Digital solutions for a sustainable future:

TELUS' avoided GHG emissions framework

Document prepared for TELUS by
Roland Berger and Agendi
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Executive summary.

The telecommunications industry and broader Information and Communication Technology (ICT) sector are at a critical juncture. In a world where economic advancements and climate goals often find themselves at odds, digital innovations and connectivity hold the key to greenhouse gas (GHG) emissions reduction in every sector – from smart manufacturing, connected vehicles, Precision Agriculture, to virtual healthcare and remote working.

At TELUS, we leverage technology to tackle the world's most urgent social issues and enable remarkable human outcomes. We're committed to investing in businesses and communities to restore our environment and promote a sustainable economy.

Through our world-leading technology, extensive networks and diverse product portfolio, TELUS enables significant carbon emissions avoidance in Canada and beyond, demonstrating how telecommunications can drive sustainability impact across multiple sectors of the economy. By facilitating tele-operations (e.g., remote work, teleconferencing), TELUS connectivity helps team members and customers live, work and learn from anywhere while avoiding the GHG emissions from commuting or travelling that would otherwise take place. For households, TELUS SmartHome and TELUS SmartEnergy offer home automation solutions, helping families reduce their home energy consumption while adding security and convenience in their daily lives. Our commitment to product refurbishment and recycling helps our mobile customers make sustainable choices when selecting products that best reflect their environmental values. TELUS Health's products enable practitioners and patients alike to reduce their carbon footprint while facilitating access to healthcare. TELUS Agriculture & Consumer Goods' proprietary solutions help farming communities reduce fertilizer usage and optimize emissions of farm animals, while increasing yield and efficiency in their farms and feedlots. TELUS' Cold Chain solution also tackles food waste through intelligent monitoring of produce during transport. Through all of these products and services, we continue to harness technology for a more sustainable and connected future.

The concept of avoided emissions has become increasingly important as organizations continue to realize that:

> "Company contributions to global mitigation of greenhouse gas (GHG) emissions should not be limited to reducing their own and value chain GHG emissions, but should also strive to accelerate global decarbonization efforts by delivering additional solutions that are compatible with a 1.5°C pathway and enabling others to reduce emissions as well."
>
> **World Business Council for Sustainable Development, Guidance on Avoided Emissions (2023).**

To better understand and broaden our impact on global decarbonization beyond our own operations and value chain, TELUS worked with Roland Berger and Agendi. Together, we quantified the carbon emissions avoided through these products and services using a science-based, transparent and credible methodology.

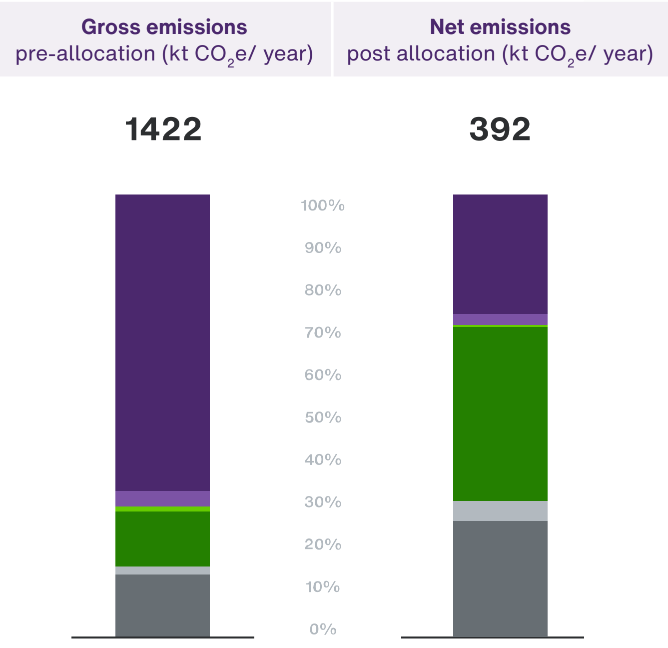
Among the many technological solutions we provide that enable our customers to reduce their GHG emissions, a wide range of use cases were identified, from telehealth and tele-operations to circular economy and precision agriculture.

The results of this methodology demonstrate TELUS' industry-leading efficacy in enabling sustainability impacts. Through our comprehensive and transparent approach to measurement, TELUS enables our customers to avoid GHG emissions at a rate of 7.6x of our own operational (i.e., Scope 1 and 2) emissions annually. This factor, combined with our diverse cross-sector solutions, not only outpaces global peers but is also expected to strengthen as we continue to reduce our operational emissions while growing our customer footprint for these key products and services. In 2024, TELUS enabled gross avoided emissions of more than 1.4 million metric tonnes (Mt) of carbon dioxide equivalent (CO_2e) – equivalent to planting a natural forest of 56 million trees, which could cover the size of a city such as Ottawa. If we take into account other factors, such as unintended increases in emissions as a result of the use of TELUS products and services (i.e., rebound emissions), as well as the proportional share of our contribution to the solution relative to other value chain participants, TELUS' net enablement factor in 2024 was 2.1x - resulting in 392 kilotonnes (kt) CO_2e avoided, equivalent to 855,049 round-trip flights between Toronto and Vancouver[1]. These metrics, derived through increasingly rigorous calculation methods, set new benchmarks for credible sustainability reporting in the telecommunications sector while demonstrating our commitment to transparent impact measurement. Our aim is to empower organizations to measure and maximize their positive climate impact by sharing this methodology. Through our digital solutions, we're not just reducing emissions, but enabling transformative change across industries and communities. By quantifying the full potential of our solutions, we're working to drive more informed decision-making and accelerate the transition to a low-carbon economy.

1 Source: ICAO Carbon Emissions Calculator (ICEC)

Figure 1. Summary of 2024 avoided emissions by TELUS product use case

Application	Use case and avoided emissions
Tele-operations	**1** Teleconferencing **2** Online business and commercial ops. **3** Full remote work **4** Hybrid work **5** E-billing
Tele-health	**6** MyCare **7** Non MyCare telehealth **8** Virtual Pharmacy
Phone refurbishment	**9** Device Care Complete (DCC) **10** Certified Pre-Owned (CPO)
Agriculture and related fields	**11** Precision Agriculture **12** Feedlot Management **13** Cold Chain
Home automation	**14** SmartHome **15** SmartEnergy
Business solutions	**16** Private Wireless Networks **17** Fleet Management Solutions



This figure illustrates TELUS' avoided emissions at both gross (pre-allocation) and net (post-allocation) levels. Net values reflect the application of role-based allocation – a methodology used to distribute avoided emissions claims across different technology providers based on their contribution. The colour-coded segments represent the relative contribution of each application category (e.g., tele-operations) to TELUS' total avoided emissions. Note that this visualization includes only those applications where avoided emissions have been quantified using TELUS' methodology.

Introduction

Introduction

As the world becomes more connected than ever in history through digital innovation and connectivity, the global information and communications technology (ICT) sector, particularly the telecommunications industry, is at the forefront of tackling one of the greatest challenges of our time – climate change. According to a report by the Global e-Sustainability Initiative (GeSI)[2], ICT solutions have the potential to reduce global emissions by up to 20% by 2030 (from 2015 levels), while generating more than $11 trillion US in economic benefits per year. The largest environmental and economic benefits can be seen in smart manufacturing, precision agriculture, smart buildings, smart energy, connected logistics and transportation, as well as lifestyle changes such as remote work, e-commerce, telehealth and e-learning. Additionally, the global ICT sector accounted for 60% of renewable power purchases in 2021[3], which further demonstrates the sector's commitment to GHG emissions reduction, despite its relatively small carbon footprint compared to other sectors (less than 3% of global emissions). Within ICT, the telecommunications industry stands out as the smallest emitter (compared to device manufacturing and data centres[4]), claiming less than a quarter of ICT emissions, while enabling transformational digital solutions through connectivity. These developments are testaments to the industry's role as a leading contributor in the global transition to low-carbon economies.

Within this context, companies such as TELUS amplify the sector's impact on broader decarbonization by extending beyond traditional telecommunications, enabling emissions reductions across multiple industries while maintaining the sector's characteristically small environmental footprint.

TELUS is a leading global communications technology company dedicated to providing a wide range of innovative solutions, including wireless, data, IP, voice, television, entertainment, video and security services in more than 30 countries. Central to TELUS' corporate strategy is its social purpose and commitment to sustainability, including ambitious goals to achieve carbon neutrality in its operations by 2030 and net-zero emissions across its value chain.

As a global leader in sustainability, TELUS has developed its own Avoided Emissions Methodology to quantify the impact of its products and services, building on existing internationally recognized frameworks and peer publications. The methodology outlined in this document leverages leading guidance from organizations such as the World Business Council for Sustainable Development (WBCSD), the World Resources Institute and the GHG Protocol, to develop an industry-specific approach that has been further refined through peer validation with major industry players and collaboration with internal and external experts.

Through this comprehensive and collaborative approach, TELUS is contributing to the evolution of industry standards, helping telecommunications companies more effectively measure and maximize their role in global decarbonization efforts. TELUS' approach to measuring avoided emissions emphasizes balanced allocation by determining a company's contribution based on the role its products play in enabling emissions reductions (following the ITU's guidance), covering varying levels of impact. This not only reflects the growing industry consensus on the need for greater transparency in avoided emissions reporting, but addresses potential concerns of fairness and defensibility of claims. By coupling this balanced allocation methodology with a comprehensive portfolio, TELUS provides a blueprint for how the ICT sector can maximize and credibly report sustainability impact across multiple industries.

