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ENVIRONMENTAL AND ECONOMIC ANALYSIS of Operating Room Textiles

Life Cycle Assessment (LCA) and Life Cycle Costing (LCC)

Ebli is an association between

ASSOSISTEMA CONFINDUSTRIA

FILCTEM CGIL

femca cisl

UILTEC

Italian Sustainability

First in the world with environmental criteria on textile reuse in public procurement.

With Article 15, paragraph 4-bis of Decree-Law 18/2020, Italy chose to lead the change by being the first to introduce a clear orientation toward environmental sustainability in public procurement.
The decree, in fact, established for the healthcare sector a priority choice for reusable medical and protective devices over single-use products.
The **Minimum Environmental Criteria (CAM)** for textiles and laundry services have had
concrete effect to this choice:

- Healthcare and social-healthcare facilities must prioritize the use—and therefore the supply—of gowns and medical devices made of reusable technical textiles to be subjected to sanitization and sterilization.
- The objective is to reduce the production of waste generated by single-use products and to promote reusable materials.



Why talk about textiles in the operating room?

The operating room represents one of the most delicate and complex environments within a healthcare facility. It is the place where advanced technologies, specialized expertise, and rigorous procedures are concentrated, but above all it is the space that welcomes people in a condition of vulnerability, often physical and emotional.

At the same time, it is important to reflect on the relationship between the operating room and environmental sustainability. High energy consumption, the production of special waste, and the use of single-use materials pose significant ecological challenges. Today, more hospitals are moving toward more sustainable solutions, promoting best practices that combine clinical efficiency with environmental responsibility.
It is also crucial to reflect on how textile materials used in this sensitive environment are managed.



Types of textiles



In the healthcare sector, numerous types of textiles are used: **surgical drapes, gowns (surgical and non-surgical), and bed linen (sheets, pillowcases, etc.).**

The study focuses on the analysis of selected **surgical drapes and gowns.**



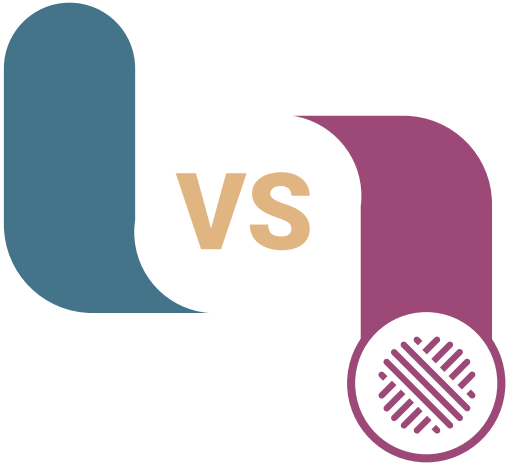
Objective of the study

To understand the more **sustainable choice between:**

Reusable products

TTR

Reusable Technical Textile



Single-use products

TNT

Nonwoven Textile

The analysis did not stop at the phase alone but included the entire life cycle: from the production of raw materials to final disposal, including transport, washing, and sterilization.

Methodologies

Two internationally recognized methodologies were used:



LCA
(Life Cycle Assessment)

according to ISO standards 14040 and 14044, to assess the environmental impacts throughout the entire life cycle of products, “from cradle to grave.”

LCC
(Life Cycle Costing)

to analyze overall economic costs, considering both the purchase of materials and management and disposal costs.

Functional unit

A gown or a drape reused 60 times, maintaining the fabric's characteristics without signs of wear that would prevent its use, **compared with 60 single-use items.**



