



How Broadband Service Providers Are Building Smarter, Greener Networks with Calix

TABLE OF CONTENTS

- 3 Introduction
- 6 **Chapter 1:** Designing a Greener Access Network for Generations To Come
- 8 **Chapter 2:** The Building Blocks You Need To Go Green
- 10 **Chapter 3:** Delivering a Greener Wi-Fi Experience in the Home
- 11 **Chapter 4:** How Calix is Leading the Way for a Greener Future
- 13 **Appendix:** Why PON Is the Right Choice for Greener Broadband
- 14 **Resources**



About the Author

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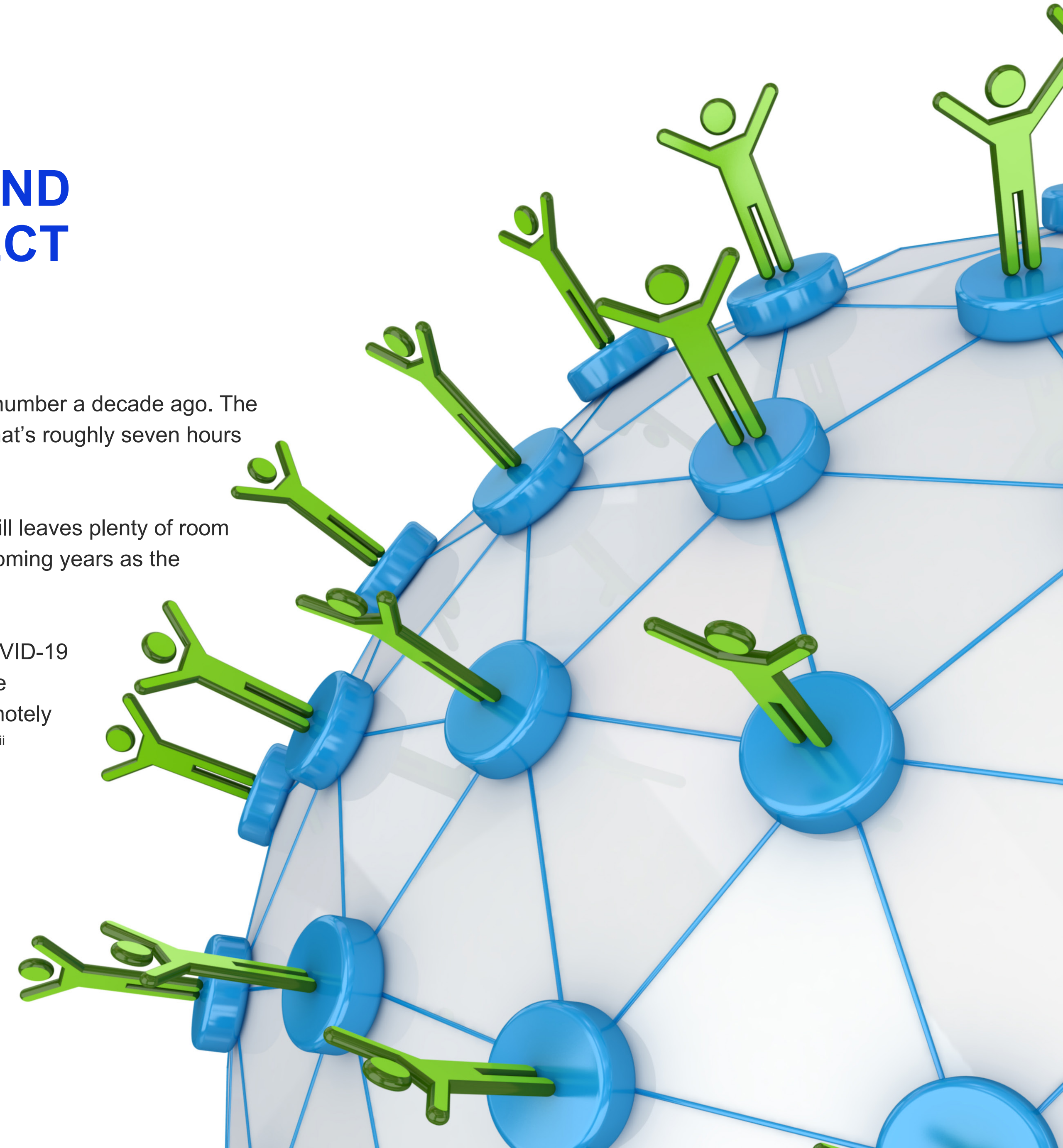
Introduction

THE HEAT IS ON FOR THE BROADBAND INDUSTRY TO CONNECT AND PROTECT THE PLANET

Almost 5 billion people worldwide are now connected to the internet, more than double the number a decade ago. The world's internet users spend a combined total of more than 2 trillion minutes online daily—that's roughly seven hours per day per user.ⁱ

The 5 billion online today only account for about 63 percent of the global population. That still leaves plenty of room for growth. Many of the (almost) 3 billion people not yet online will get connected over the coming years as the internet becomes more accessible and affordable.