2 GeSI and Accenture Strategy. #SMARTer2030 ICT Solutions for 21st Century Challenges. 2015.

3 The World Bank and ITU. Measuring the Emissions & Energy Footprint of the ICT Sector: Implications for Climate Action. 2024.

4 Bieser et al. A review of assessments of the greenhouse gas footprint and abatement potential of information and communication technology. 2023.

Methodology

2. Methodology

2.1 Development of the methodology

Avoided emissions is defined by WBCSD as the ‘positive impact on society when comparing the GHG impact of a solution to an alternative reference scenario where the solution would not be used.’

While avoided emissions reporting has emerged as a leading practice among ICT sector players, there does not currently exist a standardized methodology that is applicable to and adopted by all industry participants. To align with leading global practices, we have conducted an extensive review of existing publications from industry peers, academic institutions, industry organizations and governing bodies[5]. Furthermore, the methodology follows a value chain allocation approach to ensure all contributors in each solution are fairly acknowledged and credited, avoiding overstating TELUS’ impact.

TELUS maintains awareness of industry and regulatory guidance in sustainability claims throughout the development of this methodology. These active considerations indicate informed decision-making and align with TELUS’ commitment to accurate and transparent disclosures with a robust, conservative and replicable methodology.

TELUS continues to commit to supporting a broader net-zero transition through its diversified portfolio of consumer, business, agriculture and health solutions, demonstrating the expanding role of telecommunications in enabling cross-sector sustainability transformation.

The TELUS Avoided Emissions Methodology is in alignment with the most relevant existing standards:

- The selected TELUS use cases are consistent with case studies and recommendations highlighted in ITU-T L.1480 Annex A.1.
- Data inputs for quantification are chosen to reflect TELUS’ specific products and services, geographies of operations, customer base and use-case scenarios following WBCSD’s key principles outlined in Guidance on Avoided Emissions.
- The building blocks of net avoided emissions calculations are broadly consistent with the definitions and recommended calculation methodologies developed by GeSi, GSMA, ITU and WBCSD, and those adopted by communication technology peers across Europe, North America and Australia.
- The allocation of avoided emissions impact among various enabling technology providers consists of two components:
    - The categorization of industry contributors and the role-based allocation approach follow the ITU’s definition of contribution levels (A, B and C). In line with this framework, the “100% rule” is applied, ensuring that the combined contributions of all three levels sum to 100%.
    - The percentage allocation of different levels of contribution is consistent with GIC/Schroders’ framework where estimated economic value-add of industries is used as a proxy. This approach was adopted to avoid false precision while ensuring a fair estimate of TELUS’ contribution in any given product use case, compared to other solution providers involved in enabling the same use case.

5 Full list of references in Appendix 1.

The main references used during the development of this methodology are the following:

- International Telecommunication Union. Enabling the Net Zero Transition: Assessing How the Use of Information and Communication Technology Solutions Impact Greenhouse Gas Emissions of Other Sectors. ITU-T L.1480, December 2022
- Mission Innovation. The Avoided Emissions Framework (AEF). September 2020
- Global e-Sustainability Initiative. Evaluating the Carbon Reducing Impacts of ICT. November 2010
- GSMA. The Enablement Effect: The impact of mobile communications technologies on carbon emission reductions. December 2019
- Government of Singapore Investment Corporation, Schroders. A Framework for Avoided Emissions Analysis: Uncovering Climate Opportunities Not Captured by Conventional Metrics. November 2021
- World Business Council for Sustainable Development and Net Zero Initiative. Guidance on Avoided Emissions: Helping Business Drive Innovations and Scale Solutions Towards Net Zero. March 2023
- GIC, Shroders. A Framework for Avoided Emissions Analysis: Uncovering Climate Opportunities Not Captured by Conventional Metrics. November 2021
- Goldman Sachs. How Quantifying Avoided Emissions can Broaden the Decarbonization Investment Universe. July 2023

2.2 Guiding principles

The TELUS Avoided Emissions Methodology follows WBCSD and Net Zero Initiative's guidance on avoided emissions reporting by following five guiding principles:

- **Ensure company strategies are aligned with the latest climate science and global climate goals.** TELUS is committed to its net-zero ambition and the Avoided Emissions Methodology represents the company's latest efforts in broadening its scope of climate impact reporting.
- **Prioritize the reduction of GHG emissions across the value chain.** Scope 1, 2 and 3 emissions reduction is a top priority for TELUS. Measuring and reporting avoided emissions do not take precedence over TELUS' commitments and efforts in emissions reduction within the company's own value chain.
- **Separate reporting of inventory and avoided emissions.** Avoided emissions are reported separately from Scope 1, 2 and 3 GHG emissions and will not be used to offset TELUS' GHG inventory emissions.
- **Emphasize the long-term viability of solutions.** All solutions considered in the avoided emissions report are compatible and consistent with the global net-zero ambition.
- **Deliver actionable recommendations.** The report aims to provide actionable insights to help TELUS expand the enablement impact on its customers in avoiding GHG emissions through the use of TELUS solutions and further contribute to global decarbonization goals.

2.3 Methodology overview

The TELUS Avoided Emissions Methodology consists of three core steps:

1. Selection of relevant TELUS product and service use cases.
2. Quantification of gross avoided emissions, rebound emissions and net avoided emissions as the aggregated impact of both gross avoided emissions and rebound emissions.
3. Attribution of net avoided emissions based on the role TELUS' products and services play in the use case, according to the value chain allocation approach.

Selection of use cases

The selection of TELUS product and service use cases follows the three" eligibility gates" criteria outlined by WBCSD. A comprehensive list of 25 use cases was first developed to represent the most impactful areas where TELUS solutions have the greatest opportunity in enabling avoided emissions. The relative size of the customer base and revenue figures for these solutions were also considered to ensure that the quantified results and use cases taken into consideration reflect TELUS' core business portfolio as a whole. Baseline scenarios were chosen to represent the most likely alternative in the absence of the TELUS-enabled solution at the time of the methodology development.

Figure 2. WBCSD three eligibility gates

Climate action credibility

The company has set and externally communicated a climate strategy consistent with the latest climate science. This strategy includes robust GHG footprint measurement, science-based targets covering Scopes 1, 2 and 3, and transparent reporting on progress on a regular basis.

Latest climate science alignment

The solution (or end-solution of the intermediary solution) has mitigation potential according to the latest climate science and recognized sources, and is not directly applied to activities involving exploration, extraction, mining and/or production, distribution and sales of fossil fuels.

Contribution legitimacy

The solution has a direct and significant decarbonizing impact.

Building blocks of the calculation

Calculations of avoided emissions are determined on a use-case basis. For each use case of TELUS solutions, the net avoided emissions impact is quantified using gross avoided emissions, rebound emissions and an allocation factor representing TELUS' contribution in the enablement effect.

- **Gross avoided emissions:** The reductions in GHG emissions that occur outside of a product's life cycle or value chain but as a direct result of using that product. For example, avoided GHG emissions from eliminated commutes and petroleum consumption are a result of remote work.
- **Rebound emissions:** The unintended increase of GHG emissions through the use of the product, which partially offset the gross avoided emissions. For example, while remote work mitigates certain GHG emissions from commuting, it can lead to increased home energy consumption and may involve emissions related to the operation of telecommunications equipment used for virtual meetings. These various factors are considered in the overall rebound effect calculation.
- **Net avoided emissions:** The net effect of gross avoided emissions, subtracting any rebound emissions.
- **Allocation factor:** The contribution of TELUS in enabling an end-to-end use case, based on the role TELUS' products and services play. The allocation is necessary in acknowledging other contributors in enabling a solution. For example, internet connectivity, along with end-user devices like personal computers and productivity software are all integral components of the remote working use case. Therefore, a fair allocation of claims is required to ensure all contributors are acknowledged and credited for the total avoided emissions impact. For example, in the remote work use case, TELUS or another connectivity provider would be entitled to a 20% allocation factor.
- **Net avoided emissions post allocation:** Net avoided emissions multiplied by the allocation factor.

Figure 3-1. Building blocks of the methodology

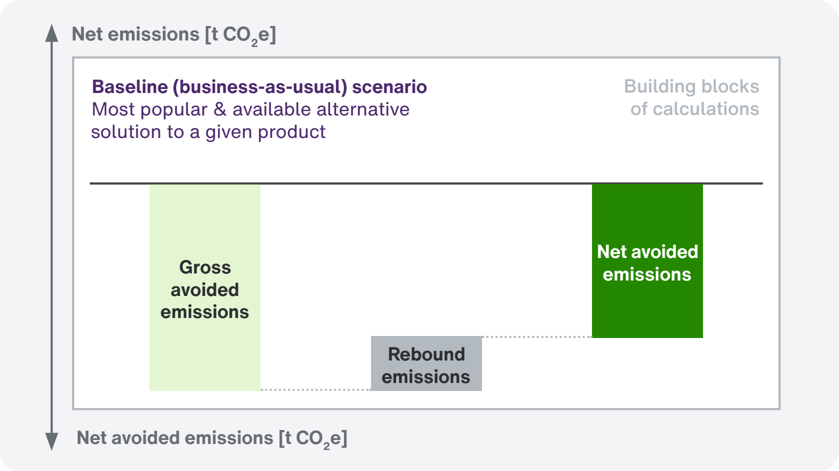
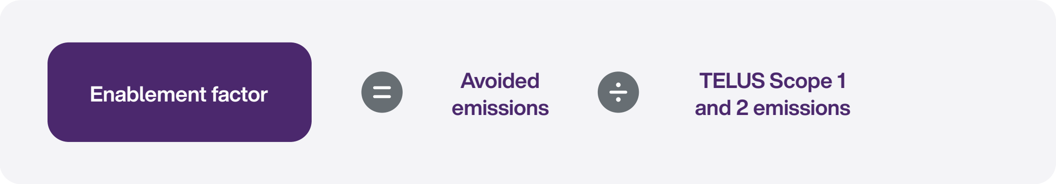


Figure 3-2

- **Net enablement factor:** Enablement factor is a metric that represents the relative avoided emissions impact TELUS enables, compared to its own emissions. The metric is calculated by dividing TELUS' own Scope 1 and 2 emissions by the net avoided emissions on a post allocation basis.