1 TTR ITEM USED 60 TIMES

60 SINGLE-USE TNT ITEMS

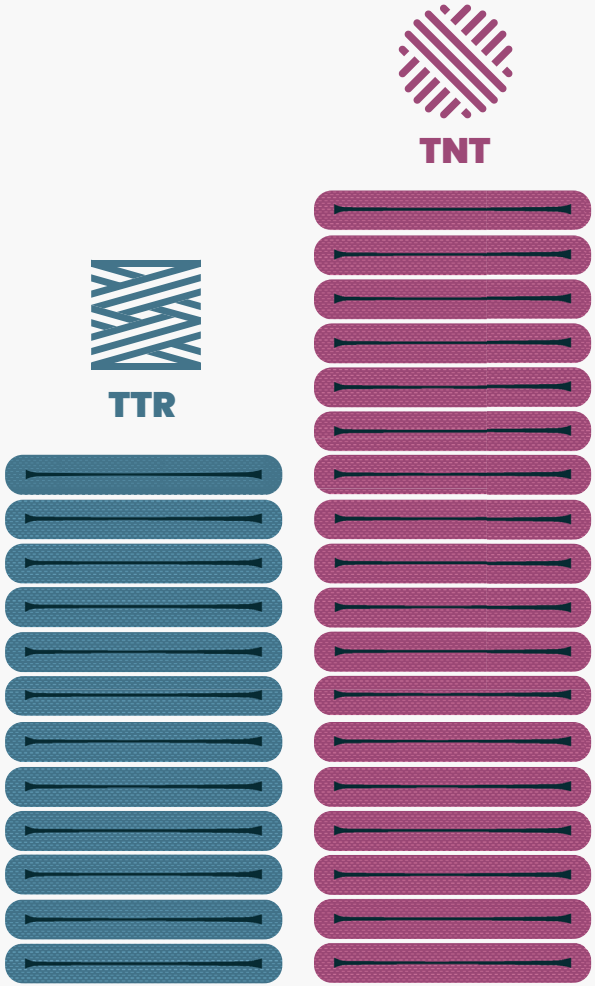
Products compared

The most used gown sizes are L and XL.
For drapes, the dimensions are based on the technical datasheets collected.

Types of gowns analyzed

- **Reinforced TTR gown:** high-performance thermoplastic material, with a “sandwich” structure in Teflon® and membrane bonded with polyurethane adhesive
- **Reinforced TNT gown:** polyethylene + polypropylene with colored pigment

Single-use textiles are sterilized with ethylene oxide, a phase included in the product life cycle.

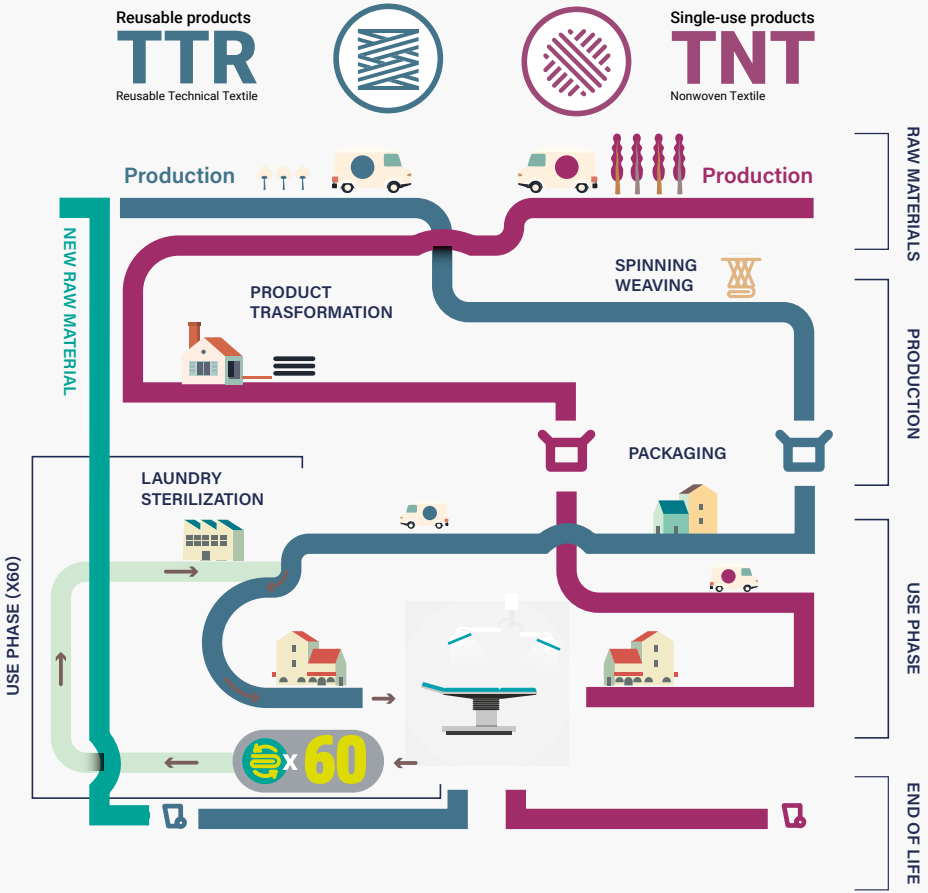


Life Cycle Boundaries

Every textile product follows a path that begins with the extraction of raw materials and ends when it becomes waste. In between we find production, washing (for reusable products), transport, and the use of packaging. For each phase, the following are considered:

- energy consumed
- water used
- chemicals employed
- packaging required
- waste generated
- emissions to air, water, and soil
- land use, when relevant

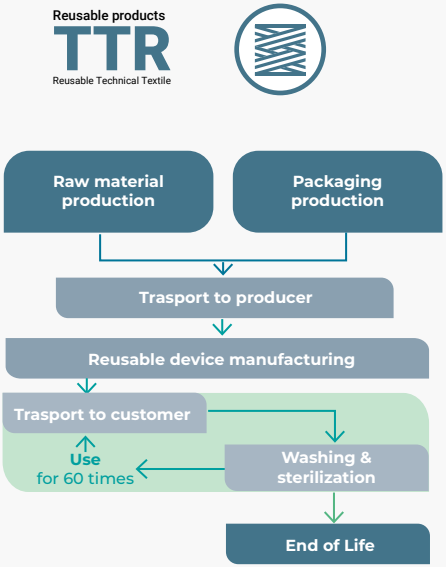
Understanding this life cycle means having an additional tool to assess environmental impact and choose more sustainable solutions.

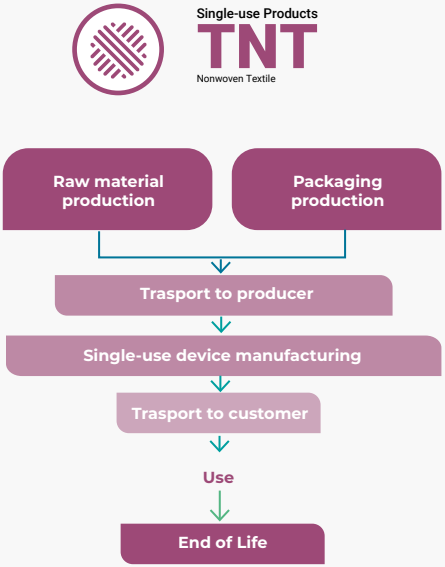


Life cycle phases

The phases with the greatest impact

- **For TTR,** the most impactful phase is **washing (85%),** followed by **transport (12%),** while **end of life** accounts for much less **(2.5%)** if the textile is sent for recycling. The production phase for this textile, since it can be reused 60 times, becomes marginal.
- **For TNT,** production has the greatest impact **(up to 69% of the total impact),** followed by **end of life (incineration: 29%).**





Reuse makes a difference:

End of life

At the end of their life cycle, two very different scenarios emerge for healthcare textiles.

Reusable (TTR): offers more sustainable options (chemical recycling, mechanical recycling, incineration, landfill) in which end-of-life accounts for approximately 2.5% of the total.

Disposable (TNT): 100% destined for incineration, with a high impact in both production and disposal, accounting for 29% of the total impact.

Composition (%) of impacts by life cycle phase – TTR in the landfill scenario (worst case)

Product	*Impact category*	*Unit*	*Production of the device and its packaging*	*Use phase, transport, washing and sterilization (60 uses)*	*End of life*
Reinforced gown TTR	Climate change	Kg CO_2 eq	0,4%	97,1%	2,5%

Composition (%) of impacts by life cycle phase – TNT in the incineration scenario

Product	*Impact category*	*Unit*	*Production of the device and its packaging*	*Use phase*	*End of life*
Reinforced gown TNT	Climate change	Kg CO_2 eq	69%	2%	29%

LCA Result

The environmental evidence is clear…

Reusable textiles significantly reduce environmental impact compared to single use (TNT).