This move online over the last decade—a trend that dramatically accelerated during the COVID-19 pandemic—has had a net positive impact on the environment. It is unarguable that it is more environmentally friendly to place a Zoom call than to fly to a meeting. The ability to work remotely means the average rural commuter in the U.S. is avoiding 4,600 miles per year on the road.ⁱⁱ That's 121 hours and countless gallons of fuel saved.

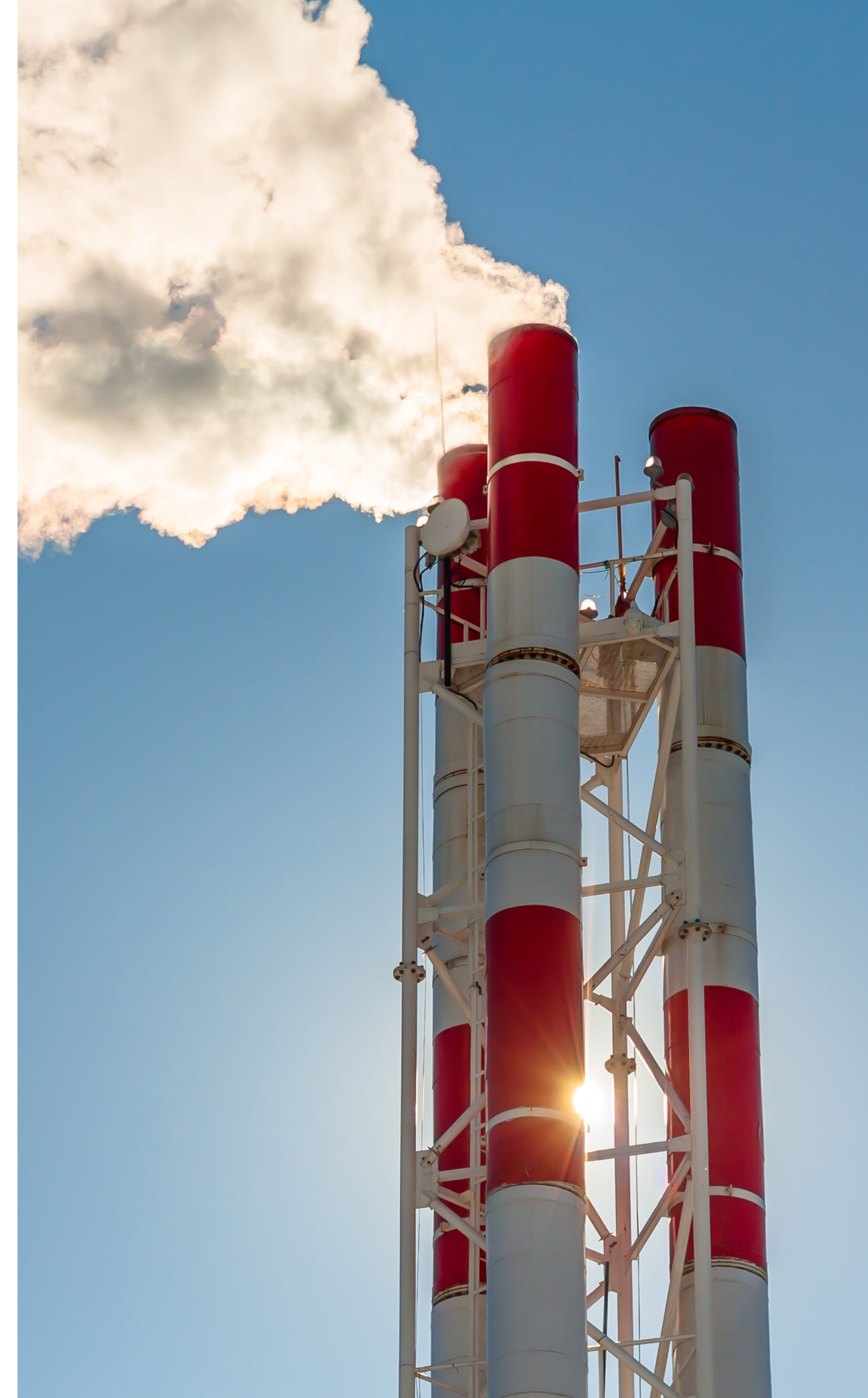


Our Industry's Fast-Growing Emissions Problem

While technology enables positive change, every action performed online nevertheless has an environmental impact. For example, carbon emissions can relate to the manufacture of connected devices, the running of networks and data centers, and the activities of companies across the broadband supply chain, including broadband service providers (BSPs).

