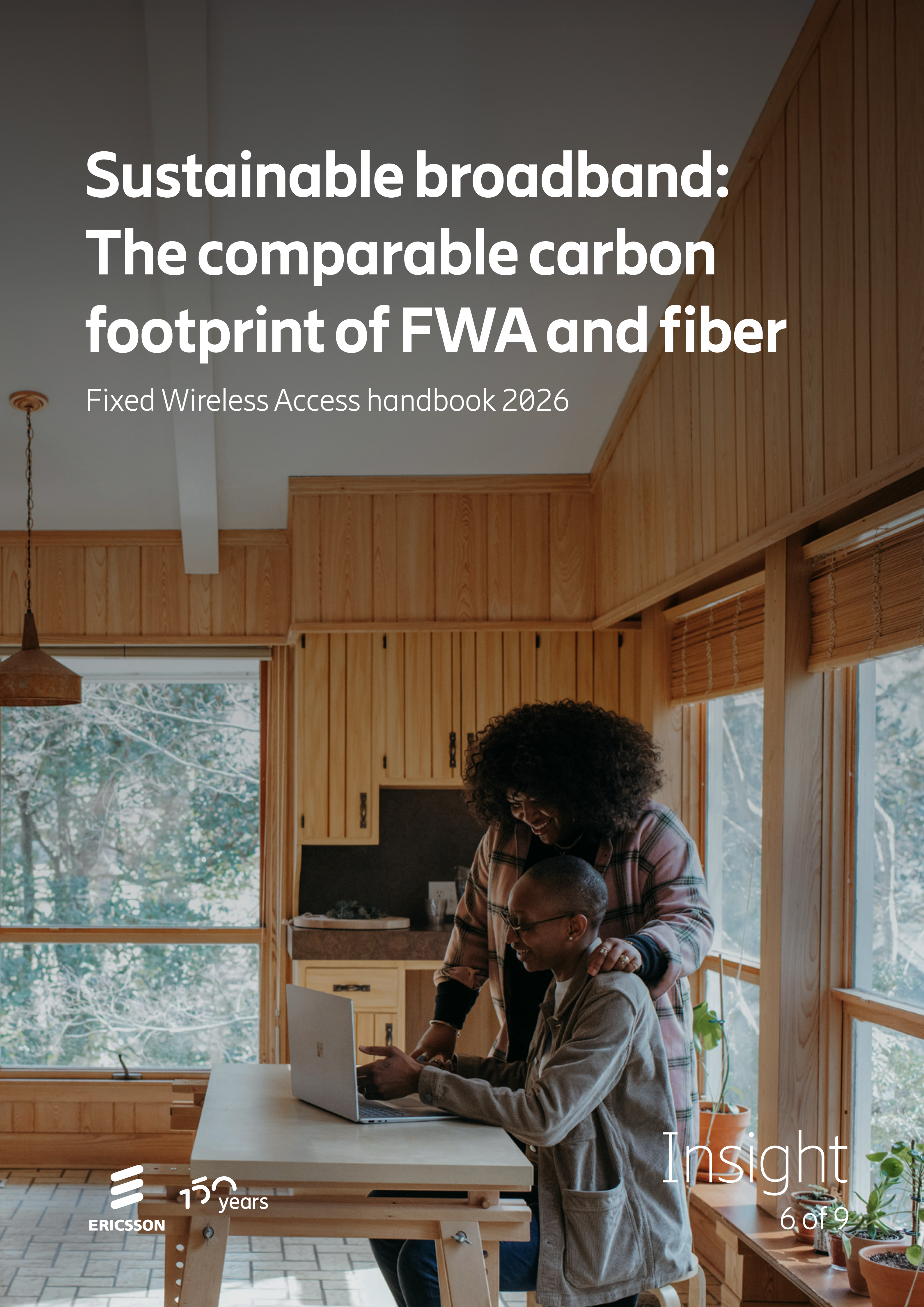
Sustainable broadband: The comparable carbon footprint of FWA and fiber