Reusable XL gown

15Kg CO_2

equivalent

Single-use XL gown

23Kg CO_2

equivalent per item

For surgical drapes, the advantage increases

Reusable drape

27Kg CO_2

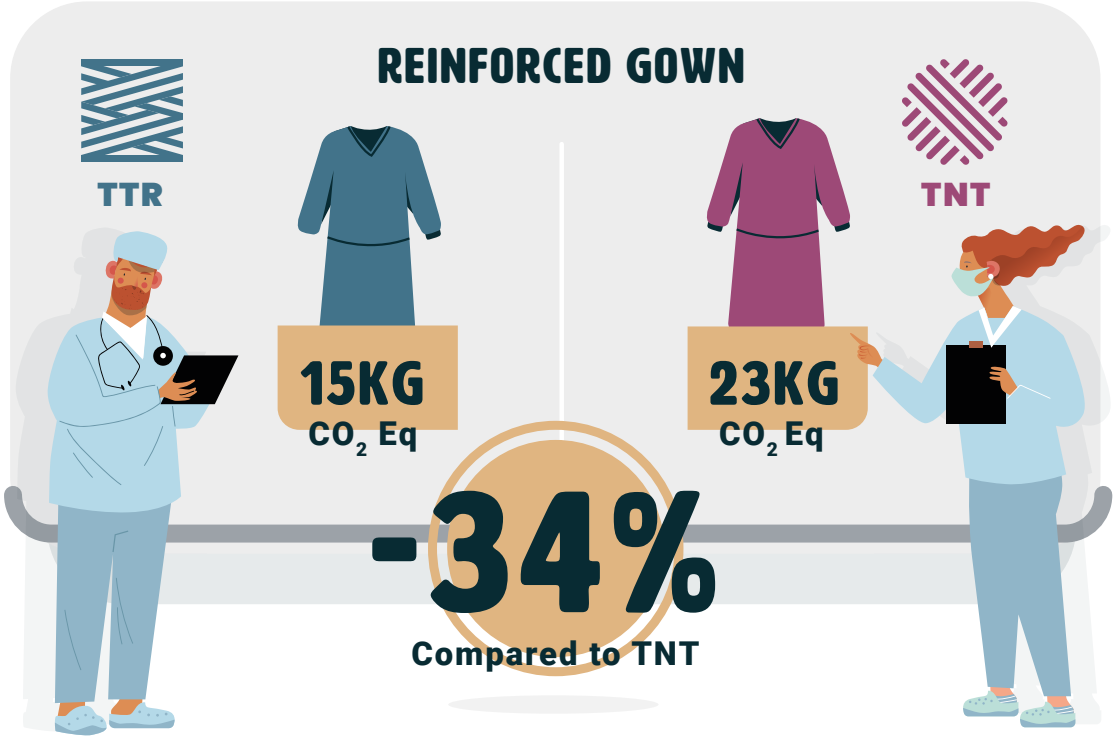
equivalent

Single-use drape

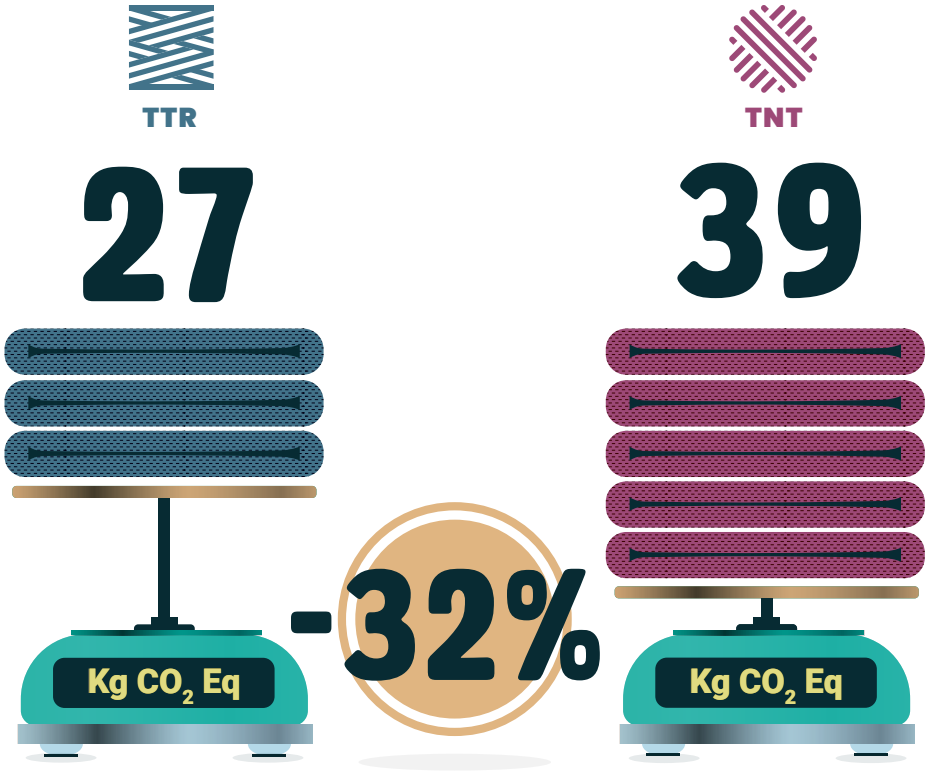
39Kg CO_2

equivalent per item

Climate footprint of gowns



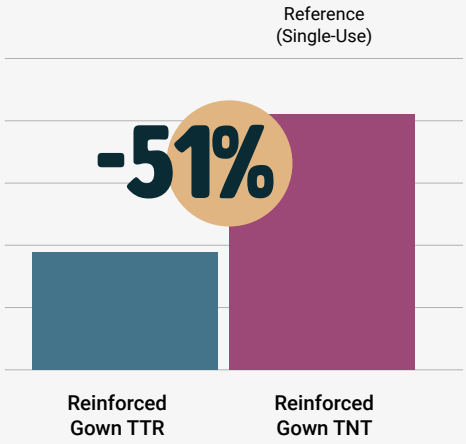
Climate footprint of drapes



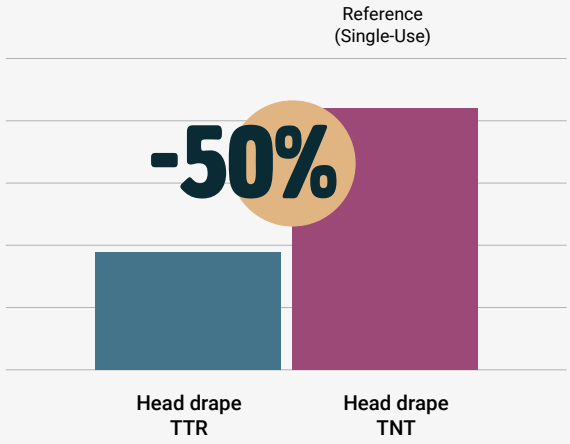
Enviromental impacts

The single environmental indicator is a number that summarizes various environmental impacts, such as emissions, water and energy consumption, or resource depletion. In the case of TTR products, even when considering the worst-case end-of-life scenario (landfill), the impacts are reduced by more than half.

