

# Product carbon footprint FAQs

The product carbon footprint (PCF) is an output from a life cycle assessment (LCA) that can be broadly defined as the total greenhouse gas (GHG) emissions, or CO<sub>2</sub>-equivalent (CO<sub>2</sub>e), generated during the production or full lifecycle of a product. Some organizations will consider different system boundaries when estimating PCFs — for example, cradle-to-gate versus cradle-to-grave. The cradle-to-gate PCF only includes those emissions produced prior to leaving the company’s “gate.” Other organizations consider cradle-to-grave PCF across the entire lifecycle, including the “Use” and “End of Life” (EOL) phases of the product.

**Additional Materials:** [Dell PCF Calculator white paper](#)      [PAIA PCF white paper](#)

March 2024

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## 1. What are product carbon footprints?

The product carbon footprint (PCF) of a product in a cradle-to-grave assessment and includes emissions related to four key product lifecycle stages:

- **Manufacturing phase:** Emissions from raw materials and manufacturing of its components and parts (e.g., drives, LCD panels, graphics cards, memory, CPU and mainboards).
- **Logistics or Transportation phase:** transportation to the country of use and then within the country of use.
- **Use phase:** Use of the products at customer locations in a given time frame. (energy consumption)
- **EOL phase:** End-of-life processing (i.e., recycling, refurbishing or disposal of the product).

## 2. How are product carbon footprints used?

In general, PCFs create an estimate of potential carbon impacts of a product. Increasingly, there are requirements by ecolabels such as [EPEAT](#) and by our customers to report PCF numbers to better demonstrate the environmental impact IT equipment. Surveys such as those administered by [CDP](#) — in which Dell Technologies has participated for many years — require reasonably accurate disclosures of an entity's CO<sub>2</sub>e emissions. PCFs are a significant factor in this equation.

## 3. How are product carbon footprints calculated?

Dell Technologies uses two PCF methodologies today:

**Dell Product Carbon Footprint (PCF) Calculator.** Dell Technologies conducted full LCAs on numerous products and, with the help of third-party consultants, built a custom, parameterized PCF tool that complies with ISO 14040. With our PCF Calculator, we can identify key parameters and develop PCFs for more product categories. We're launching it on a majority of new client laptops, desktops and displays in 2024 and will expand into additional product categories in the future.

**The Product Attribute to Impact Algorithm (PAIA) methodology.** We will continue to use this method to estimate PCFs for infrastructure hardware. (See below for more information on PAIA).

## 4. What is the Dell PCF tool methodology?

The Dell PCF Calculator is built on comprehensive LCA models for the product categories covered. When the parameters of the models are updated, it can execute a full LCA for a comprehensive PCF analysis. Note that although a full LCA has been executed, we are only reporting on the PCF at this time.

When we built this tool, we developed a unique PCF model for each of the primary product categories, including commercial monitors, notebooks, desktops and workstations. Our plan is to expand this to other categories in the future. We will use the tool for all new products' PCF calculations in these categories; for products outside these categories, we will continue to use the PAIA methodology until we're able to expand the coverage of our PCF Calculator. Dell Technologies will also be able to incorporate other impact categories in addition to carbon emissions.

## 5. What is PAIA?

Dell Technologies, as well as some other IT companies, provide PCF estimates using [PAIA](#). Developed by MIT in an industry consortium, this streamlined PCF method is based on IEC TR 62921, a quantification method for greenhouse gas emissions for ICT systems and broadly based on ISO 14040 and ISO 14044. More details about PAIA can be found in the white paper [here](#).

PAIA estimates the GHG emissions associated with a product's lifecycle and is typically depicted by an average value, along with the appropriate standard deviation. The PAIA tool also provides PCF values at the 5th and 95th percentile to account for possible calculation uncertainties.

As sustainability impact reporting continues to evolve, Dell Technologies continues to actively participate in consortiums to improve the degree of accuracy in industry modeling and in our PCFs.

## 6. What is the difference between a PCF and an LCA?

A full LCA is broader than a PCF study. A life cycle assessment evaluates a range of multiple potential environmental impact categories associated with all phases of a product's life. A PCF only focuses on a single impact category, global warming potential, while a full LCA will account for additional impact categories such as water consumption, acidification, ozone depletion and resource depletion.

