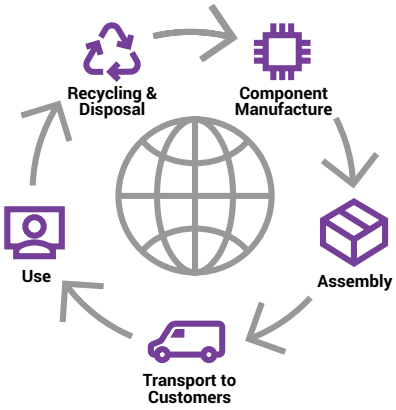
LIFE CYCLE ASSESSMENT OF

Ribbon Apollo 9603 Router



Ribbon is committed to reducing the environmental impacts of our products, covering all stages of the lifecycle. We use lifecycle assessment to find the most significant contributors to the environmental impact of our products and inform our sustainability strategies at the product and corporate level.

What is an LCA?

A life cycle assessment is the compilation and evaluation of the inputs, outputs and potential environmental impacts of a product system throughout its life cycle. (ISO 14040: 2006, sec 3.2.)

Product Chosen

A Ribbon Apollo 9603 is an enterprise, access, and metro edge transport platform which was chosen for this study to support Ribbon's engagement with key customers. The Apollo 9603 accommodates the entire range of Apollo transponder, muxponder, ROADM, and amplification blades. Each of its three slots supports dual 400G density-power-cost-optimized blades, for a total client plus line platform capacity of 4.8T. It also supports double-slot blades that delivers two performance-optimized 800G lines, for the most demanding transport applications. The chosen configuration represents the most frequently purchased option. The mass includes packaging, power cords and accessory kits.

Study Parameters	
Lifetime of the product	15 years
Use location	Germany
Cards	1 x TM400_2 card with Dual 400G Transponder/Muxponder with 100G/200/300/400G D-CFP2 uplink and 2xQSF28/56PDD clients supporting 100GE/400GE/OTU4.
Capacity	800 Gbs
Power Supplies	1 + 1 redundancy
Mass	22.831 kg

Results Summary

The impact categories assessed as part of the LCA concentrated on global warming potential over a hundred-year time horizon (GWP100). Global warming potential is also known as a "product's carbon footprint". The results show that 91% of the lifetime impacts are from the in-use phase via electricity consumption. On a global basis, Germany falls in the mid-range of carbon impact per kWh of electricity, which means the use-phase impact can be proportionally lower or higher depending on its installed location. For example, deployment on the NPCC electrical grid, which supports New York and other major US north eastern cities, would see the overall impact reduce to 4,800 kgCO2e over the product lifetime, with 85% from in-life energy usage. Transportation and end-of-life management are smaller contributors to the overall footprint.

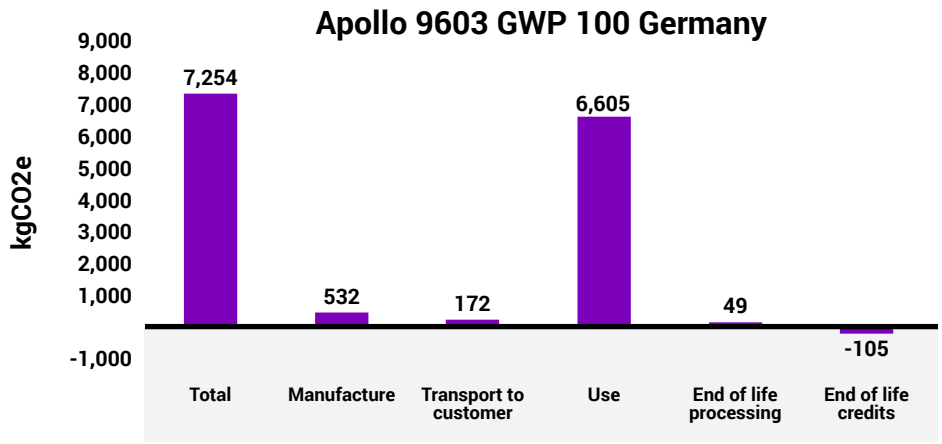


Figure 1. Lifecycle stage contribution to the GWP100 impact of a Ribbon Apollo 9603 deployed in Germany.

The manufacturing stage represents 7% of the lifecycle impact in Germany and 11% if installed in New York. The largest of the manufacturing stage impacts come from the printed circuit board in the main unit and the TM400_2 cards. The next most significant contributor is the sheet metal production and metalworking to create the required shape and form, accounting for 14% of the manufacturing impact. The third largest contributor is the microprocessors and memory chips used in both the main chassis and the TM400_2 card.

The configuration studied may be the most common, but it does not utilize the full capabilities of the unit. Up to 3 TM400 cards can be installed, bringing the capacity to 4.8 Tbps. The increase in energy consumption is approximately 220% from the studied configuration, while the capacity increased by 6 times. An intensity metric shows that the lifetime impact reduces from 8.9 kgCO2e/Gbps in the configuration studied to 5.8 kgCO2e/Gbps if the capacity is increased to 1.6 TBps.

Conclusion

The environmental impact of the Apollo 9603 in its most commonly purchased configuration is equivalent to 1.02 German citizens' annual footprint in 2023 (link). The impact of all lifecycle stages except use can be mitigated by extending the unit's lifecycle from 15 to 20 years and through ensuring the available capacity is maximized over using multiple units.

Key Facts

- The use phase contributes to 91% of the lifetime emissions in Germany and decreases in countries with lower carbon intensity electricity networks
- The manufacturing stage represents 7% of the product carbon footprint when used in Germany, rising to 11% in New York.
- Printed Circuit Board production is the greatest source of emissions in the manufacturing stage
- The transport stage's impact is dominated by the air freight transport leg, which accounts for 99% of the transport emissions. This is due to air freight covering the longest distances, as well as being the most intensive transport mode used.
- Recycling of the products resulted in a reduction in the lifecycle footprint of 56 kgCO2e.
- The largest gains from recycling come from the recycling of metals. Gold is the single largest contributor, followed by the recovery of steel. Avoiding virgin copper and aluminum production further enhances the recycling credits attributed to the product system.

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