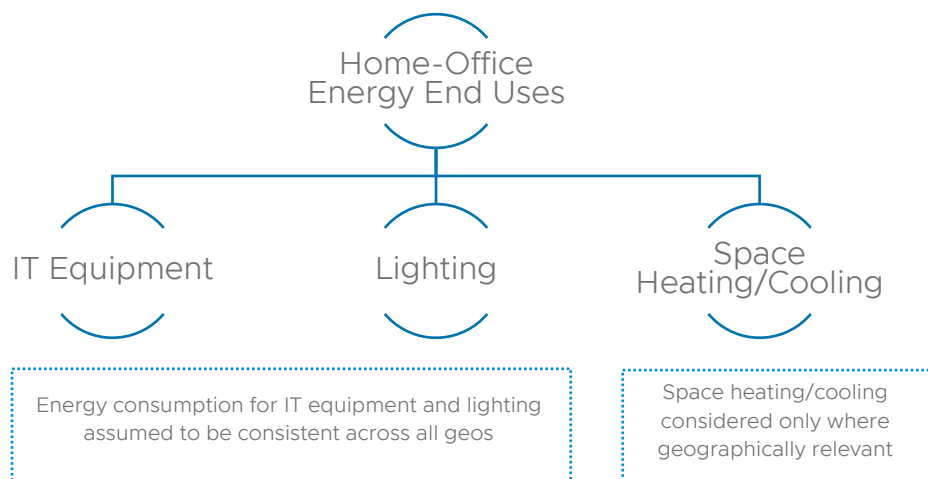
We started with a bottom-up approach to account for the impact of key energy end uses in a typical home office. IT equipment usage (the electrical plug load of the devices our employees use to work), lighting load, and space conditioning (heating and cooling) are the main emissions sources. We also divided our global workforce into groups based on our FoW Collaboration Hubs, to help account for regional variations in climate and emissions.

Energy End Uses and Data Sources

Using the average home size for each region as a starting point, we assumed a typical home office size. We recognize that not every employee has a dedicated home office, and some might be using a part of their living room or working from their dining table. Hence, we assumed that all employees would use the same amount of energy consumed by an equivalent square footage of dedicated home office. This methodology only accounts for the incremental impact associated with the specific space attributed to the home office.

KEY ASSUMPTIONS

- Remote working impacts accounted for our remote workforce for the full reporting period as well as our office-assigned employees working from home due to the COVID-19 lockdown (April 2020 – January 2021)

- Essential employees coming to the office during the lockdown were accounted for in the employee commuting category

- A standard 40-hour workweek assumed for all employees

- Space heating/cooling considered only in locations where it was geographically relevant

Home-Office Energy End Uses

IT Equipment — Lighting — Space Heating/Cooling

Energy consumption for IT equipment and lighting assumed to be consistent across all geos

Space heating/cooling considered only where geographically relevant

We assumed that IT equipment plug load and lighting load would be the same across all regions, whereas the space heating and cooling requirements would vary based on local climate.

We assigned a 90-watt power load to employees' home equipment, which we assumed to consist of one laptop and one monitor. Similarly, we assumed a 111-watt lighting load

---

[5] The GHG Protocol Corporate Accounting and Reporting Standard accounts for teleworking under Category 7: Employee Commuting category of the Scope 3 emissions and is not mandatory

for all employees, regardless of regions, based on recommendations in the Illumination Engineering Society of North America's Lighting Handbook. Those numbers were in line with our own ergonomic recommendations to ensure employee well-being and improve productivity.

We calculated regional heating and cooling needs based on the following data sources:

AMER (North, Central, and South America):

Both space heating and cooling were considered for all sub-regions in AMER except Latin America. This is due to the fact that Costa Rica (home to our major site in Latin America) boasts widespread climate-adaptive design efforts that eliminate traditional heating and cooling systems. We took the average home size from US Census Bureau data and assumed that the home office would occupy 10% of the home. 2015 US Residential Energy Consumption Survey (US RECS) offered average annual household energy consumption, which we used to calculate heating and cooling energy consumption for each home office space. Cooling, we assumed, would be completely powered by electricity, while heating emissions would come from both electricity and natural gas.

EMEA (Europe, Middle East, and Africa):

Our major sites in EMEA are in the UK, Ireland, and Bulgaria, so we used those regions as the representative sites for the VMware population. We derived the home office space per employee from the European Union average for floor area per person. Regional space heating and cooling data came from the French Agency for Ecological Transition's Odyssee-Mure project, which provides comprehensive monitoring of energy consumption and efficiency trends for EU countries. All of this data enabled us to calculate the home-office emissions for each of our Collaboration Hubs in EMEA.

APAC (Asia-Pacific):

India, China, Japan, and Singapore are our most representative sites for APAC, due to the significant size of the VMware workforce in these regions.

For India, we could not use the nation's reported per-capita consumption as a guide since energy use differs dramatically between urban and rural regions, and our employees are centered only around large urban areas such as Bangalore, Mumbai, and Pune. Again, we used a bottom-up approach, this time to estimate the space cooling requirements for our urban employees in India. Due to the low rate of air-conditioner usage in that country,[6] a typical ceiling fan was used as the reference for estimating the electricity consumption associated with space cooling. Due to the tropical climate, we did not account for space heating in India.