## 7. Why does Dell Technologies use two different ways to calculate PCFs?

We launched our Dell PCF Calculator so that we can have consistency across all categories when we provide PCF calculations for our products. We are currently transitioning from one approach to another and, as we add new products to the tool, we'll have a methodology that's consistent across all our product categories. PAIA is limited to certain product categories, so it doesn't allow for consistency across the entire Dell product suite.

## 8. Are these tools ISO compliant?

The Dell PCF Calculator complies with ISO 14040, which is a voluntary certification and an overarching standard that encompasses all four phases of an LCA, defining a life cycle assessment and how it's constructed. Being ISO 14040 compliant also means our method has been reviewed by an independent third-party expert to make sure we're following established best practices. In addition, being compliant will give customers greater assurance about our approach.

Although the PAIA methodology is not ISO compliant, it has provided the IT industry with a reasonable alternative to promptly respond to stakeholder PCF inquiries. Dell Technologies has previously used PAIA, which follows IEC TR 62921 and is a quantification method for greenhouse gas emissions for ICT systems to estimate product carbon footprints.

## 9. Can carbon emissions calculated via PAIA or the Dell PCF Calculator be used to compare the PCF of different products? What about for different generations of the same product?

Generally, comparisons of results obtained through PAIA or the Dell PCF Calculator should be treated with caution due to variations in data quality, assumptions made around configuration or location of use and methodological approaches. Dell Technologies is participating in a consortium to drive industry standards that will allow for comparability.

In cases where the manufacturer uses a standardized method, comparisons from generation to generation or between models of the manufacturer could be explored. However, a comparison between different brands will be uncertain due to the use of different data and assumptions.

The discrepancies introduced through differences in primary data, tools and modeling will be too large, so results are always given with a deviation channel and/or formulated as an estimated impact.

These limitations of PCF should be considered when making comparisons.

## 10. What factors can typically influence the total product carbon footprint?

- Emissions generated during the product Use phase are determined by two main factors: the energy required by the equipment to run, and the location and source of the energy. Keep in mind that different energy grids will yield different carbon emissions depending on the production method (renewable, coal, nuclear, etc.). Dell Technologies is continuously working to make our products more energy efficient. By 2030, we plan to reduce absolute scope 3 GHG emissions associated with the use of sold products by 30%.
- Similar product configurations will have comparable energy draw regardless of use location. However, energy sourcing decisions like variations in the power grid and the electricity source our customers are using impact the carbon emissions associated with our products. For example, a Dell product plugged into a grid largely dependent on fossil fuels will have higher carbon emissions compared with that of a product plugged into a grid powered by solar or nuclear energy.

Emissions related to the Manufacturing phase of our products (also called embodied carbon) represent the raw materials used and the processes used for manufacturing parts and components.

- Typically, the majority of embodied carbon comes from the display panels, the solid state hard drives, memory (RAM), PCBs and CPU. For example, selecting a product with a larger storage capacity (bigger SSD) and more memory will increase the embodied carbon emissions for those products.
- Obtaining detailed information on manufacturing impact areas (hotspots) allows us to work with our original design manufacturers (ODMs) and suppliers to improve and reduce manufacturing emissions hotspots (for example, by using sustainable energy, low-impact materials or better manufacturing processes).

## 11. Which has a greater PCF, client products or infrastructure products?

### Key points to note about PCFs:

- Emissions in the ICT industry are mainly driven by the Manufacturing and Use phases of products.
- On a unit-by-unit basis, estimates of total PCF (across all four lifecycle stages) for infrastructure products are typically much larger than estimates for client products. This is primarily driven by differences in size, configuration, complexity and energy use.
- For infrastructure products, the Use phase of total PCF is typically higher than for other lifecycle stages (unless these products are plugged into a fully renewable or green energy source)
- For client products, the Manufacturing phase of total PCF is typically higher than for other lifecycle stages because of their smaller size and lower energy consumption compared to infrastructure equipment.

## 12. Is the PCF the same across configurations and geographic use?

No. As depicted in the graph below, the emissions for the Manufacturing, Transportation and End-of-Life phases remain static no matter where the configuration is being used. However, a variety of factors — including the geographic location's energy mix and the specific hardware configuration — have a significant impact on the Use phase of the product carbon footprint. This makes it difficult to assign a singular value across multiple configurations of a single Dell Technology product that could be used globally.