According to estimates, the information and communications technology (ICT) industry is responsible for as much as 4 percent of global greenhouse gas emissions (GHG).ⁱⁱⁱ That is about twice the emissions of the global aviation industry. Moreover, emerging technologies such as big data, AI, the Internet of Things, and blockchain/ cryptocurrencies will increase this GHG contribution further. The ICT industry is forecast to account for more than 20 percent of total projected energy demand by 2030.^{iv}

Like individual countries, industry sectors are being urged to set road maps to achieve “net zero” emissions by 2050. This is the target set by the Paris Agreement required to keep global warming below 1.5°C. Meeting this target requires unprecedented coordination between industry and policymakers.



Introduction:

GOVERNMENTS AROUND THE WORLD ARE SUPPORTING BROADBAND DEPLOYMENTS

Governments worldwide are looking at passive optical networks (PONs) to extend high-speed broadband to hard-to-reach rural areas. In the U.S., for example, the [Rural Digital Opportunity Fund \(RDOF\)](#) is a \$20 billion program from the Federal Communications Commission (FCC) designed to help BSPs connect 6 million homes across the country.

More recently, the [Broadband Equity, Access, and Deployment \(BEAD\) program](#) has focused on connecting under-served areas by channeling money through state grants. Every U.S. state will receive an initial allocation of \$100 million from a \$42.45 billion fund.

Countries around the world are making similar investments. In the U.K., for example, Project Gigabit is a £5 billion government infrastructure program designed to bring at least “gigabit-capable” (1 Gbps) broadband to all homes and businesses across the U.K. by 2025.

Initiatives such as these support a new wave of BSPs rolling out fiber networks across their communities and closing the digital divide. These new providers are often electric cooperatives, wireless ISPs, or BSPs upgrading from older—and less environmentally-friendly—cable and copper network infrastructures.

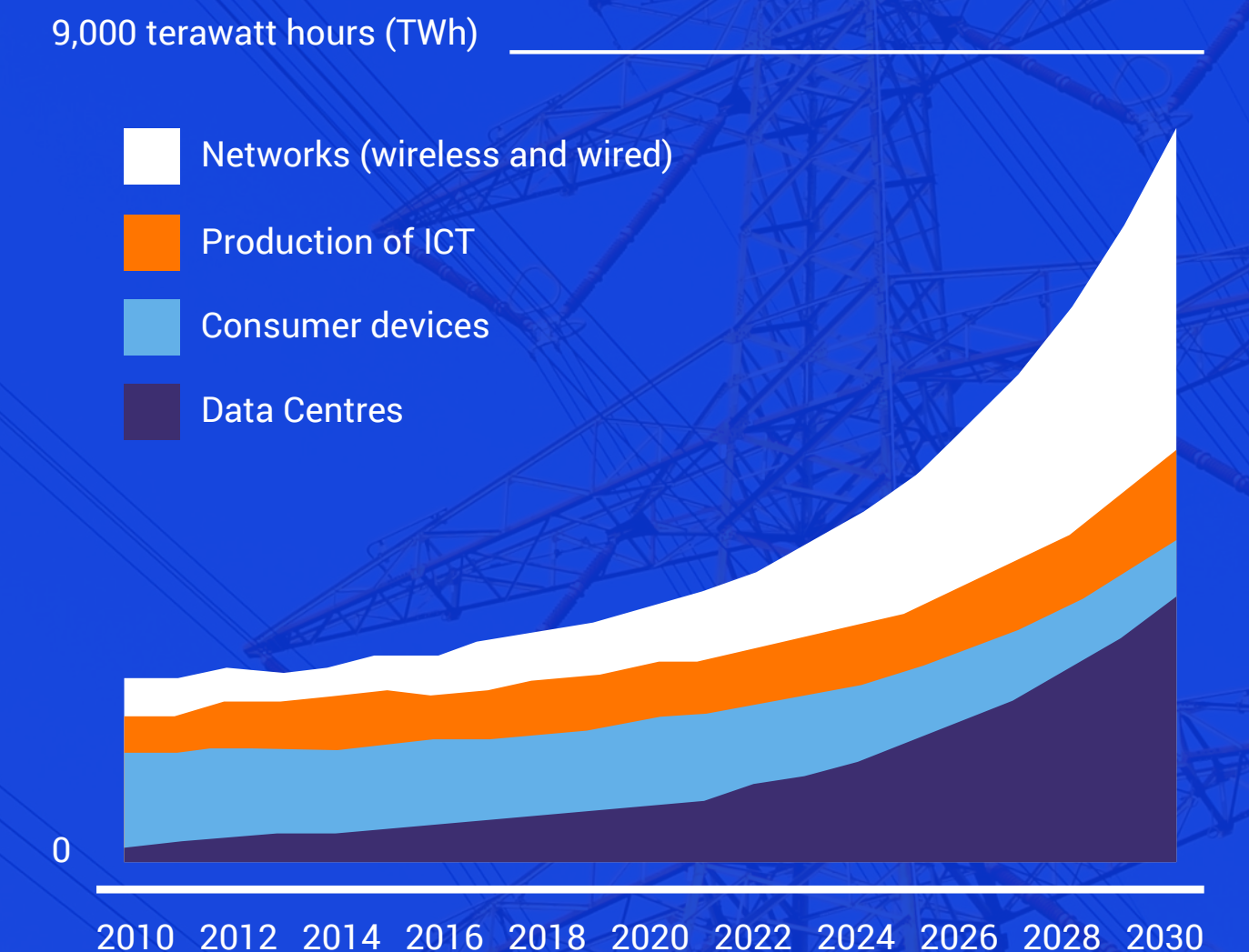
Calix is committed to helping you deploy and operate broadband networks that are sustainable and environmentally responsible. Now is the time to show your subscribers that you are committed to preserving their communities by leading the green broadband transformation.