Fixed Wireless Access handbook 2026



ERICSSON

150 years

Insight

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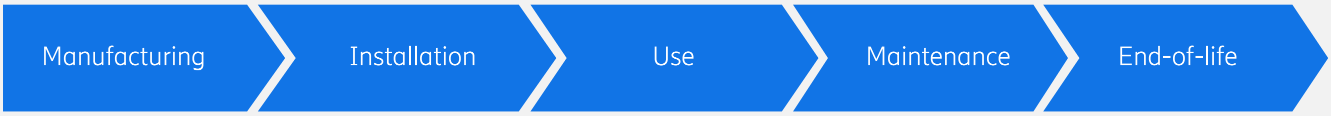
Study boundary, method and data sources

This study assesses and compares the full lifecycle carbon emissions of FiberToTheHome (FTTH) and 5G enabled Fixed Wireless Access (FWA) broadband at the household level.



Input data was sourced from:

1. Network equipment manufacturers (including Ericsson for FWA)
2. Life cycle inventories (e.g. ecoinvent)
3. Desk-based research and prior studies on network deployment
4. Interview validation with leading FWA and FTTH service providers

For over 20 years, the Carbon Trust has helped businesses, governments and public bodies decarbonize. We are global leaders in end-to-end life cycle carbon foot printing and contributors to the standards that underpin it.

Using a bottom-up lifecycle assessment approach, the analysis includes emissions associated with manufacturing, installation, use phase energy consumption, maintenance, and end-of-life disposal of network equipment. To enable meaningful comparison, results are expressed in $kgCO_2e$ per household per year, providing a consistent basis for evaluating environmental performance across different geographies and configurations.

Input data was sourced from a combination of lifecycle inventories such as ecoinvent, previous studies on telecommunications infrastructure, and manufacturer data. Ericsson contributed primary data for FWA radio equipment, while three fiber network operators supported validation of FTTH assumptions. The study defines a typical network structure for FTTH, recognizing that fiber architectures vary, and models realistic FWA receiver configurations across urban, suburban, and rural environments.

Key assumptions include that all households are connected to the assessed network type, CPE energy consumption remains constant over the study period, and infrastructure lifetimes are fixed. The analysis excludes core and backhaul networks, as these are largely common to both technologies and do not materially affect the comparison.

Overall, this approach ensures a comprehensive and transparent comparison of the emissions linked to last mile connectivity technologies, highlighting where emissions arise in the network lifecycle and establishing the analytical foundation for the results presented in the following slides.

This insight is an extract from the full report written by The Carbon Trust. The complete report is available at → www.ericsson.com/fwa or downloaded directly via the following link: → www.ericsson.com/4b092e/assets/local/networks/doc/comparing-the-carbon-footprint-of-ftth-and-fwa_report.pdf

"Last mile" focus and study boundaries

The study focuses exclusively on the emissions generated by the last mile access network and customer premises equipment (CPE) for FTTH and FWA.