Figure 3-3



Role-based allocation approach

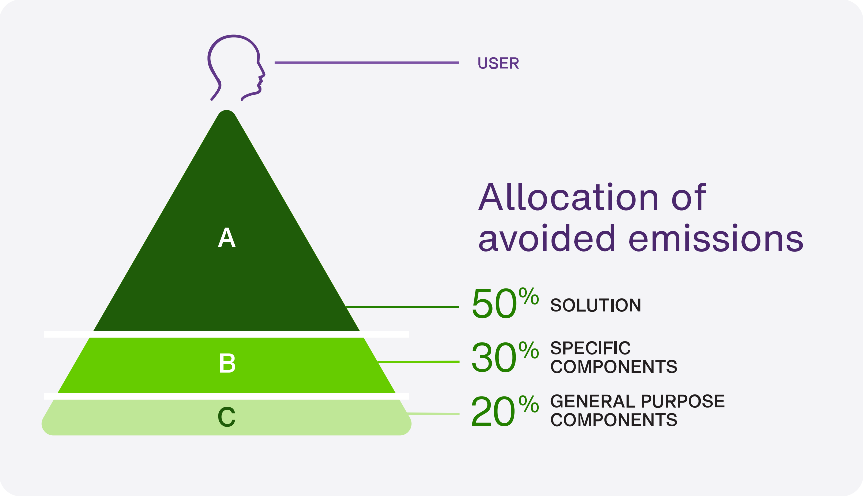
Following the guidance of ITU.T-L 1480, a company's contribution to a particular avoided emissions use case is based on the role the company's products or services play in enabling the whole end-to-end solution. There are three levels of contributions:

Level	Allocation factor	Description	Application example
A	50%	The integrated solution that directly enables avoided emissions	TELUS end-to-end application such as MyCare
B	30%	Building blocks or key components of the integrated solution that are specifically built for the solution	Components of MyCare application such as the video conferencing and e-billing features, which are purpose-built for MyCare
C	20%	The platform or generic hardware, software or infrastructure enabling the solution	TELUS connectivity

In the MyCare application use case, for example, TELUS would be responsible for 100% of the avoided emissions impact when the customer uses both TELUS connectivity and the integrated end-user solution of MyCare App, which is fully developed and owned by TELUS.

A set of allocation factors are then assigned to reflect the relative attribution of solutions at each level. Allocation factors can be summed up if a company provides solutions across more than one level, but cannot exceed 100%. The allocation factors are as follows:

Figure 4. Role-based allocation approach and allocation factors



The 50/30/20 allocation is the result of an economic value-add (EVA) analysis, as we assume EVA to be a proxy for company contribution in an avoided emissions use case. We compare EVAs from different companies in aggregate, based on their industries and respective positions in the value chain. The resulting shares for Level A, B and C companies are approximately 50%, 30% and 20%.

We choose these rule-of-thumb allocation factors instead of exact contribution percentages for each use case to avoid any false precision.

2.4 Steps for applying the methodology to individual use cases and aggregation

For each of the product use cases selected, these steps were followed in the quantification process:

- **Establish boundary and baseline reference scenario:** The baseline scenario is defined as the most probable and prevalent alternative on the market at the time of the impact quantification. Boundaries of the use case are clearly identified to avoid double counting or overestimation of the avoided emissions. The boundaries are established to be as conservative and defensible as possible.
- **Identify avoided emissions and rebound effects:** Identify direct/primary avoided emissions as well as indirect/secondary avoided emissions.
- **Collect best available data:** Most credible, relevant, location and TELUS solution-specific data sources are used in quantification assumptions and calculations. All data sources and descriptions are clearly documented and validated by internal TELUS product teams.
- **Determination of contribution level:** An allocation factor is applied according to TELUS' contribution level in each use case.
- **Calculate avoided emissions:** Calculation is performed on both a gross and net-avoided emissions basis.
- **Document aggregated results at the portfolio/company level:** Results are documented and reviewed by internal stakeholders, including product owners.

2.5 Limitations and future iterations

The following limitations of the current methodology must be acknowledged:

- **Life cycle assessment (LCA) considerations:** While ongoing work is being done on estimating product emissions through LCAs, the methodology currently focuses on the difference in emissions between the use-case scenario and the baseline scenario, without considering differences in product lifecycle emissions. In future iterations of the methodology, the analysis of product emissions should be included, to the extent allowed by available data, in order to provide a more complete view of TELUS' impact on avoided emissions.
- **Baseline scenario:** The baseline solutions are based on "business-as-usual" scenarios; in other words, the most popular and available alternative to a given product/service, if the product/service did not exist. In future iterations of the methodology and the avoided emissions report, new baselines may be chosen to reflect the dynamic nature of reference scenarios; however, any change should be clearly documented and aligned across different product use cases.
- **Allocation factors.** The allocation factors are estimated based on high-level EVA data of relevant industries and companies. We acknowledge that EVA, though adopted by certain investors as a proxy for avoided emissions contribution, is an imperfect metric and may be replaced with better proxies in the future.
- **Industry standards alignment:** This methodology reflects industry-best practices and prevalent industry standards at the time of its development. Future updates will continue to incorporate further evolution in recommended industry reporting practices, standards and methodologies.
- **Scope and coverage:** Specific products and use cases are chosen to represent most of TELUS' revenue-generating business activities and thus should represent most of TELUS' avoided emissions impact as a company.
- **Future iterations:** Given the complexity of emissions reduction allocation methods and avoidance calculation frameworks, it should be recognized that results may vary from similar models used by peers. TELUS remains committed to transparency and accuracy in its reporting to support the most objective benchmarking. Through proactive engagement with regulatory bodies and industry peers, TELUS aims to contribute to the evolution of industry standards and practices. As updated and more enhanced data become available, the developed models will continue to be refined and updated to stay aligned with best practices and emerging standards.

Application of methodology

to specific TELUS product use cases

3. Application of methodology to specific TELUS product use cases

More than 25 use cases enabled by TELUS products and services were initially considered for this quantification, with the 17 most significant ones in terms of avoided emissions listed here and quantified, totaling more than 1.4 Mt of CO_2e.

Application	Use Case	TELUS core product or service	Main source of avoided emissions
Tele-operations	Teleconferencing	Internet connectivity	Avoided traveling for business trips, conferences etc.
	Virtual commercial operations and virtual business		Avoided store energy emissions and commuting for shopping
	Remote and hybrid work		Avoided commuting for work
	E-Billing		Avoided paper production and mailing services
Tele-health	MyCare and non MyCare virtual medical appointment	Online health platform and internet connectivity	Avoided commuting to medical clinics and hospitals
	Virtual Pharmacy	Online drug prescription management and delivery	Avoided trips to pharmacies
Phone refurbishment	Device Care Complete (DCC)	Full phone refurbishment services	Avoided manufacturing and purchase of new phones
	Certified Pre-Owned (CPO)	Sales of refurbished phones just as good as new	
Agriculture and related fields	Precision Agriculture	Consulting for fertilizer rate of use for agricultural clients	Reduced fertilizer usage
	Feedlot Management solutions	Consulting for livestock raised and fed in controlled environments	Reduced and optimized emissions per animal
	Cold Chain	Digital platform connecting to sensors tracking perishable food items during transport	Reduced food wastage
Home automation	SmartHome solutions	Home automation devices such as smart ecofriendly lightbulbs, smart plugs, window sensors and cameras	Reduced residential energy consumption
	SmartEnergy solutions	Smart thermostats and weekly challenges with consumers to reduce heating/cooling needs	
Business solutions	Private Wireless Networks	Connectivity for IoT devices	Automation, remote operations and fuel-efficient fleet management
	Fleet management	Full stack fleet management solution, in collaboration with Geotab	Optimized routing and reduced fuel consumption

Alongside the **17 use cases** outlined in the table above, TELUS also invests in nature-based solutions, including **forest resilience solutions,** to enhance carbon sequestration and wildfire prevention. For instance, Shakti by TELUS, TELUS' dedicated nature restoration company, provides comprehensive services including land reclamation, site preparation, seed collection, tree sourcing and planting. Through the TELUS Pollinator Fund for Good, TELUS is also investing in pioneers like **Dryad,** enabling **ultra-early wildfire detection** to prevent large-scale forest loss in Canada and globally. While these initiatives provide **significant environmental benefits,** TELUS does not include them in its avoided emissions calculations in alignment with **WBCSD reporting guidelines** relating to contributions to carbon sinks.