We know that ICT has an ever-growing role in society and brings efficiencies to almost every corner of the global economy. But its relationship to carbon reduction may not be as straightforward as many people assume.”

Mike Berners-Lee, founder and director, Small World Consulting

Energy Forecast

Widely cited forecasts suggest that the total electricity demand of information and communications technology (ICT) will accelerate in the 2020s, and that data centers will take a larger slice.



The chart above is an ‘expected case’ projection from Anders Andrae, a specialist in sustainable ICT. In his ‘best care’ scenario, ICT grows to only 8 percent of total electricity demand by 2030, rather than 21 percent.

Source: <https://www.nature.com/articles/d41586-018-06610-y>

Chapter 1

DESIGNING A GREENER ACCESS NETWORK FOR GENERATIONS TO COME

A fast and secure broadband connection delivers digital technologies into homes that eliminate commutes, save energy, and develop smarter and cleaner ways to live our lives. This starts with developing broadband networks that are greener and more durable. At the same time, these new networks must be able to support high bandwidth use cases and rapidly shifting subscriber expectations.

Investors, regulators, and—increasingly—subscribers demand that BSPs have robust environment, social, and governance (ESG) initiatives in place. Therefore, a commitment to a green network should form a central part of a BSP's ESG framework. This commitment also means building a network that will last for decades.

For these reasons, XGS-PON networks are becoming the access technology of choice for BSPs. There are several reasons why these are more sustainable than traditional copper-based (coaxial) networks. They consume less energy, fiber optics are sourced from more sustainable materials, and are far more durable—lasting longer and requiring less maintenance (see resources).

Success Story

Blue Ridge Communications

Pennsylvania-based Blue Ridge Communications partnered with Calix to rebuild its entire cable (DOCSIS) network with fiber-to-the-home (FTTH).^{vi} Following a successful test deployment in Westfield, Pennsylvania, Blue Ridge commenced a multi-year project to rebuild 8,000 miles of Blue Ridge's existing cable plant with XGS-PON. The goal is to cover its entire footprint with XGS-PON, offering symmetrical speeds many times faster than possible.

Blue Ridge is realizing OPEX savings of up to 50 percent by working with Calix. These savings are driven by an up to 90 percent reduction in energy consumption compared to its previous network—making the new network more cost-effective and environmentally friendly.

“We believe the need for speed and bandwidth will continue to increase as more and more people work, learn, and are entertained at home. Fiber allows for ultra-fast symmetrical speeds, increased network reliability, as well as the added environmental benefits of lower power consumption. It is the next logical step in the evolution of our network.”

Mark Masenheimer, VP of operations, Blue Ridge Communications

So how should BSPs approach designing and building new fiber-based, sustainable and future-proof networks? The key is to move towards a fully software-defined network that provides the building blocks to build, automate, and scale green broadband networks for years to come.

To realize these objectives, BSPs must deploy subscriber-facing networks that allow them to manage a distributed design effectively and efficiently. To do so, they need a modular architecture that supports a common service model, in which the hardware and services abstraction layers are independent of one another.

Meanwhile, consistent service models and workflows are required to simplify operational tasks, build end-to-end orchestration and management, and integrate workflows to further reduce operating expenses. This sustainable network infrastructure will allow BSPs to incorporate future technologies into the networks they use today, avoiding the need for costly upgrades further down the line.



Chapter 2

THE BUILDING BLOCKS YOU NEED TO GO GREEN

Designing a sustainable and future-proof green network starts with the Calix Intelligent Access EDGE™ platform. This enables network design using an abstracted service layer, hardware independence, common service models and automated workflows, enabling a stateful, always-on operation.

By decoupling the hardware and software layers, the Intelligent Access Edge platform redefines the access edge of the network, enabling BSPs to build networks capable of delivering the ultimate subscriber experience.

Intelligent Access EDGE also simplifies the structure and operation of the network. By consolidating the network’s subscriber-facing functions into optional specialized software modules, BSPs can dramatically reduce the total cost of ownership (TCO) and the time it takes to bring new services to market.

On the hardware side, the Intelligent Access EDGE platform operates the Calix E-Series family of modular systems designed for specific deployment locations. These include the E9-2 (designed for data centers), the E7-2 (for smaller central office or remote cabinet locations), and

the E3-2 (for remote locations that are in environmentally challenged areas or where it is not financially viable to install a cabinet).