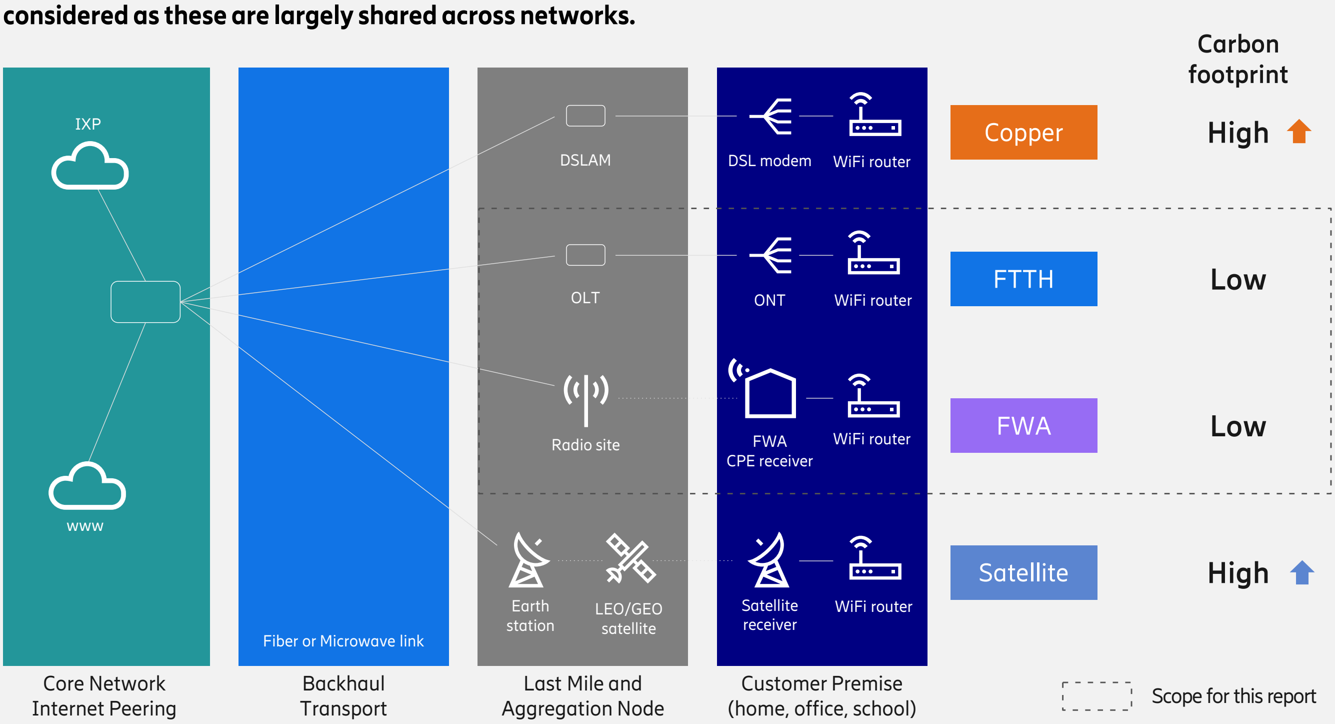
Core network and backhaul infrastructure are excluded because they serve all broadband users irrespective of access technology, and thus would not meaningfully differentiate the two solutions. By isolating the last mile, the analysis captures the components that vary most between FTTH and FWA—namely, fibre cables, civil engineering requirements, radio equipment, and CPE energy consumption.

For FWA, emissions within scope include the 5G baseband units, three radios deployed per site, and the various types of FWA receivers and associated WiFi routers. FWA site density varies significantly by geography, from 2.6 sites per km^2 in urban areas to just 0.15 in rural areas, reflecting the lower population density and reduced need for radio capacity.

For FTTH, the boundary encompasses Optical Line Terminals (OLTs), passive splitters, fiber optic cables, street cabinets, and installation activities. FTTH deployment requires physical cabling to each household, meaning the carbon footprint is heavily influenced by civil engineering methods, availability of ducts, and the length of fiber required—parameters that increase markedly as household density declines.

By focusing on these components, the study effectively highlights the defining environmental trade-offs: FTTH's extensive infrastructure requirements versus FWA's higher energy use in operation. This boundary choice allows clear insights into technology-specific emission drivers and the conditions under which each access method performs best.

Core and backhaul network infrastructure are not considered as these are largely shared across networks.



In collaboration with the Carbon Trust. Source: Carbon Trust White Paper - FTTH vs FWA Networks

Objective, functional unit and key parameters

The objective of this study is to provide fact-based insights into the comparative carbon performance of FTTH and FWA at the household level.

Rather than identifying a single superior technology, the goal is to illuminate the factors that most strongly influence emissions and guide sustainable broadband deployment decisions.