3.1 APPLICATION #1:
Tele-operations

3.1.1 USE CASE #1
Teleconferencing

Description and carbon-saving process

Communications technology plays a critical role in enabling teleconferencing, which allows business professionals to conduct meetings, attend conferences and collaborate remotely rather than traveling in person. With the expansion of high-speed broadband, fibre-optic networks and mobile connectivity, businesses can replace in-person meetings with high-quality video calls, reducing reliance on travel by car and plane. This is particularly impactful for corporate travel, industry conventions, trade shows and client meetings, where virtual alternatives significantly reduce carbon emissions by eliminating the need for long-distance transportation. However, videoconferencing itself consumes electricity, requiring us to consider the emissions associated with data centres, network infrastructure and user-end energy consumption when quantifying net carbon savings.

Calculation methodology and formula

To assess the avoided emissions from teleconferencing, business trips that were replaced with virtual meetings were estimated, considering the transport mode shift from cars and planes to videoconferencing. The methodology accounts for:

1. **Avoided vehicle travel for business trips –** Emissions saved from eliminating car travel for in-person meetings.
2. **Avoided air travel for business trips –** Emissions saved by avoiding flights for long-distance business travel.
3. **Avoided vehicle travel for conferences, trade shows, and conventions –** Emissions saved from reducing ground transportation to large-scale professional events.
4. **Avoided air travel for conferences, trade shows and conventions –** Emissions saved by replacing international and long-haul travel for major industry gatherings.
5. **Rebound emissions from videoconferencing –** The emissions generated from running virtual meetings, including energy consumption from internet connectivity, server usage and device power consumption.

Total net avoided CO_2 emissions (tCO_2 e) =

- \+ Number of business trips avoided (trips/person/year) × average emissions for a business trip by vehicle (tCO_2 e) × % of business trips by vehicle
- \+ Number of business trips avoided (trips/person/year) × average emissions for a business trip by plane (tCO_2 e) × % of business trips by plane
- \+ Number of conference/ convention/ trade show trips avoided (trips/person/year) × average emissions for a conference trip by vehicle (tCO_2 e) × % of conference trips by vehicle
- \+ Number of conference/ convention/ trade show trips avoided (trips/person/year) × average emissions for a conference trip by plane (tCO_2e) × % of conference trips by plane
- \- Number of telecom-enabled virtual meeting users (# TELUS connectivity enabled business travelers) × Number of trips avoided (trips/ person/ year) × average meeting duration (minutes) × emissions per minute of videoconferencing (tCO_2 e/minute)

Total net avoided CO_2 emissions post role-based allocation (tCO_2 e) =

- \+ Total net avoided emissions (tCO_2 e) × role-based allocation for teleconferencing use case (%)

Assumptions and data sources

Assumption	Data source
Total number business trips for Canadian workforce	Statistics Canada - travel by Canadian residents in Canada and abroad by trip purpose (2024)
% Trips avoided due to teleconferencing	Cisco - CSR Report (2012)
Canadian workforce	Statistics Canada - labour force survey (2024)
Average travel distance by car and plane for business purposes	U.S. Bureau of Transportation - U.S. business travel (2011)
Emissions per km driven	National Observer - Canadian vehicle study (2019)
% travel for business by car	Transport Canada - domestic travel in Canada (2011)
Number of working individuals per household	Statistics Canada - Canadian family study (2021)
Emissions per km per plane passenger	Statista - carbon footprint of select modes of transportation (2022)
Share of business travelers in premium classes	Business Traveler - business travel insights (2018)
Emissions adjustment factors due to premium classes	Climate Action Accelerator - business travel facts
% Travel for business by plane	Transport Canada - Transportation and the Economy (2011)
Total number of conference/ convention/ trade show trips for Canadian workforce	Statistics Canada - travel by Canadian residents in Canada and abroad by trip purpose (2024)
% Conference/ convention/ trade show trips avoided from teleconferencing	Bizzabo - the events industry's top marketing statistics, trends, and data (2024)
Average time spent in virtual meeting or virtual trade show	Trade Show Hosting - recommended virtual event duration (2024)
Average emissions per minute of videoconferencing	Greenspector - impact of videoconferencing (2022)

3.1.2 USE CASE #2

Virtual commercial operations and virtual business

Description and carbon saving process

High-speed broadband and mobile connectivity have allowed businesses to operate fully online, eliminating the need for physical retail stores and customer-facing locations. This transformation significantly reduces retail energy consumption, as fewer brick-and-mortar stores require electricity, heating and cooling. Additionally, e-commerce enables consumers to shop from home, reducing personal vehicle trips that would have otherwise been made to physical stores. However, while these shifts lower emissions, they also introduce rebound effects, including increased parcel deliveries and larger warehousing requirements, which contribute to emissions from transportation and storage.

Calculation methodology and formula

To quantify the net carbon impact of online business operations, the avoided emissions from store closures and reduced shopping trips were assessed, while also accounting for increased parcel deliveries and warehousing needs:

1. **Avoided store energy consumption –** The emissions saved by not operating retail stores that would otherwise require heating, cooling, lighting and other energy use.
2. **Avoided customer travel to stores –** The emissions avoided by reducing personal vehicle trips for shopping, as consumers purchase products online instead.
3. **Increased e-commerce deliveries (rebound effect) –** The emissions generated by higher parcel delivery volumes, as goods are now shipped directly to consumers instead of being purchased in stores.
4. **Increased warehousing needs (rebound effect) –** The emissions from larger warehouse spaces needed to store products that would have previously been stocked in retail locations.

Total net avoided CO_2 emissions (tCO_2 e) =

\+ [Avoided stores due to e-commerce (sq m) × average emission per sq m of retail (tCO_2 e/ sq m/ year)] × TELUS connectivity market share (%)

\+ [Number of shopping trips eliminated (trips/ year) × average distance driving to shops (kms/ trip) × average emissions per km driven (tCO_2 e/ km)] × TELUS connectivity market share (%)

\- [Total litres of petrol consumed for package deliveries (L/ year) × average emission per litre of petrol (tCO_2 e/ L)

\+ Total litres of diesel consumed for package deliveries (L/ year) × average emission per litre of diesel (tCO_2 e/ L)] × TELUS connectivity market share (%)

\- [Added warehouse due to e-commerce (sq m) × average emissions for warehousing needs (tCO_2 e/ year/ sq m)] × TELUS connectivity market share (%)

Total net avoided CO_2 emissions post role-based allocation (tCO_2 e) =

\+ Total net avoided emissions (tCO_2 e) × role-based allocation for virtual business use case (%)

Assumptions and data sources

Assumption	Data source
Average emission per commercial institution per year	Statistics Canada - average energy use intensity by commercial and institutional building activity type (2022)
Average national emissions per kWh	Canada Energy Regulator - provincial and territorial energy profiles (2022)
Total inventory of retail space in Canada	Retail insider - Canadian retail leasing report (2022)
E-commerce share of retail in Canada	Emarketer - Canada ecommerce forecast (2024)
Average number of stores visits per trip	Statista / ICSC - number of stores visited by shoppers during shopping mall visits in the U.S. (2016)
Total number of delivered parcels	Pitney Bowes - parcel shipping index (2022)
Population concentration in downtown	Statistics Canada - Canadian urban centre growth and spread (2022)
Car ownership rate	Statista - share of car owners worldwide (2024)
Total registered cars	Statistics Canada - vehicle registrations (2024)
Canadian population	Statistics Canada - Canadian population estimates (2023)
Average distance driving to shopping mall	University of Florida - A Better Understanding of Shopping Travel in the US (2019)
Emissions per km driven – private vehicle	National Observer - Canadian vehicle study (2019)
Total litres of petrol consumed	Roland Berger analysis
Average emissions per litre of petrol and diesel	Natural Resources Canada - Fuel consumption and CO_2 fact sheet (2014)
Total litres of diesel consumed	Roland Berger analysis
TELUS connectivity market share	TELUS - internal data (2023)

3.1.3 USE CASE #3 & 4
Work from home (hybrid and full remote)

Description and carbon saving process

The expansion of high-speed broadband and fibre-optic networks has enabled millions of workers to perform their jobs from home, eliminating the need for daily commutes and reducing office space requirements. Hybrid and fully remote work models reduce carbon emissions by decreasing vehicle travel, fuel consumption and congestion. Additionally, as fewer employees occupy office buildings, the demand for heating, cooling and electricity usage in commercial spaces declines, further reducing emissions. However, working from home increases residential energy consumption, as individuals use more heating, cooling and electronic devices throughout the day. In addition, videoconferencing-related emissions were also accounted for, which increase as virtual meetings replace in-person interactions.

Calculation methodology and formula

To quantify the avoided emissions from remote work, reductions in commuting emissions and office energy consumption were first assessed, while also accounting for increased residential energy use and videoconferencing emissions. The methodology includes:

1. **Avoided commuting emissions –** The emissions saved from fewer daily round-trip commutes due to hybrid and fully remote work arrangements.
2. **Reduced office energy consumption –** The reduction in emissions from unoccupied or downsized office spaces due to fewer in-person employees.
3. **Increased home energy consumption (rebound effect) –** The additional emissions generated from heating, cooling and power usage in home offices.
4. **Videoconferencing emissions (rebound effect) –** The increase in emissions from virtual meetings replacing physical office interactions.