Calix provides a common operational model and workflow across the entire subscriber-facing network by running the Intelligent Access EDGE platform across the whole E-series family of systems. In addition, as new technologies (such as XGS-PON) are incorporated into the systems, the operational model remains the same—reducing the time it takes to deploy new technologies and services from weeks and months to days.

Environmental Benefits Realized with Calix Systems

The Intelligent Access EDGE network with E9-2:

- Eliminate 10 or more systems from every region of the network; the E9-2 combines them all into a single unit.
- Reduce space and facility cooling requirements.
- Reduce power consumption by an average of 73 percent due to less equipment.
- Simplify operations by 85 percent, on average, by eliminating pieces of equipment.



The Intelligent Access EDGE access network with E7-2:

- Reduces space and facility cooling requirements.
- Reduces power consumption by an average of 50 percent.
- Offers twice the capacity thereby decreasing the number of systems needed to service subscribers by half.



The Intelligent Access EDGE access network with E3-2:

- Can be deployed anywhere—even outside in harsh environments without the need to shelter and provide heating or cooling.
- Delivers twice the 10G PON capacity thereby decreasing the number of systems needed to service subscribers by half.
- Requires 50 percent less power consumption per PON.
- Supports multi-PON capability to allow broadband service providers to simplify the transition from GPON to XGS-PON without requiring any hardware modifications to the E3-2 system—further reducing e-waste.



73% greener network architectures using Intelligent Access EDGE

- Eliminates more than 10 systems from every region of your network
- Reduces space and facility cooling required
- Reduces power consumption requirements by 73%
- Simplifies your operations by as much as 85%



Building the most efficient network isn't just about reducing the management and maintenance efforts required to operate the network. It also reduces the total footprint—space, power, and cooling resources required. Calix broadband service providers (BSPs) are deploying the greenest broadband networks.

52% Greener managed WiFi per home using Revenue EDGE

- One system—delivering Wi-Fi 6 to the whole home
- 93% of subscriber homes don't need a mesh unit
- Reduce subscriber power consumption by over 52% per home



We are in this together

Calix has consolidated our labs into the Calix Virtual Innovation LAB enabling our workforce to access the equipment needed from anywhere

- Eliminated 1 office building and reduces the footprint of 4 other office buildings
- Reduced power consumption of our facilities by 3 million kilowatts of power per year or 52% of our previous usage
- Eliminated the impacts of commutes on our environment since our teams can work from anywhere



50% Greener access networks using Intelligent Access EDGE

- Reduces power consumption requirements by 50%
- Reduces facility space required
- Reduces facility cooling required



Success Story

AcenTek

In its migration away from DSL, Minnesota-based AcenTek used the Intelligent Access EDGE platform, advanced routing module (ARm), and subscriber management module (SMm) to consolidate functions within the E9-2 system. As a result, the BSP reduced energy consumption in the access network by 73 percent.

“After 17 years of partnership, Calix continues to be an invaluable guide as we drive to fulfill our green power initiative. We’ve reduced our core routing power footprint by 73 percent by eliminating routing systems with the Intelligent Access EDGE E9-2 system. We’ve also increased network capacity and simplified operations and management.”

Ethan Webinger, chief operating officer, AcenTek.

AcenTek also cut energy consumption in the outside plant by eliminating high-power remote cabinets and outdated DSL systems. During the upgrade, it removed 113 remote cabinets and DSL systems and replaced them with as few as 10 central office-based E7-2 systems. Ultimately, this upgrade reduced network energy consumption by an additional 85 percent.

Chapter 3

DELIVERING A GREENER WI-FI EXPERIENCE IN THE HOME

The network does not end when it reaches the subscriber's premises—and neither should a BSP's commitment to offering subscribers environmentally-friendly solutions. Subscribers generally have as many as 22 devices on average in the home supported by their in-home Wi-Fi experience.^{vii} This could include additional mesh units or pods if the main internet gateway device cannot extend Wi-Fi throughout the home.

It's another area where energy and cost savings are being made. And it's why the Calix GigaSpire® BLAST Wi-Fi systems are designed to be the only system that the subscriber will need in the home. In fact, in 93 percent of deployments, one system is enough to ensure whole-home Wi-Fi coverage. This means subscribers do not need to install additional pods or extenders. As a result, subscribers can reduce the power requirements of their in-home Wi-Fi by 50 percent or more.