The comparison uses a functional unit of $kgCO_2e$ per household per year, enabling a standardized assessment of emissions across different geographies and network configurations. A 20 year analysis period is applied to reflect expected infrastructure lifetimes, with sensitivity analyses exploring shorter and longer timespans.

Several key parameters shape the comparative footprint:

- **Household density** strongly affects infrastructure needs. Urban areas (879 households/km^2) benefit from shared infrastructure efficiency, whereas rural areas (54 households/km^2) require substantially more cabling, civil engineering, and travel for installation teams.
- **Electricity grid carbon intensity** influences operational emissions, particularly for FWA, which has higher energy consumption in the use phase.
- **Network configuration** varies according to geography. FWA requires different receiver types—indoor units in cities, flexible or outdoor units in suburban and rural areas—while FTTH deployment methods range from narrow trenching and micro trenching to aerial installation or ploughing.
- **CPE specifications** are a dominant factor in emissions for both technologies, shaping manufacturing and energy use impacts.

This framework allows the study to attribute emissions fairly and explore how different real world conditions influence the total carbon footprint of FTTH and FWA networks.

Household density (households per km^2)

Urban = 879
Suburban = 227
Rural = 54

Timespan

20 years [1]

Electricity grid emissions intensity [2]

High = Germany
Medium = UK
Low = Sweden

Network configuration

Several factors, i.e. type of FWA receiver, civil engineering method used to install fiber optic cables, etc.

1. Recent research indicates that FTTH may last significantly longer: Fiber Broadband Association, 2024. Fiber Broadband Scalability and Longevity
2. Grid decarbonization was considered in line with International Energy Agency (IEA) scenarios from WEO (2024)

Emissions by lifecycle stage

The analysis shows that both FTTH and FWA experience rising per household emissions as deployment moves from urban to rural areas, though for different underlying reasons.

In all geographies, emissions are primarily driven by manufacturing and use phase electricity consumption.

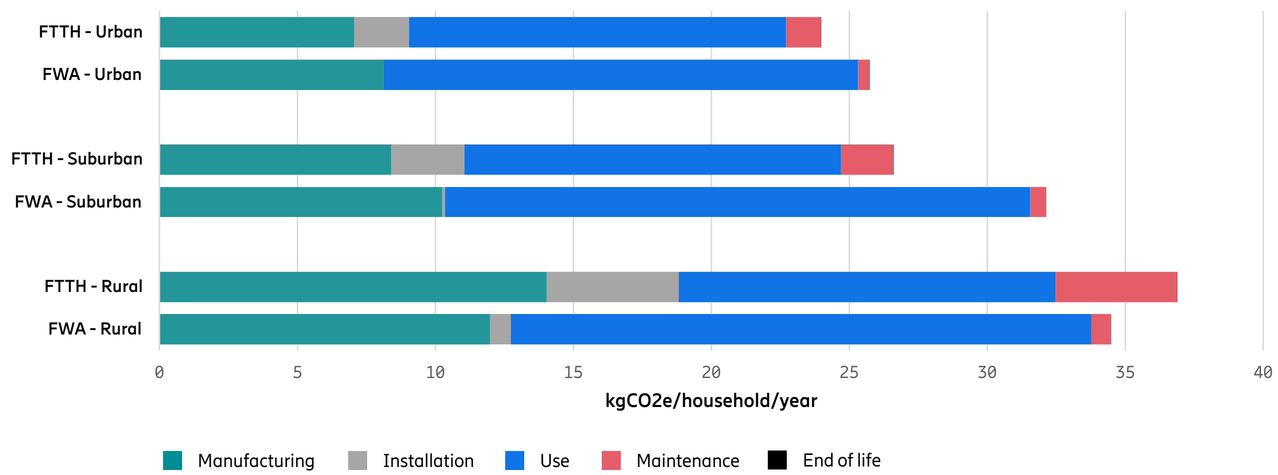
For FWA, increased emissions in suburban and rural areas reflect the need for more powerful or additional CPE equipment to maintain signal quality at greater distances from radio sites. Use phase emissions grow accordingly, as do manufacturing emissions for larger or outdoor receivers. Installation emissions also increase modestly in rural areas due to longer travel distances for engineers installing outdoor units.