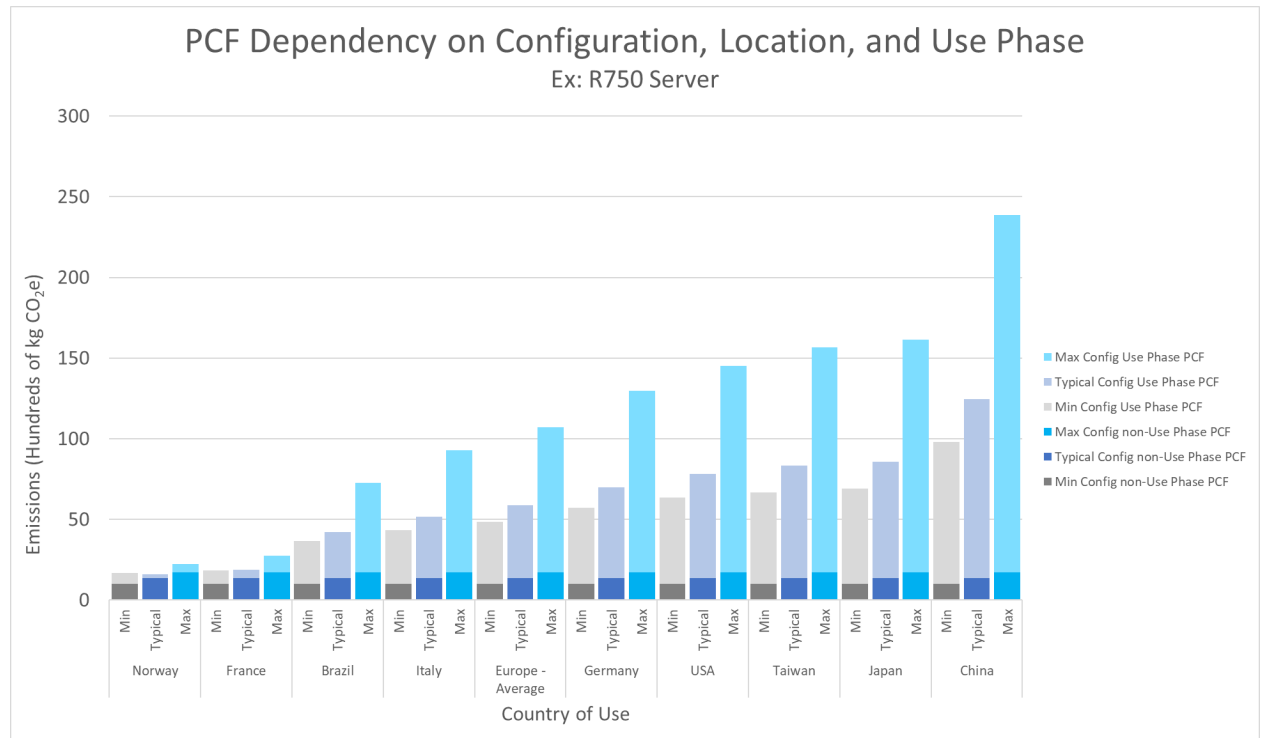


Figure 1 PCF for multiple regions

## 13. What about the other lifecycle stages of PCF?

Transportation and EOL phases of a PCF are relevant to many industries, but emissions related to Transport and EOL are relatively lower for the ICT industry than they are for the other two phases. Dell Technologies will continue to focus on emissions related to Transport and EOL for overall improvement of related emissions, while making significant improvement on the Use phase and Manufacturing phase emissions. Shipping products by air, of course, would increase the carbon emission of the Transportation phase.

## 14. How do scopes of emissions relate to product carbon footprints?

Scopes 1, 2 and 3 are typically corporate level accounts of greenhouse gas emissions, whereas PCFs are carbon emissions at a product level. However, many of the scope 3 categories do correlate to phases within the product carbon footprint. Purchased goods and services, transportation and distribution, use of sold products, and product end-of-life treatment are examples of scope 3 categories with corresponding PCF phases.

## 15. Can a product's PCF change over time?

Yes. As our suppliers improve their processes, use more recycled materials and switch to renewable energy sources, the manufacturing footprint of the products they support may change.

## 16. What plans does Dell Technologies have for PCF and LCA calculation?

We plan to add more product categories to our Dell PCF Calculator, including keyboards, mice, docking stations and data center products. Our goal is to have one standard approach to all product categories. We also anticipate other environmental impact categories to be added to reporting requirements in the future, and our custom tool will allow for this expansion.