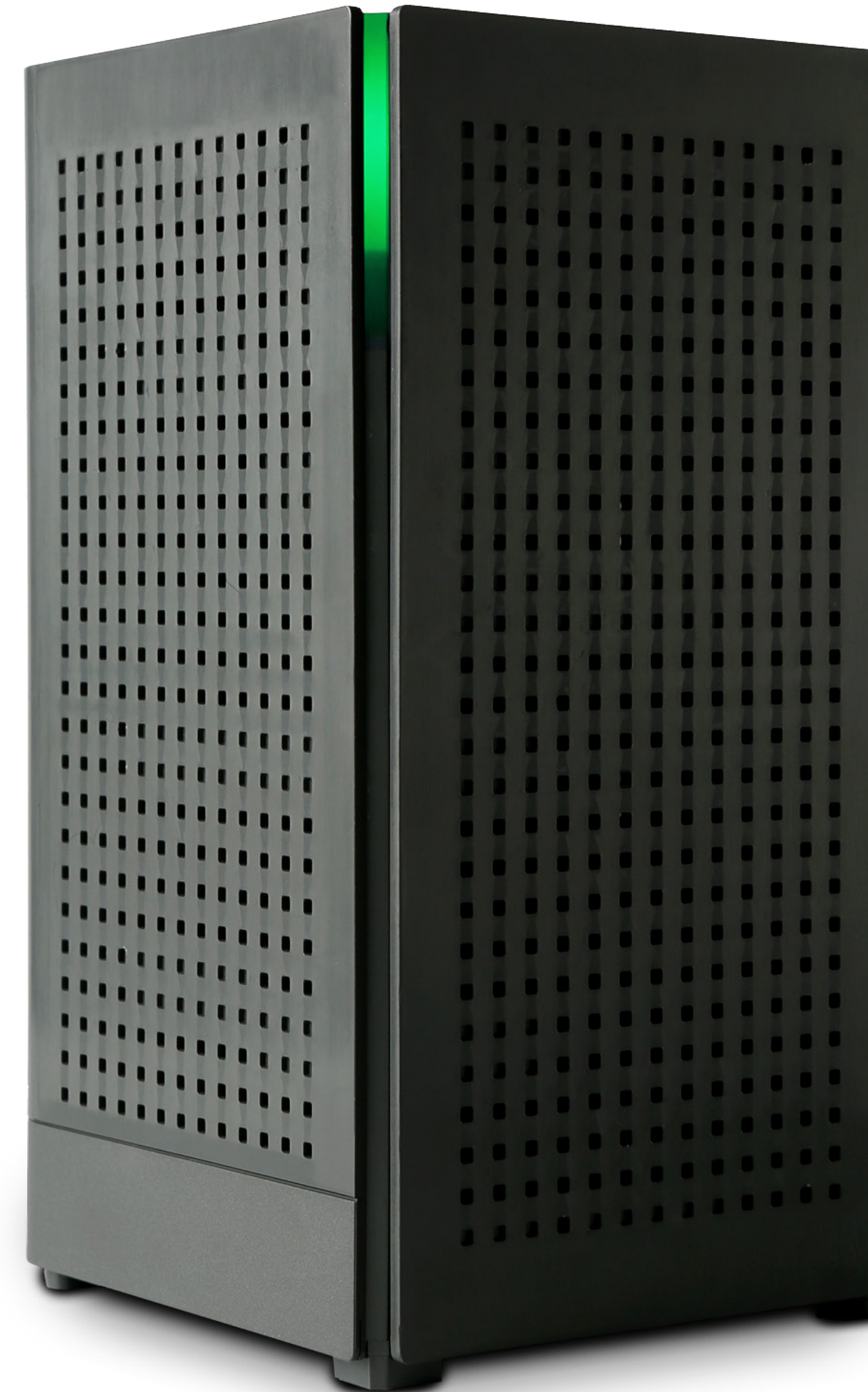
Every system in the GigaSpire BLAST portfolio delivers carrier-class reliability and performance. It will be the only system subscribers may need for many years, minimizing supply chain and stock control issues. The GigaSpires are managed by the BSP using Calix Support Cloud enabling comprehensive remote troubleshooting with minimal on-site support, meaning fewer truck rolls to fix or replace equipment. And subscribers are empowered to self-serve through the CommandIQ App.

Seamlessly Migrate to New Wi-Fi Technologies

Based on the Revenue EDGE platform, the GigaSpire BLAST family incorporates the latest technologies, such as Wi-Fi 6E, the new Wi-Fi standard that takes advantage of the newly available 6 GHz band. This delivers higher throughput, lower latency, increased network efficiency, and better performance in dense environments.

The new GigaSpire® BLAST u6me from Calix is the world's first carrier-class Wi-Fi 6E system. With the GigaSpire BLAST u6me, even the smallest BSPs can support subscribers wanting to be early adopters of leading-edge 6E-enabled devices without “ripping and replacing” existing systems.

Calix has recently expanded its portfolio of Wi-Fi 6E systems to include the new GigaPro™ u6he. The GigaPro u6he is a weather-hardened system that enables businesses and community organizations to offer outdoor Wi-Fi 6E services. By delivering seamless Wi-Fi coverage with SmartTown Wi-Fi and SmartBiz you blanket the community everywhere from patios and parks to farms and festivals with the same high-speed broadband experience your subscribers have at home.



Chapter 4

HOW CALIX IS LEADING THE WAY FOR A GREENER FUTURE

Over the past decade, Calix has invested over \$1 billion in developing platforms and solutions enabling BSPs to build sustainable broadband networks.