Total net avoided CO_2 emissions (tCO_2 e) =

- \+ Average number of days working from home per year hybrid or full remote (days/ person/ year) × average emissions per round trip commute to work (tCO_2 e) × TELUS connectivity enabled hybrid/ remote workers
- \+ Reduced vacant office space due to TELUS enabled hybrid/ remote work (sq ft) × average annual emissions per square footage of office (tCO_2 e/ sq ft)
- − TELUS connectivity enabled hybrid/ remote workers × average increased home emissions (tCO_2 e/ worker/ year)
- − TELUS connectivity enabled hybrid/ remote workers × average time spent in calls/ meetings (minutes/ year) × average meeting duration (minutes) × emissions per minute of videoconferencing (tCO_2 e/minute)

Total net avoided CO_2 emissions post role-based allocation (tCO_2 e) =

- \+ Total net avoided emissions (tCO_2 e) × role-based allocation for work-from-home use case (%)

Assumptions and data sources

Assumption	Data source
% of commuters using private vehicles, public transport and active transportation	Statistics Canada Canadian commuter study (2024)
Average commuting distance using private vehicle, public transport and active transportation	Statistics Canada Canadian commuter study (2019)
Emissions per km driven – private vehicle	National Observer Canadian vehicle study (2019)
Emissions per km – public vehicle	UK Department for Energy Security & Net Zero Greenhouse gas reporting (2023)
Number of TELUS connectivity customers	TELUS - internal data (2024)

Assumption	Data source
Number of working individuals per household	Statistics Canada Canadian family study (2021)
Canadian population	Statistics Canada Canadian population estimates (2023
Canadian workforce	Statistics Canada labour force survey (2024)
Fully remote workers as share of workforce	Statistics Canada Canadian commuter study (2024)
Hybrid workers as share of workforce	Statistics Canada Canadian commuter study (2024)
Average square footage of office space per employee	Canadian Centre for Occupational Health and Safety Office ergonomics (2020)
TELUS connectivity market share	TELUS - internal data (2023)
Average annual emissions per square metre of office	The Atmospheric Fund Building performance standards (2022)
Reduction factor of office spaces due to hybrid work arrangements	Benefits Canada Work models study (2023)
Average home emissions when working from home	UK Department for Energy Security & Net Zero Greenhouse gas reporting (2023)
% of workforce's weekly time in meetings	Medium Virtual Meeting Study (2022)
Average worked hours per week	Statistics Canada Average hours worked in a reference week by type of work (2024)
Work weeks per year in Canada	Dutton Employment Law Number of workdays annually In Canada (2024)
Average emissions per minute of videoconferencing	Greenspector Impact of videoconferencing (2022)

3.1.4 USE CASE #5

E-Billing

Description and carbon saving process

Telecom networks play a crucial role in enabling e-billing, which allows companies to send digital invoices instead of traditional paper-based billing. This transition significantly reduces paper consumption, printing emissions and postal deliveries, contributing to lower carbon emissions from paper production, processing and fuel use for distribution. By eliminating the need for physical mail, telecom networks streamline financial transactions and help reduce the reliance on postal services. However, while e-billing reduces emissions from paper and transportation, it introduces a rebound effect – the increased energy consumption associated with email processing, data storage and server activity. Despite being less visible, digital services require data centre energy, which contributes to indirect emissions.

Calculation methodology and formula

To quantify the net carbon impact of e-billing, the avoided emissions from paper mail reduction and postal deliveries were measured, while factoring in the added emissions from digital transactions:

1. **Reduced paper mail production –** The emissions saved by reducing paper usage, printing and processing for invoices and statements.
2. **Avoided mail delivery emissions –** The emissions avoided by reducing postal transportation needs, leading to lower fuel consumption.
3. **Increased email-related emissions (rebound effect) –** The additional emissions from higher email traffic, including energy-intensive data centre operations, cloud storage and network transmission.

Total net avoided CO_2 emissions (tCO_2e) =

+ [Number of paper mail avoided (mail/ year) × average emission per paper mail (tCO_2e/ mail)] × TELUS connectivity market share (%)
+ [Total litres of petrol avoided (L/ year) × average emission per litre of petrol (tCO_2e/ L) + total litres of diesel avoided (L/ year) × average emission per litre of diesel (tCO_2e/ L)] × TELUS connectivity market share (%)
- [Number of emails sent replacing paper mail (emails/ year) × average emission per email (tCO_2e/ email)] × TELUS connectivity market share (%)

Total net avoided CO_2 emissions post role-based allocation (tCO_2e) =

+ Total net avoided emissions (tCO_2e) × role-based allocation for e-billing use case (%)

Assumptions and data sources

Assumption	Data source
Average emission per paper mail	8 Billion Trees Project - email carbon footprint vs. paper letter by mail (2024)
Number of postal addresses – 2014/2023	Canada Post - Annual Report (2023)
Number of paper mail per address – 2014/2023	Canada Post - Annual Report (2023)
Total litres of petrol or diesel avoided	Roland Berger analysis
Average emissions per litre of petrol and diesel	Natural Resources Canada - fuel consumption and CO_2 fact sheet (2014)
Average emission per email	8 Billion Trees Project - email carbon footprint vs. paper letter by mail (2024)
TELUS connectivity market share	TELUS - internal data (2023)

3.2 APPLICATION #2

Telehealth

3.2.1 USE CASE #6 & 7:

TELUS MyCare and non MyCare virtual medical appointments

Description and carbon-saving process

Communications technology is a key enabler of telehealth services, allowing patients to consult doctors remotely via video calls, chat or phone rather than traveling in person to hospitals or clinics. TELUS offers MyCare, its proprietary telehealth solution, while also providing connectivity for competing telehealth platforms through wireless and broadband services. Telehealth helps reduce in-person patient visits to hospitals and clinics, lowering commuting emissions from personal vehicles. Additionally, clinicians themselves can avoid traveling to clinics for consultations, further reducing emissions associated with transportation. However, hospital-based doctors were not included in the avoided emissions, as they still have other essential duties even when they don't have patient appointments.

By replacing in-person consultations with virtual ones, telehealth reduces the time, cost and emissions associated with patient transportation, particularly in rural areas where hospital and clinic visits require longer trips. It also helps alleviate congestion in healthcare facilities, leading to more efficient patient management.

Calculation methodology and formula

To quantify the avoided emissions from telehealth, the focus was on the reductions in patient and clinician travel, considering average commute distances in both urban and rural settings:

1. **Avoided emissions from hospital visits by patients –** Emissions saved from reducing patient commutes to hospitals for consultations now handled online.
2. **Avoided emissions from clinic visits by patients –** Emissions saved from reducing patient commutes to local medical clinics due to telehealth availability.
3. **Avoided emissions from clinic visits by clinicians –** Emissions saved from clinicians not traveling to clinics for patient appointments that are now virtua. .
4. **Exclusions:**
   - Hospital-based doctors' travel was excluded, as their responsibilities extend beyond scheduled patient visits.

Total net avoided CO_2 emissions (tCO_2 e) =

+ Number of hospital visits avoided per year by patients × average commute to hospital in urban and rural setting (km) × average emissions per km driven (tCO_2 e)
+ Number of clinic visits avoided per year by patients × average commute to clinic in urban and rural setting (km) × average emissions per km driven (tCO_2 e)
+ Number of clinic visits avoided per year by clinicians × average commute to clinic in urban and rural setting (km) × average emissions per km driven (tCO_2 e)

Total net avoided CO_2 emissions post role-based allocation (tCO_2 e) =

+ Total net avoided emissions (tCO_2 e) × role-based allocation for telehealth use case (%)

Assumptions and data sources

Assumption	Data source
Number of MyCare appointments	TELUS - internal data (2023)
% of MyCare appointments that would have gone to hospital	TELUS - internal surveys (2023)
Average urban commute to hospital – urban	Canadian Institute for Health Information / Statistics Canada
Average urban commute to hospital – rural	Canadian Institute for Health Information / Statistics Canada
% of MyCare appointments in rural areas	TELUS surveys (2024)
Emissions per km driven	National Observer - Canadian Vehicle Study (2019)
% of MyCare appointments that would have gone to walk-in clinic or their own GP	TELUS surveys (2023)
Average urban commute to clinic – urban	Canadian Institute for Health Information / Statistics Canada
Average urban commute to clinic – rural	Canadian Institute for Health Information / Statistics Canada
Average number of appointments per day for clinicians	Canadian Institute for Health Information - International Health Policy Survey of Primary Care Physicians (2020)
Average medical visit per capita in Canada	Canadian Medical Association Journal - Canadian healthcare access and wait times (2016)
Online doctor consultations users in Canada	Statista market insights - Digital Health Study - Canada (2024)
TELUS connectivity market share	TELUS - internal data (2023)

3.2.2 USE CASE #8
Virtual Pharmacy

Description and carbon saving process

TELUS' VirtualPharmacy platform enables individuals to consult pharmacists online, manage prescriptions digitally and receive medications delivered directly to their homes. This eliminates the need for in-person trips to pharmacies, reducing emissions from personal vehicle use for prescription pickups and consultations. Virtual pharmacy services are especially impactful in rural areas, where pharmacy access may require longer commutes.

While virtual pharmacies significantly reduce travel-related emissions, they also introduce a rebound effect in the form of increased emissions from medication deliveries. Prescriptions that would have been picked up in person are now delivered through logistics networks, generating emissions from gas and diesel-fueled delivery vehicles. Despite this, the consolidation of deliveries (e.g., multiple prescriptions delivered in a single route) can offset some of these emissions compared to individual trips made by customers.

