

Medical device carbon footprint assessment: comparison of different methodologies

The **greenhouse gas emissions** of the **healthcare sector** represent **5 to 10%** of national emissions of most countries in the world,ⁱ making the healthcare sector a key contributor to global warming. Since medical devices and pharmaceutical products roughly account for half of these emissions,ⁱⁱ it is critical to better evaluate and reduce their carbon footprints to contribute to the overall reduction of emissions by the health sector. Ecovamed, a company specialized in Life Cycle Assessment (LCA) and carbon footprint evaluation of health products healthcare pathways, developed a methodology to perform such evaluations in a more efficient way, facilitating the obtention of high-quality results in less time, which is critical to eco-design healthcare pathways. This methodology is well adapted to medical devices (MD), medicines and their components, and can be performed within a cradle-to-gate or cradle-to-grave scope. This paper focuses on medical devices, whose carbon footprints are generally quite difficult to assess due to limited information on their composition, manufacturing processes, including their waste streams and energy consumption, real locations of production and type of transport between each manufacturing plants and then to the hospital.

A Comparative View

Estimating the carbon footprint of medical devices (MD) is essential for assessing their environmental impact and supporting eco-care strategies. Several methodological approaches exist:

- The **ADEMEⁱⁱⁱ economic emission factor** (0.30 kgCO₂eq/€), which provides a general average applicable across sectors.
- The **Corporate Carbon Accounting method**, which estimates emissions using the manufacturer's annual carbon emissions and annual revenues, to derive an average economic carbon intensity, in kgCO₂eq/€, for all MD produced by the manufacturer.
- The **Carebone tool^{iv}**, developed by AP-HP, which offers a simplified but detailed-enough tool, to assess MD carbon footprint from their composition (material types and weights, transformation processes, country of production, transport, end of life).
- **Life Cycle Assessment (LCA)^v**, based on ISO 14040–14044, which relies on comprehensive, product-specific data.

Another **hybrid approach** has been developed by Ecovamed (referred in this document as “Ecovamed Calculator”), which uses non-confidential data to perform the assessment: type of material, weight without and with packaging, price and main production location. Though less precise than LCA, it yields comparable results and enables standardized, transparent and scalable comparisons across products,

making it a robust alternative when primary data is unavailable. Indeed, this approach is more reliable than the average ADEME emission factor and generally even better than the corporate average emission factor if the manufacturers is producing a wide range of different products. Moreover, only a limited number of medical device manufacturers are publicly communicating their full scope 1, 2 and 3 carbon accounting. When all production data are available from all plants involved in the production of a medical device, the LCA methodology is by far the best option, but this information are rarely available, even more when health professionals are assessing a healthcare pathway requiring tens of medical devices and start to request information to suppliers. The alternative often seen in scientific publications is a **simplified LCA** from secondary data, meaning data you can have in observing the device (type of materials, weight, declared country of production in the packaging). However, it doesn't give any information on "hidden materials", operational losses, production waste, specific transformation processes, energy consumption, infrastructure of production, purchase of indirect goods and services, employee commuting, and the complexity of the supply-chain. In many cases, these simplified LCAs are underestimating medical carbon footprint by a factor from 2 up to 10, or even 100 in some cases.

	Economic factor (ADEME)	Corporate carbon accounting	Simplified LCA (ISO 14040–44)	Carebone (AP-HP)	Full LCA (ISO 14040–44)	Ecovamed Calculator
	A unique economic emission factor (0,30 kgCO ₂ eq/€) to estimate emissions based on the purchase price.	An average economic emission factor based on corporate carbon accounting and revenues	Impact assessment based on secondary data across the product life cycle, with many assumptions and cut offs	Provides a template with default activity data and emission factors to run a simplified LCA.	Impact assessment based on a full life cycle inventory , using detailed and confidential primary data .	Combines price, material type, weight and manufacturing location using a standardized approach.
Pros	Easy & Fast. Include all emissions	Specific to the manufacturer. Include all emissions	Based on materials and weight, with physical data	Based on materials and weight, with physical data	Based on the exact process, supply chain and materials	Easy and not too time consuming. Include all emissions.
Cons	Too generic. Overestimate complex ND and underestimate simple ones	Not easy to have full and accurate carbon accounting	Too many simplifications, leading to under-estimations. Takes time	Some simplifications that could lead to under-estimations	Require primary data and more time intensive	Do not consider specificities of different manufacturers
Required data						
Uncertainty						
Comparability						
Time						

- Data simple to get / lower uncertainty
- Data more difficult to get / middle uncertainty
- Data requiring a lot of time to get / higher uncertainty

Table 1 : Overview of methodologies for assessing the carbon footprint of medical devices

The Ecovamed methodology estimates the product's process complexity and assign an economic emission factor based on this complexity and the location of production, using Exiobase database, which allows for a nuanced yet standardized approach, even when detailed production data is unavailable. Another key advantage, as for the ADEME economic emission factor and the corporate carbon accounting-based method, this calculator integrates all greenhouse gas emissions (material, energy, transport, waste, infrastructure, purchase of services and goods, employee commuting, corporate activities) whereas LCA methods generally only focus on material, energy, transport and waste. For the medical device industry, it can lead at least to a 20-50% difference in carbon emissions.

A few examples

Based on a study made with the CHU Bordeaux, France, several medical devices have been assessed according to 3 methodologies: Carebone, a simplified LCA with detailed processes and operational losses, and the Ecovamed calculator. Some results on 3 different medical devices are shown in Figure 1, highlighting the interest of the calculator.