FTTH displays a different pattern: while CPE use phase emissions remain stable across geographies, manufacturing and installation emissions rise significantly in lower density areas. Rural regions require longer fiber runs, more extensive civil engineering (including trenching or poles), and increased maintenance, all of which contribute to the higher carbon footprint observed.

Despite this increase, installation emissions are distributed across all connected households over a 20 year period, which helps moderate their per household impact. Still, installation and maintenance become more prominent contributors in suburban and rural FTTH deployments.

Overall, this lifecycle perspective highlights the contrasting emission drivers—FWA's equipment intensive profile versus FTTH's infrastructure intensive footprint—and underscores the importance of geography when assessing technology sustainability.

Comparison of results by lifecycle stage for each network and geography



Key findings:

- Annual per-household emissions increase from urban to rural areas for both FWA and FTTH.
- For FWA this is driven mainly by higher manufacturing and use-phase emissions from more powerful customer equipment in lower-density areas.
- For FTTH use-phase emissions are broadly consistent across geographies, with higher rural emissions driven by increased manufacturing (longer cables) and installation impacts over greater distances.

In collaboration with the Carbon Trust. Source: Carbon Trust White Paper - FTTH vs FWA Networks

Emissions by equipment type

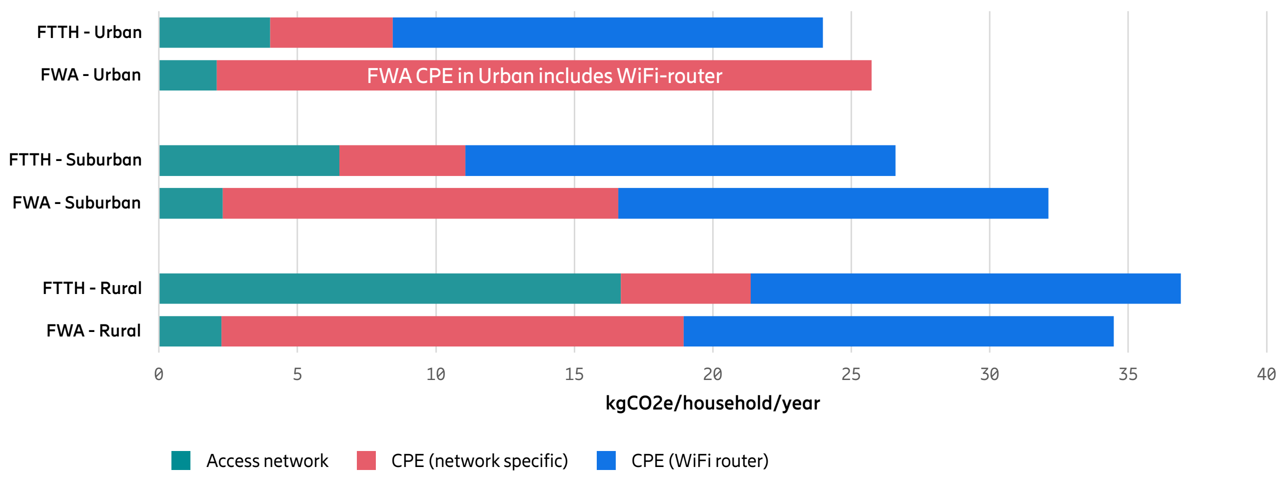
The study finds that Customer Premises Equipment (CPE) is the dominant source of emissions for both FTTH and FWA across all geographies, yet the nature of the CPE differs substantially between the two technologies.