Gowns - single indicator



Head drape - single indicator



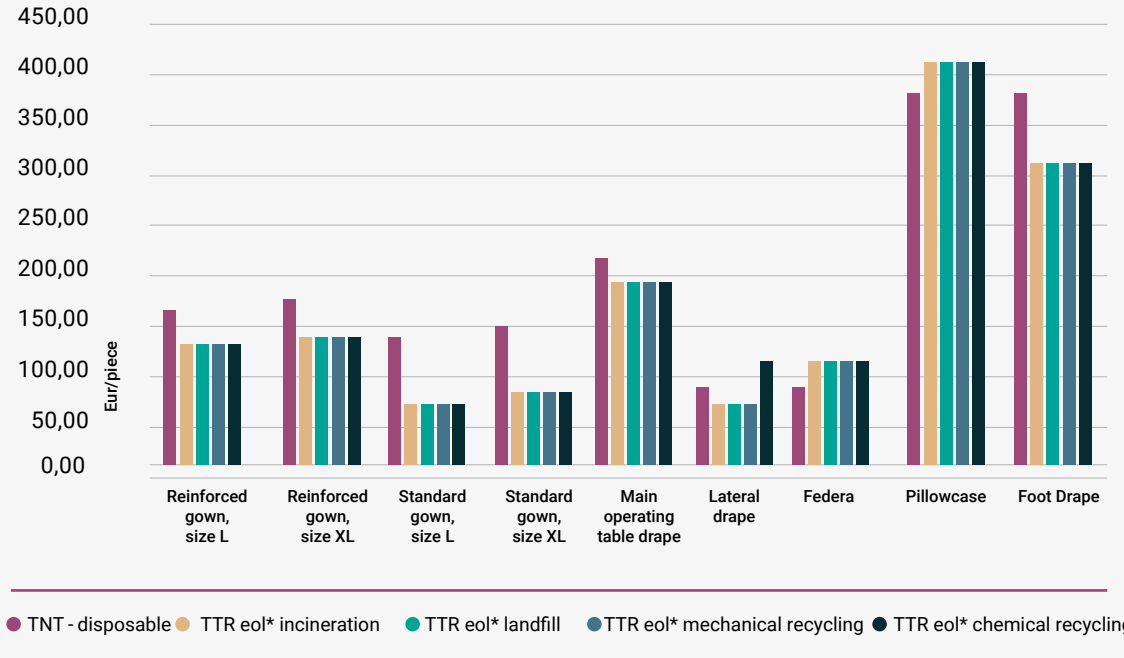
LCC Results

Economic advantage

From an economic perspective as well, reusable products win.

The results show life cycle cost differentials in favor of TTR **ranging from a minimum of 18–20% up to 48–50%** (except for pillowcases and drapes, due to the greater fabric weight, which affects the final value).

Comparative Analysis of Items - Life-Cycle Costing

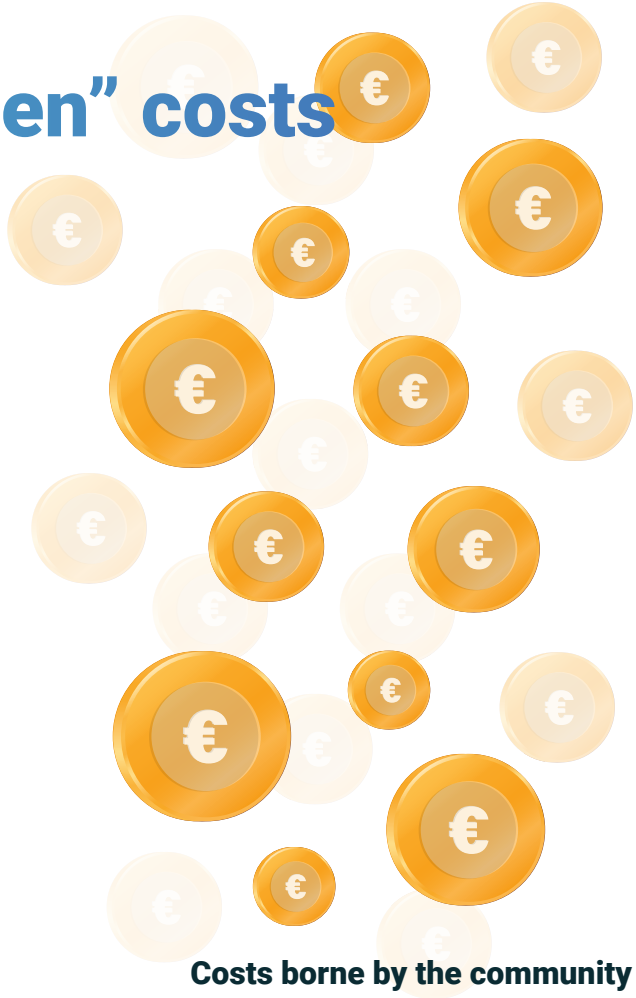


*eol: end of life

Externalities: the “hidden” costs

A single-use gown generates 14.5 kg more CO_2 than the reusable one, an environmental burden that, when translated into social costs, is estimated to reach up to €1.3 more per gown (including environmental damage and costs borne by the community). Multiplied by 60 devices, this amounts to a total of €78.





Costs borne by the community

The assessment was carried out using the eco-cost method.

Why choose reusable products?

Choosing reusable means:

- reducing CO_2 emissions
- reducing resource consumption
- cutting costs for the healthcare system and for the community
- supporting the transition toward sustainable healthcare





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LCA e LCC Study

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