Calculation methodology and formula

To quantify the net emissions impact of TELUS VirtualPharmacy, the following factors were assessed:

1. **Avoided emissions from trips to the pharmacy –** Emissions saved from reducing personal vehicle trips to pharmacies for consultations and medication pickups.
2. **Added emissions from prescription deliveries (rebound effect) –** Emissions generated from the fuel consumption of delivery vehicles transporting medications directly to customers.

Total net avoided CO_2 emissions (tCO_2 e) =

\+ Number of pharmacy trips avoided per year × average commute to nearest pharmacy (km) × average emissions per km driven (tCO_2 e)

− Total litres of gas consumed for package deliveries (L/ year) × average emission per litre of petrol (tCO_2 e/ L) + total litres of diesel consumed for package deliveries (L/ year) × average emission per litre of diesel (tCO_2 e/ L)

Total net avoided CO_2 emissions post role-based allocation (tCO_2e) =

Total net avoided emissions (tCO_2e) × role-based allocation for virtual pharmacy use case (%)

Assumptions and data sources

Assumption	Data source
Total VirtualPharmacy prescriptions	TELUS - internal data (2024)
Ratio of VirtualPharmacy prescriptions vs regular prescriptions	TELUS - internal data (2024)
Population concentration in downtown	Statistics Canada - Canadian urban centre growth and spread (2022)
Car ownership rate	Statista - share of car owners worldwide (2024)
Average commute to nearest pharmacy	National Library of Medicine - Geographic accessibility of community pharmacies in Ontario (2013)
Emissions per km driven	National Observer - Canadian Vehicle Study (2019)
Total VirtualPharmacy parcels delivered	TELUS - internal data (2024)
Total parcels delivered in Canada	Pitney Bowes - parcel shipping index (2022)
Total litres of gas consumed for prescription deliveries	Roland Berger analysis
Average emissions per litre of gas and diesel	Natural Resources Canada - fuel consumption and CO_2 fact sheet (2014)
Total litres of diesel consumed for prescription deliveries	Roland Berger analysis

Other telehealth solutions offered by TELUS

TELUS offers additional telehealth solutions beyond traditional patient care, including Electronic Medical Records (EMR) and MyPet, both designed to enhance healthcare efficiency while supporting sustainability. EMR enables the secure digital management and sharing of patient records, reducing the need for paper-based documentation and administrative travel, while also minimizing duplicate medical procedures. MyPet provides virtual veterinary consultations, helping pet owners avoid unnecessary trips to clinics for routine check-ups and advice. Together, these services contribute to avoided emissions through reduced paper usage, optimized healthcare workflows and fewer in-person visit.

3.3 APPLICATION #3

Phone refurbishment

3.3.1 USE CASE #9

Device Care Complete (DCC)

Description and carbon saving process

TELUS' Device Care Complete (DCC) service provides coverage for accidental damage, cracked screens, lost or stolen devices, and offers screen or battery replacements for smartphones, tablets and smartwatches. When devices are beyond repair, DCC facilitates the provision of refurbished devices instead of new ones. By extending the lifespan of electronic devices, DCC reduces the need for frequent device replacements, thereby lowering emissions associated with raw material extraction, manufacturing and supply chain logistics involved in producing new devices. This not only supports the circular economy, but also helps decrease the carbon footprint of electronic waste.

Calculation methodology and formula

To quantify the emissions avoided through DCC, the focus was on the emission savings from refurbishing devices instead of manufacturing new ones. The calculation considers:

1. **Reduced emissions per refurbished device –** The difference in CO_2 emissions between producing a new device and refurbishing an existing one to extend its useful life, varying by brand due to different manufacturing processes.

2. **Number of refurbished devices per year –** The annual volume of devices that were refurbished and put back into circulation through DCC.

Total net avoided CO_2 emissions (tCO_2 e) =

+ Average reduced emissions from avoided new device sales by brand (tCO_2 e) × total devices refurbished by brand.

Total net avoided CO_2 emissions post role-based allocation (tCO_2 e) =

+ Total net avoided emissions (tCO_2 e) × role-based allocation for DCC use case (%).

Assumptions and data sources

Assumption	Data source
Average reduced emissions due to refurbishing (various models)	TELUS internal studies (2025)
Share of phones sold in Canada (various models)	Statista - most popular smartphone brands in Canada (2025)
Number of refurbished devices per year	TELUS - internal data (2024)

3.2.2 USE CASE #10

Certified Pre-Owned (CPO)

Description and carbon saving process

Closely related to Device Care Complete, TELUS' Certified Pre-Owned (CPO) program offers refurbished smartphones that have been thoroughly tested, restored and certified to meet quality standards. By providing customers with high-quality pre-owned devices, the CPO program reduces the demand for new device manufacturing, thereby lowering emissions associated with the extraction of raw materials, production processes and global supply chain logistics. This approach supports a circular economy, reduces electronic waste and helps minimize the overall carbon footprint linked to the device lifecycle.

Calculation methodology and formula

To quantify the emissions avoided through the CPO program, the emphasis was on the emission savings from reducing the need to manufacture new phones by reselling certified pre-owned units instead of producing new ones. The calculation includes:

1. **Reduced emissions per refurbished device sold –** the difference in CO_2 emissions between manufacturing a new device and certifying a pre-owned device for reuse, varying by brand due to differences in production impacts.
2. **Number of Certified Pre-Owned devices sold per year –** the annual volume of devices resold through the CPO program.

Total net avoided CO_2 emissions (tCO_2 e) =

+ Average reduced emissions due to refurbished device sale by brand (tCO_2 e) × total CPO devices sold by brand

Total net avoided CO_2 emissions post role-based allocation (tCO_2 e) =

+ Total net avoided emissions (tCO_2 e) × role-based allocation for CPO use case (%)

Assumptions and data sources

Assumption	Data source
Average reduced emissions due to refurbishing (various models)	TELUS internal studies (2025)
Share of phones sold in Canada (various models)	Statista - most popular smartphone brands in Canada (2025)
Number of CPO devices sold per year	TELUS - internal data (2024)

3.4 APPLICATION #4

Agriculture and related fields

3.4.1 USE CASE #11

Precision Agriculture

Description and carbon saving process

TELUS' Precision Agriculture solutions use data analytics and field-level assessments to optimize fertilizer application across different acres of farmland. By adopting agricultural best practices such as the 4Rs (right source, right rate, right time and right place), farmers can precisely determine where and how much fertilizer is needed, reducing excess nitrogen application. This leads to a significant reduction in nitrous oxide (N_2O) emissions, a greenhouse gas nearly 300 times more potent than CO_2. Precision Agriculture also minimizes fertilizer runoff, improving soil health and reducing water pollution. The largest impact is seen in Western Canada, where vast agricultural lands benefit from optimized nitrogen application and improved soil efficiency

Calculation methodology and formula

To quantify the avoided emissions from Precision Agriculture, N_2O emissions reduction per acre of land where precision nitrogen management is applied were calculated across all acres.

Total net avoided CO_2 emissions (tCO_2 e) =

+ Reduced emissions per treated acre of land (tCO_2 e)

× Total acres as part of the Precision Agriculture solution

Total net avoided CO_2 emissions post role-based allocation (tCO_2 e) =

+ Total net avoided emissions (tCO_2 e) × role-based allocation for Precision Agriculture use case (%)

Assumptions and data sources

Assumption	Data source
Baseline N_2O-N emissions per acre	Environmental Defense Fund - How to Use Nitrogen Balance to Estimate Nitrous Oxide and Nitrate Losses (2021)
Reduction factor due to Precision Agriculture	The Association of Equipment Manufacturers - Environmental benefits of Precision Agriculture (2024)
N_2O-N to N_2O conversion factor	Environmental Defense Fund
N_2O to CO_2e conversion factor	Environmental Protection Agency
Total acres in the Precision Agriculture program	TELUS - internal data (2024)

3.4.2 USE CASE #12

Feedlot Management solutions

Description and carbon-saving process

TELUS' Feedlot Management solutions optimize livestock feeding, health and growth conditions using data-driven monitoring techniques. By analyzing animal diet, weight progression and health metrics, the system ensures that cattle receive optimized nutrition, and improves feed-to-weight conversion efficiency. This shortens the time needed for animals to reach market weight, reducing the total methane emissions per animal. Additionally, advanced health monitoring reduces disease prevalence, minimizing losses and improving overall livestock sustainability. These efficiency improvements contribute to lower greenhouse gas (GHG) emissions, particularly from enteric fermentation (methane) and manure management.

Calculation methodology and formula

To quantify the avoided emissions from feedlot solutions, TELUS estimated the efficiency gains per animal per year due to optimized feed and health management, reducing total emissions per head.

Total net avoided CO_2 emissions (tCO_2 e) =

+ Average emissions efficiency per animal (tCO_2 e) × total animals in TELUS feedlot program

Total net avoided CO_2 emissions post role-based allocation (tCO_2 e) =

+ Total net avoided emissions (tCO_2 e) × role-based allocation for Feedlot Management use case (%)

Assumptions and data sources

Assumption	Data source
Average emissions efficiency per animal per year	TELUS Feedlot - internal data (2024)
Total animals in TELUS feedlot program	TELUS Feedlot - internal data (2024)

3.4.3 USE CASE #13

Cold Chain

Description and carbon-saving process

TELUS' Cold Chain solutions provide real-time temperature monitoring for perishable goods such as meat, poultry, seafood, fruits and vegetables during transportation and storage. By integrating sensor-driven temperature tracking with shelf-life prediction models, businesses can prevent spoilage and optimize food quality throughout the supply chain. Additionally, TELUS has incorporated supply chain sustainability metrics, allowing companies to benchmark their greenhouse gas (GHG) emissions and operational efficiency against industry peers. By reducing food waste during transportation, these solutions directly lower emissions from food production, as wasted food still carries the embedded carbon footprint of agriculture, processing and logistics. TELUS primarily targets fresh food transported to grocers, ensuring that less food is discarded before reaching consumers.