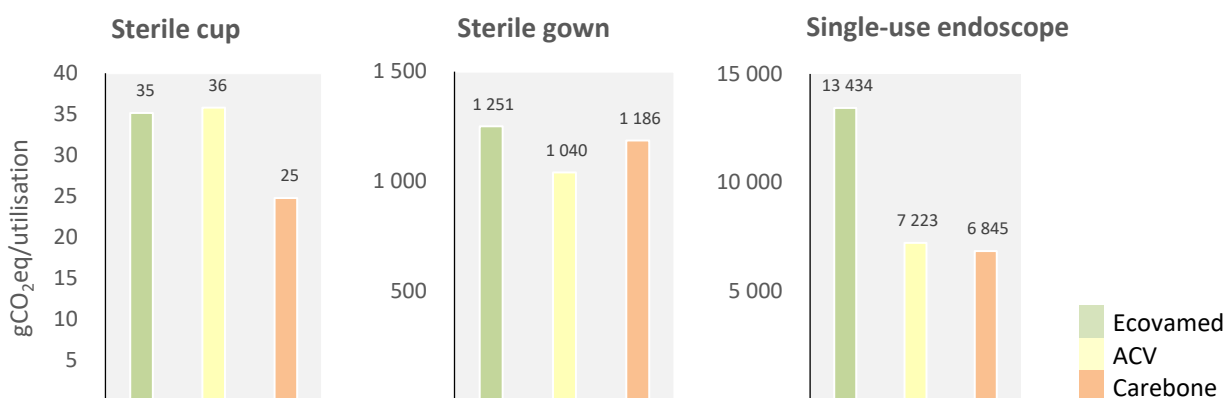


Figure 1 : Emissions of three medical devices depending on the methodology used for calculating

For low-cost medical devices, such as a sterile cup, the Ecovamed Calculator and the LCA provide similar results. Considering a medical device with intermediate complexity (e.g., a sterile gown), the Ecovamed Calculator allows a precise assessment of the carbon footprint, similar to other methodologies but requiring less time. Finally, for highly complex medical devices (e.g., single-use endoscope), the Ecovamed Calculator captures more GHG emissions, linked to the more complex manufacturing process, and may avoid some under-estimations. .

Conclusion

Several methods exist to assess the carbon footprint of medical devices, each with varying levels of precision, comparability and feasibility. Life Cycle Assessment (LCA) from primary data is the most accurate but requires confidential, product-specific data and is more time-consuming. Corporate carbon accounting-based methods are easier to apply but rely on aggregated data, limiting reliability. Tools like Carebone offer a simplified LCA approach with generic activity data which are useful and reliable, especially for simple medical devices, but results can be underestimated for complex MD. The ADEME is overly generic and lacks product relevance. The Ecovamed hybrid approach offers a practical compromise based on accessible data, enabling consistent comparison across products without requiring sensitive information.

About Ecovamed

We are an innovative company created in 2020, with the ambition to contribute to a sustainable access to health products. By relying on an improved process, **Ecovamed allows the healthcare industry and the chemical, polymer and biotechnology industries to assess the carbon footprint and LCA of their products at a lower cost**, which is the first step before setting greenhouse gases emission reduction plans. Ecovamed is also supporting health professionals to eco-design healthcare pathways. For more information on Ecovamed, visit www.ecovamed.com or contact us at contact@ecovamed.com.

Conflict of interest

Ecovamed provides services to the healthcare industry, including LCA and carbon footprint assessment of their products and support to reduce their greenhouse gas emissions. Ecovamed notably provides consulting services to medical device manufacturers.

Example of Medical Devices which can be assessed (carbon footprint and life cycle assessment)

Surgical gowns, Isolation gowns, Disposable coveralls, Surgical caps, Face masks, Goggles, Gloves (latex, nitrile, vinyl), Shoe covers, Aprons, Surgical drapes, sponges, gauze, Bandages (elastic, crepe, cohesive), Dressings (hydrocolloid, alginate, etc.), Swabs (alcohol, iodine), Pads, Hemostatic agents (powders, dressings), Syringes, Needles, Infusion sets (gravity and IV pump compatible), IV cannulas, Catheters, Extension tubing, Blood collection tubes (vacutainers), Lancets, Butterfly needles (winged infusion sets), Intravenous fluid bags (saline, glucose, Ringer's, etc.), Endotracheal tubes, Feeding tubes, Spatulas, Kits, Diagnostic test kits (e.g., COVID-19, malaria, HIV), Disposable ECG electrodes, Surgical blades, Scalpel blades, Biopsy punches, Electrosurgical pencil sleeves, Disposable suction tubing, Suture removal kits, Surgical instrument pouches, Bedpans, Ostomy bags, Imaging (X-ray, MRI, CT scanner, ultrasound...), Pacemakers...

ⁱ P.-P. Pichler *et al*, 2019, Environ. Res. Lett., **14**, 064004

ⁱⁱ Decarbonizing Health for Sustainable Care, Shift Project, April 2023, <https://theshiftproject.org/article/decarbone-sante-rapport-2023/>

ⁱⁱⁱ Base empreinte, ADEME, 2025, [Accueil | Base Empreinte®](#)

^{iv} Assistance publique – Hôpitaux de Paris, 2025, [Carebone® : un outil pour décarboner le soin mis à la disposition de tous les professionnels de santé | APHP](#)

^v Normes ISO 14044:2006, 2006, [ISO 14044:2006 - Environmental management — Life cycle assessment — Requirements and guidelines](#)