In China,[7] Japan, and Singapore, we based our cooling estimates on national averages for air conditioner use. We accounted for space heating in China and Japan, which in Beijing is powered by natural gas, and in Tokyo is powered by electricity. Like India, we did not account for space heating in tropical Singapore.

Emissions Factors

The US Environmental Protection Agency's region-specific Emissions & Generation Resource Integrated Database enabled us to calculate the home-office emissions for the US. For all other regions, we used electricity emissions factors from the International Energy Agency's 2020 proprietary dataset.

---

[6] Residential Electricity Consumption in India, Prayas (December 2016)
[7] The Future of Cooling in China, IEA (June 2019)

Home-Office Emissions Results

FY21 VMware home-office emissions Intensity

0.47 MT CO2e/Employee
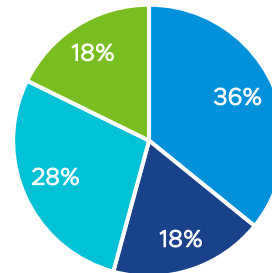
IT Assets ▪ Lighting ▪ Space Heating ▪ Space Cooling

We found our FY21 VMware home-office emissions to be approximately **0.47 metric tons of carbon dioxide equivalent (MT CO2e) per employee. Computers and monitors used during the workday were the leading contributors.** Regionally speaking, AMER was the largest contributor, accounting for 43% of our total emissions, closely followed by APAC at 40 percent. EMEA contributed just 16%.

Our country-specific emissions intensity was well below the national averages, due to the geographical distribution of our remote workforce. For example, 40% of our US workforce is based on the West Coast, in California, Washington, and Nevada. These states have significantly lower grid emissions and heating and cooling requirements than the US national average. Similarly, 75% of our EU workforce is based in regions with no space cooling requirements for a typical household. In APAC, we only needed to consider heating requirements for Beijing and Tokyo, which constitute only 15% of our APAC workforce.

Currently, our home-office impact assessment is based on the designated office location for non-remote workers and home office regions for remote workers. It does not account for any renewable energy or carbon offsets that our employees procured independently. The accuracy of this assessment can be improved by using actual home-office location, and by enacting an employee survey to collect primary data on key home-office characteristics and energy usage patterns.

Impact of Distributed Workforce Models

Pre-COVID, we calculated the environmental impact of all our employees commuting to our office locations using the average daily distance travelled by each employee, the distribution of transport modes for specific locations and EPA emissions factors. This data helped us shape our regional low-carbon employee commute programs through a combination of strategies, including public transport subsidies, vanpooling, dedicated parking spots for electric vehicles, bike racks, and so on.

As we move into our Future of Work model, our current methodology will evolve into a hybrid model that will help account for the impact of our distributed workforce, whether they choose to come in to one of our office locations, work remotely, or do a combination of both.

We estimate that the overall carbon impact of all VMware employees working from home is 2.5 times smaller than our pre-pandemic footprint, in which all employees physically commuted to offices. In other words, the carbon impacts of our employees working from home are less than traditional employee commuting and have resulted in reducing our overall footprint. While this savings is a global average specific to VMware employee locations only, the actual difference for other companies will vary depending on factors

vmware®

OFFICE OF THE CTO

that include the energy sources feeding the electrical grid of the home-office location and the commonly used modes of transport for specific office locations. For example, in cities where public transport is used and employees have housing options at a reasonable distance from the office location, the impact of moving to a remote workforce will only marginally improve a company's footprint. Whereas in regions where employees predominantly travel in a single-driver personal car with significant commute miles influenced by urban sprawl, the impact of reducing commute through remote working will be significant.

Organizations will need to strike a balance among employee flexibility, business productivity, and environmental sustainability to maximize the benefits of distributed workforce models.

Employee Benefits

In this "new normal," the environmental impacts of our workforce are no longer limited to corporate office buildings. Employees' homes are now part of our operational boundary, and companies need to expand the scope of our footprint reduction strategies to truly meet our carbon commitments.

VMware will continue to work towards bringing sustainability benefits to our employees' homes through regional programs. For example, in the US, we have teamed with companies such as Common Energy and SunPower to provide our employees with clean-energy options for their homes and community. Our Sustainability at Home initiative, launched by our employee-led Sustainability Ambassadors program, aims to connect our employees to local organizations offering clean energy, zero-waste goods, and other sustainable products and services in each region.

The Way Forward

Corporate carbon emissions are going through a transformational change. As hybrid work models gain traction and become commonplace, the resulting impacts will play out in the future.

The future of hybrid work models may take many forms. During the pandemic year, we saw one scenario, in which almost all employees who could work remotely did so for an extended time. But that's only one possibility. Most likely, some employees will return to the office full time, while others split their work week between the office and home, and still others remain entirely remote. While employee commute emissions will no doubt fall in a hybrid workforce model, home-office emissions will kick in—and the net impact of these two categories must be the new standard for corporate carbon reporting. We are ready to take on this challenge and look forward to sharing our work and leading positive change.

Learn more about VMware's 2030 Agenda at: https://www.vmware.com/company/esg

References

1. The Greenhouse Gas Protocol - A Corporate Accounting and Reporting Standard [https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf]
2. EcoAct - Homeworking emissions whitepaper [https://info.eco-act.com/en/homeworking-emissions-whitepaper-2020]
3. Anthesis - Whitepaper: Estimating Energy Consumption & GHG Emissions for Remote Workers [https://www.anthesisgroup.com/whitepaper-estimating-energy-consumption-ghg-emissions-for-remote-workers/]