Calculation methodology and formula

To quantify the avoided emissions from reduced food waste, the focus was on estimating the emissions embedded in fresh food that would have spoiled without Cold Chain monitoring but was preserved through TELUS' sensors. This use-case calculation only quantifies avoided emissions in Australia, where our most notable commercial contract for Cold Chain monitoring is located.

Total net avoided CO_2 emissions (tCO_2 e) =

+ Total emissions from fresh food production (tCO_2 e) × Cold Chain usage for fresh food transportation (%) × share of fresh food going to grocers (%) × fresh food wastage during transportation in Australia (%) × wastage reduction factor thanks to Cold Chain sensors (%) × TELUS partner share of food retail (%) × penetration rate of Cold Chain smart sensors in grocer partner's operations (%)

Total net avoided CO_2 emissions post role-based allocation (tCO_2 e) =

+ Total net avoided emissions (tCO_2 e) × role-based allocation for Cold Chain use case (%)

Assumptions and data sources

Assumption	Data source
Total fruit and vegetable production - Australia	Australian horticulture statistics handbook (2024)
Total meat production (mutton, lamb, pig, poultry) - Australia	Australian bureau of statistics Livestock Products (2024)
Total seafood production - Australia	Food and agriculture organization of the UN Fishery and Aquaculture Country Profiles (2023)
CO_2 emissions per kg of food production - various products	Maddison project Environmental impacts of food production (2018)
Cold Chain usage for fresh food transportation	The international fresh produce association
Share of fresh food going to grocers	USDA - foreign agriculture services (2023)
Fresh food wastage during transportation - Australia	IFCO - global food waste by country (2023)
Penetration rate of Cold Chain smart sensors in transportation	TELUS - internal data (2024)
Reduced food wastage with use of sensors	Supply Chain Dive Food sensor report (2019)
TELUS partner grocer share of food retail - Australia	TELUS - internal data (2024)

Other agriculture solutions offered by TELUS

TELUS’ farm management software helps agricultural operations digitize records, monitor IoT sensors and optimize farm logistics, leading to potential reduced fuel consumption and improved efficiency. By enabling remote monitoring, farmers can track field conditions, equipment status and spoilage risks without unnecessary travel, thus reducing fuel usage. While TELUS provides small IoT devices, they are not deployed across all acreage, meaning the impact varies by farm. Additionally, digitized farm records eliminate the need for printing and physical transport of documents, further contributing to lower emissions by reducing paper waste and vehicle travel for administrative purposes.

3.5 APPLICATION #5

Home automation

3.5.1 USE CASE #14

SmartHome solutions

Description and carbon saving process

TELUS offers a range of more than 20 SmartHome devices designed to enhance home automation and promote energy efficiency. For this analysis, the focus was on the devices with the most significant environmental impact: smart plugs (for lamps and appliances) and smart LED lightbulbs.

- Smart LED lightbulbs reduce emissions by being more energy efficient than traditional incandescent bulbs, consuming up to 80% less energy while providing the same level of brightness. Their longer lifespan also reduces waste and the need for frequent replacements.
- Smart plugs help reduce energy consumption by enabling users to schedule on/off times, remotely control devices and eliminate standby power consumption, which can account for 5-10% of household energy use. This prevents unnecessary energy waste when appliances are not actively in use.

Calculation methodology and formula

To quantify the avoided emissions from SmartHome devices, the emphasis was the reduction in energy consumption for both smart LED lightbulbs and smart plugs compared to traditional alternatives.

Total net avoided CO_2 emissions (tCO_2 e) =

+ Reduced energy consumption from smart LED lightbulbs (tCO_2 e) × total smart lightbulbs sold
+ Reduced energy consumption from smart plugs for lamps and appliances (tCO_2 e) × total smart plugs sold

Total net avoided CO_2 emissions post role-based allocation (tCO_2 e) =

+ Total net avoided emissions (tCO_2 e) × role-based allocation for SmartHome solutions use case (%)

Assumptions and data sources

Assumption	Data source
Baseline lightbulb wattage	Natural Resources Canada - energy efficient light bulbs (2014)
New LED smart lightbulb wattage	TELUS - internal data (2024)
Average hours of use for lightbulb per day	Natural Resources Canada - basic facts about residential lighting (2008)
Average national emissions per kWh	Canada Energy Regulator - provincial and territorial energy profiles (2022)
Total smart lightbulbs	TELUS - internal data (2024)
Standby power duration per day – TV	Statista - daily time spent with selected media among adults in Canada (2024)
Standby power duration per day – Console	Statista - average weekly time spent on video games in Canada (2022)
Standby power consumption – TV and console	EnergyRates dot CA - standby energy statistics
Lamps energy reduction factor due to smart plug	Bob Vila - smart plug energy usage study (2023)
Total smart plugs sold	TELUS - internal data (2024)

3.5.2 USE CASE #15

SmartEnergy solutions

Description and carbon saving process

TELUS' SmartEnergy solution focuses on improving home energy efficiency through the use of smart thermostats, often bundled with other SmartHome products. Smart thermostats help households optimize heating and cooling schedules based on occupancy, weather patterns and user preferences, significantly reducing energy waste. These devices enable automated temperature adjustments, ensuring HVAC systems run efficiently without manual intervention.

Additionally, TELUS encourages households to participate in energy-saving challenges, such as turning off heating or AC for one hour per week during peak demand times, promoting a culture of sustainability. While the impact of these challenges wasn't quantified, they demonstrate TELUS' commitment to reducing home energy consumption. Furthermore, TELUS supports environmental sustainability by planting four trees annually for every SmartEnergy user, contributing to carbon sequestration.

Calculation methodology and formula

To quantify the avoided emissions from smart thermostats, the energy savings achieved through improved heating and cooling efficiency compared to traditional thermostats were measured across all households with a TELUS smart thermostat.

Total net avoided CO_2 emissions (tCO_2 e) =

+ Reduced energy consumption from smart thermostats (tCO_2 e) × total smart thermostats sold

Total net avoided CO_2 emissions post role-based allocation (tCO_2 e) =

+ Total net avoided emissions (tCO_2 e) × role-based allocation for SmartEnergy use case (%)

Assumptions and data sources

Assumption	Data source
Average household energy consumption in Canada	Statistics Canada - households and the environment survey (2021)
Share of energy for space heating and cooling	Natural Resources Canada - appliances for residential use (2023)
Reduced energy consumption factor due to smart thermostat	Energy Star - smart thermostats FAQs for EEPS
Average national emissions per kWh	Canada Energy Regulator - provincial and territorial energy profiles (2022)
Total smart thermostats	TELUS - internal data (2024)

3.6 APPLICATION #6

Business solutions

3.6.1 USE CASE #16

Private Wireless Networks

Description and carbon saving process

TELUS' Private Wireless Networks (PWN) offer industrial-grade broadband connectivity designed for sectors like oil and gas and mining, enabling advanced digital applications that improve operational efficiency and support sustainability goals. PWNs allow companies to deploy real-time monitoring systems, IoT devices and automation technologies in remote and challenging environments. This connectivity facilitates a wide range of emission-reducing applications, including remote operations (reducing on-site personnel travel), predictive maintenance (preventing equipment failures and energy waste), water and waste management optimization, fleet fuel optimization, electrification of vehicles and environmental metric monitoring. By digitizing operations, PWNs reduce the need for manual intervention, decrease fuel consumption, optimize equipment performance and support more sustainable resource management.

Calculation methodology and formula

To quantify the avoided emissions from PWN technology, the focus was on the average emissions reduction achieved by industries adopting PWN for digital transformation and operational efficiency. The calculation includes:

1. **Average reduced emissions per PWN customer by industry –** emissions avoided due to improved energy efficiency, reduced fuel consumption, optimized resource management and automation across key sectors such as mining and oil and gas.
2. **Total TELUS PWN customers –** The number of organizations leveraging TELUS' PWN solutions, reflecting the scale of impact across industries.

Total net avoided CO_2 emissions (tCO_2 e) =

+ Average reduced emissions per PWN customer by industry (tCO_2 e) ×total customers integrating PWNs

Total net avoided CO_2 emissions post role-based allocation (tCO_2 e) =

+ Total net avoided emissions (tCO_2 e) × role-based allocation for PWN use case (%)

Assumptions and data sources

Assumption	Data source
Reduced emissions with private wireless network – mining copper, lithium, iron ore or nickel	Nokia - private wireless sustainability calculator
Total PWN customers	TELUS - internal data (2024)

3.6.2 USE CASE #17

Fleet management

Description and carbon saving process

TELUS provides Fleet Management Solutions, including vehicle tracking, video telematics and advanced fleet optimization tools. These technologies help fleets operate more efficiently, safely and sustainably by optimizing fuel consumption, reducing idle time, improving driver behaviour and enabling predictive maintenance. TELUS also partners with Geotab to offer advanced telematics solutions that support data-driven fleet decisions, contributing to lower emissions and reduced environmental impact.