For FWA, CPE configurations vary with signal conditions. In urban areas, households use integrated indoor receivers that combine FWA and WiFi functions. These units have higher energy consumption and greater embodied emissions, making urban FWA CPE particularly carbon intensive. Moving to suburban and rural areas, FWA shifts to flexible or outdoor receivers paired with standalone WiFi routers. Although outdoor receivers are more energy efficient, total CPE emissions rise in rural deployments because additional equipment is required, and outdoor units carry higher embodied carbon. Meanwhile, emissions from the FWA access network (radios and basebands) remain relatively stable across geographies and contribute only 6.5–8.1% of total FWA emissions.

For FTTH, access network emissions show strong geographic variation because fibre cable lengths and civil engineering needs increase significantly in less dense areas. However, FTTH CPE emissions remain consistent, using the same ONT and WiFi router regardless of geography. CPE represents 55–83% of total FTTH emissions, depending on household density.

These findings underscore that while FTTH's infrastructure demands drive variability in emissions, FWA's emissions are shaped primarily by the type and performance of CPE deployed. Across both technologies, improving CPE energy efficiency and lifespan offers the most direct and scalable pathway to emission reductions.

Comparison of results by equipment type for each network and geography



Key findings:

- CPE dominates per-household emissions for both FWA and FTTH across all geographies.
- FWA emissions increase from urban to rural areas due to higher CPE requirements, including additional routers and outdoor receivers.
- FTTH emissions increase from urban to rural areas due to higher access network impacts, driven by longer fiber runs and civil engineering.

Key takeaways: Location, CPE, grid intensity and hybrid approach

The study highlights that location is critical in determining whether FTTH or FWA offers the lower carbon solution.

In urban and suburban areas with medium carbon electricity grids, FTTH generally performs slightly better because fiber infrastructure can be shared efficiently among many households. In contrast, in rural environments where FTTH requires extensive civil engineering and longer cable distances, FWA often results in lower emissions.

A central conclusion across all geographies is the **dominant role of CPE**. Whether using ONTs and WiFi routers for FTTH or integrated/flexible/outdoor receivers for FWA, CPE accounts for the majority of per household emissions. Energy consumption, device weight, embodied carbon and replacement cycles drive this impact. Ensuring more energy efficient, longer lasting CPE therefore represents one of the largest opportunities for emissions reduction.

The analysis also demonstrates that **electricity grid carbon intensity** significantly affects results. FWA is more sensitive to grid carbon intensity than FTTH due to its higher operational energy consumption. As grids decarbonize, differences in emissions between the two technologies shrink, and in some scenarios FWA may outperform FTTH even in suburban areas. Conversely, in high carbon electricity markets, FTTH has a structural advantage during the use phase.

Ultimately, the study concludes that a **hybrid approach**, deploying FTTH or FWA based on local conditions, delivers the most sustainable broadband evolution. This strategy combines the deployment speed and flexibility of FWA with the long-term efficiency of FTTH, ensuring climate aligned connectivity expansion tailored to geographic and infrastructural realities.

Location matters

The carbon performance of FTTH and FWA is highly dependent on local conditions. Generally, FTTH has a slightly lower carbon footprint in cities, and FWA in rural areas.

The role of CPE

Customer Premise Equipment (CPE) is the main source of household-level carbon emissions (that arise from last mile network) across both FTTH and FWA.

Electricity gridcarbon intensity

The carbon intensity of the electricity used to power FWA and FTTH networks significantly impacts environmental performance. The relative sustainability of each technology can shift as grids become cleaner.

Hybrid path forward

Differences between FTTH and FWA in per-household carbon emissions are marginal, making a hybrid approach sensitive to local conditions the most practical and environmentally sound path forward.

In collaboration with the Carbon Trust. Source: Carbon Trust White Paper - FTTH vs FWA Networks

Key actions to reduce broadband emissions

Reducing the carbon footprint of broadband access requires targeted interventions across the full lifecycle of FTTH and FWA networks, with the most significant opportunities centered around CPE and infrastructure deployment.