By developing green broadband solutions, Calix is taking advantage of a unique opportunity to respond to the climate change emergency. However, our commitment to environmental sustainability does not end with providing our customers with green solutions. Like every major corporation, we must also look at our own activities to see how we can make a difference.

Calix prioritizes sustainability across all departments in a commitment to reduce our carbon footprint. For example, we have consolidated all our labs into one Calix Virtual Innovation Lab, enabling the workforce to work on projects from wherever they are in the world.

By deploying this model, Calix has significantly reduced the carbon footprint at four office buildings—and eliminated one physical office building altogether. As a result, Calix has reduced annual power consumption across its facilities by 3 million kilowatts of power per year, a 52 percent year-on-year reduction. The initiative has also eliminated the environmental impact of employee commutes, since all teams can work remotely. A recent study outlined that GHG emissions can be reduced by 54 million tons if telework-compatible employees work from home just half of the time.^{viii}

Calix continues to explore and implement initiatives to reduce its carbon footprint. This includes holding our supply chain to high standards and encouraging robust ERG programs for partners, vendors, and suppliers.



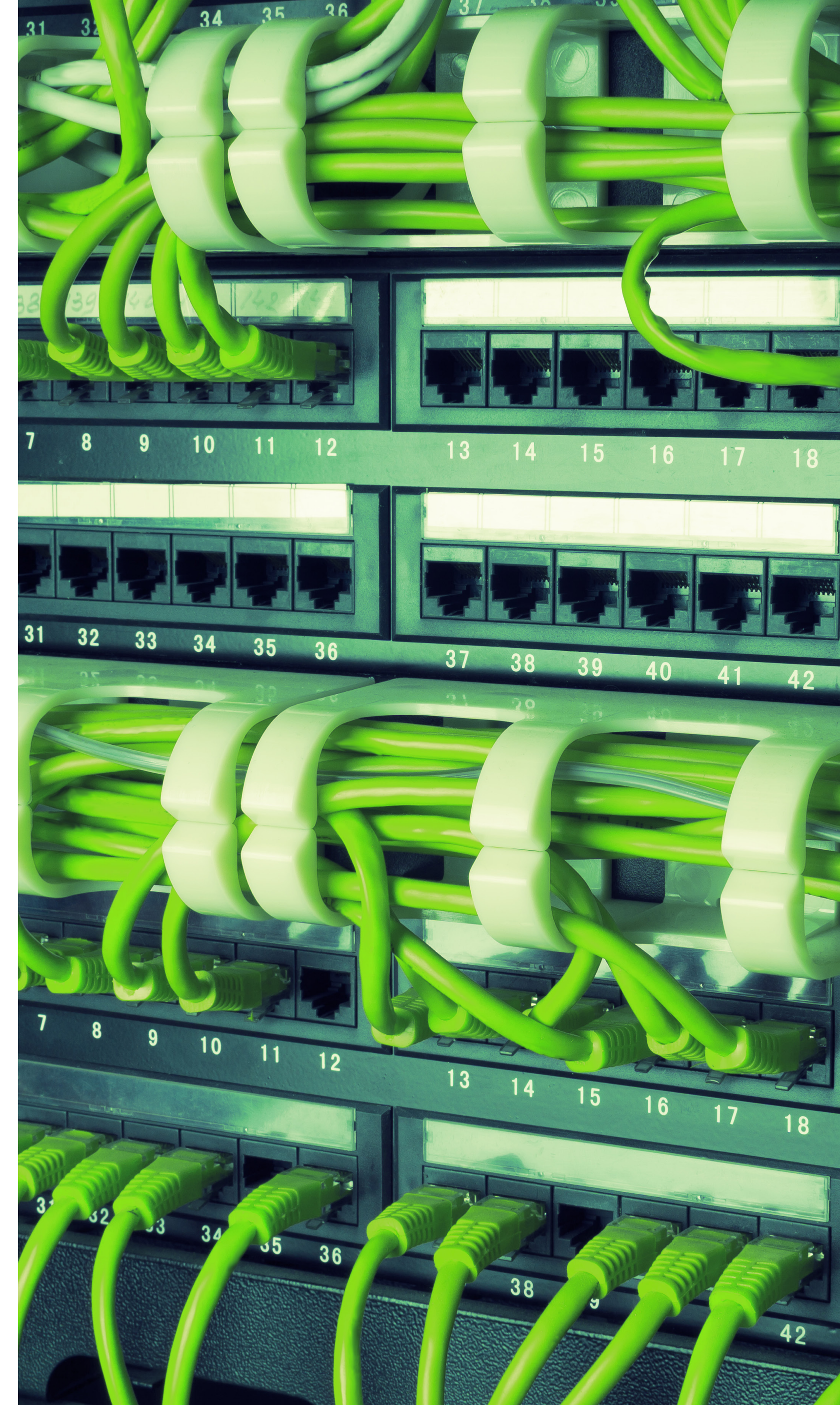
WHY GO GREEN WITH CALIX?