Calculation methodology and formula

To quantify the avoided emissions from Fleet Management Solutions, different factors were considered, including:

1. Number of vehicles equipped with TELUS telematics
2. Annual fuel consumption
3. Emissions saved through improved fuel efficiency after implementing TELUS' Fleet Management Solutions

Total net avoided CO_2 emissions (tCO_2 e) =

+ Number of vehicles using TELUS telematics solution × average fuel consumption per vehicle per year (L/ year) × average emission per litre of fuel (tCO_2 e/ L) × fuel consumption reduction factor (%)

Total net avoided CO_2 emissions post role-based allocation (tCO_2 e) =

+ Total net avoided emissions (tCO_2 e) × role-based allocation for fleet management use case (%)

Assumptions and data sources

Assumption	Data source
Number of vehicles using TELUS telematics solution	TELUS - internal data (2024)
Average fuel consumption per commercial vehicle per year	Roland Berger analysis
Average emissions per litre of fuel	Natural Resources Canada Fuel consumption and CO_2 fact sheet (2014)
Fuel consumption reduction factor from fleet management solution	Geotab (2024)

Other business solutions offered by TELUS

TELUS offers additional business solutions that support sustainability, including Public Wireless Networks for IoT devices and Managed Cloud Services. These wireless networks enable connectivity for smart city applications, such as intelligent traffic management, smart lighting and environmental monitoring, which help reduce fuel consumption, optimize energy use and improve resource efficiency. Managed Cloud Services consolidate data processing in energy-efficient data centres, reducing the need for on-premises servers that typically consume more power. This leads to lower energy consumption, improved server utilization and reduced cooling demands, contributing to overall carbon emission reductions. Together, these solutions help businesses and cities optimize operations, minimize waste and reduce their environmental footprint.

Appendices

Appendices

References of documents reviewed

Publishing entity	Year	Publication name
The World Bank and International Telecommunication Union (ITU)	2024	Measuring the Emissions & Energy Footprint of the ICT Sector – Implications for Climate Action
Government of Canada	2024	Publishing entity
European Green Digital Coalition	2024	Net Carbon Impact Assessment Methodology for ICT Solutions
World Business Council for Sustainable Development (WBCSD) and Net Zero Initiative (NZI)	2023	Made-in-Canada Sustainable Investment Guidelines
IFRS	2023	IFRS S1 General Requirements for Disclosure of Sustainability-related Financial Information
IFRS	2023	IFRS S2 Climate-related Disclosures
Goldman Sachs	2023	How quantifying Avoided Emissions can broaden the decarbonization investment universe
International Telecommunication Union (ITU)	2022	Enabling the Net Zero transition: Assessing how the use of information and communication technology solutions impact greenhouse gas emissions of other sectors
Net Zero Initiative (NZI)	2022	The Pillar B Guide: Calculating and leveraging avoided emissions
GIC & Schroders	2021	A framework for avoided emissions analysis: uncovering climate opportunities not captured by conventional metrics
European Commission	2021	EU taxonomy for sustainable activities
Mission Innovation	2020	The Avoided Emissions Framework (AEF)
The GHG Protocol	2019	Estimating and reporting the comparative emissions impacts of products
GSMA	2019	The Enablement Effect
Global Reporting Initiative (GRI)	2016	Disclosure 305-5: Reduction of GHG emissions
International Electrotechnical Commission (IEC)	2014	Guidance on quantifying GHG emission reductions from the baseline for electrical/electronic products & systems
Global enabling Sustainability Initiative (GeSI)	2010	Evaluating the carbon reducing impacts of ICT – an assessment methodology
GHG Protocol	2004	The GHG Protocol for Project Accounting

Glossary

Term or acronym	Description
Avoided emissions	Greenhouse gas (GHG) emissions prevented due to a product or service, compared to a baseline scenario.
Baseline scenario	The most probable alternative technology or process used if the avoided emissions solution was not implemented.
Carbon sequestration	The process of capturing and storing atmospheric CO_2, typically through natural means such as tree planting.
Circular economy	A system that minimizes waste and maximizes resource efficiency by reusing, refurbishing and recycling products.
Cold Chain	A temperature-controlled supply chain ensuring perishable goods such as food and pharmaceuticals remain fresh and viable.
Device Care Complete (DCC)	A TELUS program that provides insurance coverage for damaged, lost or stolen devices, promoting refurbishment over new purchases.
E-billing	The digital delivery of invoices and statements, reducing the need for paper-based billing and postal mail services.
Electronic Medical Records (EMR)	Digital records of patient health information, reducing paper use and improving efficiency in healthcare management.
Emission factors	A coefficient representing emissions generated per unit of activity, such as kg CO_2 per km traveled or per kWh consumed.
Fleet management	Solutions that optimize vehicle tracking, fuel usage and driver behavior to improve efficiency and reduce emissions.
Greenhouse Gas Protocol (GHG Protocol)	The most widely used international standard for measuring and managing greenhouse gas (GHG) emissions.
Global enabling sustainability initiative (GeSI)	A non-profit organization promoting sustainability in the information and communications technology (ICT) industry.
Global System for Mobile Communications Association (GSMA)	An industry organization that represents mobile network operators worldwide.
Gross avoided emissions	Total emissions prevented through a product or service before considering rebound effects or allocation factors.
Hybrid work	A flexible work model where employees split their time between remote work and office attendance, reducing commuting emissions.
Information and Communications Technology (ICT)	Technologies enabling communication, data processing and digital services.
Internet of Things (IoT)	A network of connected devices that collect and exchange data, improving efficiency in industries such as agriculture, logistics and smart cities.
International Telecommunication Union (ITU)	A UN agency responsible for global telecommunications standards and policies.

Term or acronym	Description
Lifecycle assessment (LCA)	A method for assessing a product's environmental impact from raw material extraction to disposal.
Mission Innovation (MI)	A global initiative focused on accelerating clean energy innovations.
MyCare	TELUS' proprietary telehealth solution enabling virtual doctor consultations, reducing patient travel emissions.
MyPet	A TELUS telehealth solution for veterinary services, reducing unnecessary in-person visits to clinics for pet health concerns.
Nature restoration	The process of restoring degraded ecosystems, including reforestation and land rehabilitation, to enhance biodiversity and carbon sequestration.
Net avoided emissions	Gross avoided emissions minus rebound emissions and adjusted for allocation of enabling technology.
Nitrous oxide (N_2O)	A potent greenhouse gas with high global warming potential, primarily emitted through agriculture and industrial activities.
Net Zero Initiative (NZI)	A global framework supporting organizations in setting net-zero emission targets.
Nitrogen Efficiency and Reduction Protocol (NERP protocol)	A nitrogen management protocol improving fertilizer application efficiency to reduce nitrous oxide (N_2O) emissions from agriculture.
Parcel delivery emissions	The carbon footprint associated with shipping goods, particularly in e-commerce logistics.
Precision Agriculture	The use of technology and data analytics to optimize farming practices, reducing resource waste and emissions.
Private Wireless Networks (PWN)	Dedicated high-speed networks enabling industrial automation and remote operations in sectors such as mining and energy.
Rebound emissions	Additional emissions resulting from increased use of a technology, partially offsetting the gross avoided emissions.
Refurbished devices	Pre-owned electronic devices restored to working condition, reducing the demand for new device manufacturing.
Remote work	A work arrangement where employees perform their duties from home, reducing commuting emissions.
Role-based allocation	A methodology to distribute avoided emissions claims across different technology providers based on their contribution.
Science-Based Targets Initiative (SBTi)	A corporate climate action organization that develops standards, tools and guidance which allow companies to set GHG emissions reduction targets in line with climate science.
Scope 1 emissions	Direct emissions from company-owned or controlled sources, such as fuel combustion in company vehicles or facilities.
Scope 2 emissions	Indirect emissions from purchased electricity, heat or steam used by an organization.

Term or acronym	Description
Scope 3 emissions	Indirect emissions occurring in a company's value chain, including customer and supplier activities.
SmartHome solutions	Home-automation technologies such as smart plugs, smart lightbulbs and smart thermostats that improve energy efficiency.
SmartEnergy solutions	Technologies such as smart thermostats that optimize heating and cooling to reduce household energy consumption.
Sustainable supply chain	A supply chain that minimizes environmental impact through efficient resource use and emission reductions.
Telehealth	Remote healthcare services, including virtual medical consultations, reducing patient and doctor travel emissions.
Telematics	Technology used in fleet management to track vehicle data, optimize routes and improve fuel efficiency.
TELUS Certified Pre-Owned (CPO)	TELUS' refurbished device program, offering second-hand smartphones to extend product lifespans and reduce electronic waste.
Tree planting offsets	Carbon sequestration achieved through tree planting initiatives to counterbalance carbon emissions.
Virtual Pharmacy	Online prescription management and pharmacist consultations, reducing pharmacy visit emissions but increasing delivery-related emissions.
Videoconferencing emissions	The energy consumption associated with online meetings, including data center processing and device power usage.
World Business Council for Sustainable Development (WBCSD)	A global network of businesses focused on advancing sustainability.
Wildfire detection sensors	IoT-enabled sensors, such as those from Dryad, that provide early wildfire warnings to reduce forest loss and associated carbon emissions.
World Resources Institute (WRI)	A research organization that provides sustainability data and policy recommendations.