First, operators should deploy networks based on local conditions, selecting FTTH, FWA, or hybrid models according to household density, grid carbon intensity, and existing infrastructure. This prevents unnecessary emissions from fiber deployments in areas where FWA provides comparable service with lower carbon impact, while still leveraging FTTH efficiency in dense areas.

Second, CPE should be the primary decarbonization focus. Improving the energy efficiency of WiFi routers, ONTs, and FWA receivers can materially reduce household level emissions, given that CPE accounts for the majority of total footprint for both technologies. Extending device lifespans, improving repairability, and lowering embodied carbon through material and manufacturing enhancements contribute additional reductions.

Third, deployment related emissions should be minimized. Reusing ducts, poles, and existing infrastructure where possible avoids the heavy carbon cost associated with civil engineering, particularly in rural FTTH deployments. Avoiding the installation of new utility poles and prioritizing trenchless installation techniques further reduces upstream emissions.

Fourth, operators should phase out older, high carbon technologies such as copper based DSL networks. Transitioning users to FTTH or FWA reduces operational energy consumption and improves system level efficiency.

Finally, broadband planning should align with expected grid decarbonization pathways, maximizing the long-term emissions benefit of cleaner electricity. By combining smarter deployment choices, efficient CPE, and infrastructure reuse, network operators can significantly reduce the environmental impact of broadband expansion.

Migrate away from technologies with a high Carbon footprint

Migrate away from technologies with a high Carbon foot-print, e.g., decom-mission copper/DSL networks.

1

Deploy networks based on local conditions

Use FTTH, FWA, or hybrid approaches according to density, grid carbon intensity, and existing infra-structure rather than a one-size-fits-all strategy.

2

Target CPE as the primary decarboni-zation lever

Improve the energy efficiency, embodied carbon, and lifespan of routers, ONTs, and FWA receivers to achieve the largest emissions reductions.

3

Minimize deploy-ment-related emissions

Reuse existing ducts, poles, and sites wherever possible and avoid carbon-intensive civil engineering, particularly in low-density areas. forward.

4

Plan for long-term, low-carbon operation

Extend asset lifetimes and align broadband rollout with electricity grid decarbonizsation to reduce lifecycle emissions over time.

5

DSL decommissioning by Telenor Norway

Fixed Broadband (FBB) Net Adds
During 2021 and 2022

21GWh /year

By end of October 2023, Telenor been able to turn off electricity equal to consumption of 21 GWh /year.

Challenge: Decommissioning 18 percent of broadband connections

Copper networks are unable to meet the need for speed, stability and capacity for broadband services. They have high operating costs due to high power consumption, many faults, customer churn and maintenance costs. Many of remaining 18 percent (136,000) DSL lines are in rural areas, where replacement costs with fiber increase significantly.

Solution: A mix of 5G FWA and fiber

Replacement of copper-based broadband (DSL) with a mix of fiber and Fixed Wireless Access (FWA). Telenor and Ericsson partnered to deploy 5G with commercial launch in 2020. During 2021 and 2022, Telenor added 51,000 FWA and 60,000 fiber broadband connections.

Result: Major savings in maintenance and electricity costs

Telenor's copper network has accounted for approximately half of the electricity consumption of Telenor's infrastructure. With the decommissioning of all its own customers on the copper network in December 2022, Telenor will have major savings in maintenance and electricity costs. In connection with the clean-up of the copper grid, Telenor has by end of October 2023 been able to turn off electricity corresponding to an annual consumption of 21 GWh. This is as much as the average annual consumption for 1050 Norwegian detached houses. Most of the energy savings come from power cuts on tele-technical equipment at the largest control panels. The remaining wholesale customers on the copper network will continue with services for decommissioning by 2025.

Source: Ericsson analysis based on public service providers information

Read all nine insights on capturing the value of 5G FWA

ericsson.com/fwa-insights

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