Broadband service providers can realize various environmental and business benefits by reducing the physical space, power consumption, and cooling resources required to run their networks.

The Intelligent Access EDGE platform makes it easy to deploy simplified, highly efficient networks that reduce the need for management and maintenance. Meanwhile, within the home, Calix is developing customer premises equipment (CPE) that cuts the number of devices—and energy required—to deliver superior Wi-Fi performance.

There is still much to do. We look forward to working with our customers, partners, and supply chain over the coming years to build a cleaner and more sustainable future today and for future generations.

Take your first step towards designing a smarter, greener network, and [schedule a consult](#) with Calix experts.

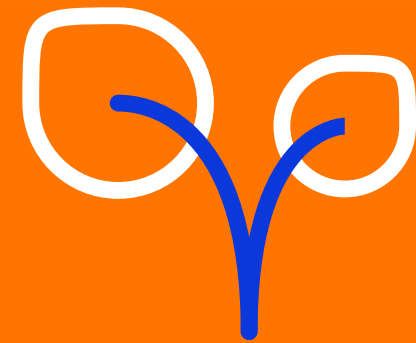


WHY PON IS THE RIGHT CHOICE FOR GREENER BROADBAND

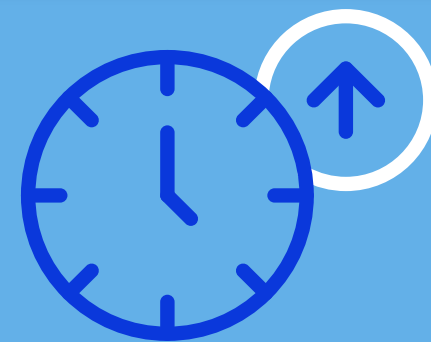
There are multiple reasons why PONs are more sustainable than traditional copper-based (coaxial) networks, including:^{ix}



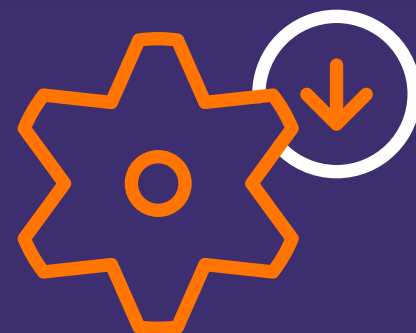
Less energy consumption. Because fiber networks transmit using light, they consume up to 12 times less energy than coaxial cables. Fiber uses a single watt to send data over 300 meters, while copper consumes 3.5 watts to send data just 100 meters.ⁱ Less energy usage also generates less heat, requiring fewer cooling systems.



Raw materials are more sustainably sourced. Mining for copper produces hazardous chemicals such as sulphur dioxide and sulfuric acid. By contrast, fiber is derived from silicon dioxide, a common element found in sand, rocks, and water.



A longer lifespan. A fiber network should last 25 years or more without needing replacement. However, it can be easily upgraded to support faster speeds during its lifespan.



Lower maintenance. Fiber is more resilient than copper to severe weather events such as flooding. Fiber networks also require fewer pieces of equipment that can fail. The result is fewer costly—and environmentally unfriendly—truck rolls to repair the network.

RESOURCES

- i) We Are Social 'More Than 5 Billion People Now Use the Internet'
<https://wearesocial.com/hk/blog/2022/04/more-than-5-billion-people-now-use-the-internet/>
- ii) Accenture '5G Connectivity'
<https://api.ctia.org/wp-content/uploads/2022/01/5G-Connectivity-A-Key-Enabling-Technology-to-meet-Americas-Climate-Change-Goals-2022-01-24.pdf>
- iii) The Shift Project 'The Unsustainable Use of Online Video'
<https://theshiftproject.org/en/article/unsustainable-use-online-video/>
- iv) Nature 'How to stop data centres from gobbling up the world's electricity'
<https://www.nature.com/articles/d41586-018-06610-y>
- v) Science Daily 'Emissions from computing and ICT could be worse than previously thought'
<https://www.sciencedaily.com/releases/2021/09/210910121715.htm>
- vi) Calix 'Blue Ridge Communications Announces the Beginning of a Complete Fiber-to-the-Home (FTTH) Rebuild of Its DOCSIS 3.1 Cable Systems Serving Rural Pennsylvanians'
<https://www.calix.com/press-release/2022/03-march--/blue-ridge-communications-announces-the-beginning-of-a-complete-.html>
- vii) Consumers Benefit From Virtual Experiences, but Need Help Managing Screen Time, Security and Tech Overload
<https://beyondtech.us/blogs/beyond-blog/how-fiber-optic-save-the-world>
- viii) 6 Surprising Environmental Impacts of Remotely Working from Home
<https://earth.org/environmental-impacts-of-remotely-working-from-home/>
- ix) Beyond Tech 'How will fiber optics save the world'
<https://beyondtech.us/blogs/beyond-blog/how-fiber-optic-save-the-world>