

Beyond Heating & Mixing: Sustainability Aspects around the Eppendorf ThermoMixer® C

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Executive Summary

Eppendorf is committed to accountability, consistency and transparency – the three principles of the ACT® label – to reduce its environmental impact and provide its customers with high-quality, sustainable products. In addition to the various products Eppendorf offers, including ULT freezers, consumables, pipettes, benchtop centrifuges, PCR cyclers, the Eppendorf ThermoMixer® C is certified with the ACT label. This label scores a product's total environmental impact with respect to multiple sustainability factors, such as manufacturing, packaging, energy consumption, and recyclability. Besides the external validation in the course of the ACT-certification, there are further aspects supporting an improved sustainability footprint like power consumption, flexible usage, lifetime, service, spare part availability and finally, disposal at the end of lifetime.



A trend in industry and academia

Sustainability in the lab is a topic that continues to grow in importance at organizations across the globe. The large global pharma companies have established sustainability programs to analyze their internal processes and make changes to improve efficiencies, to weigh the influence of their behavior and their processes in respect to sustainability. The goal of many of these programs is to provide benefits to society and the environment while also positively impacting the economics of the business.

My Green Lab®

My Green Lab's mission is to constantly and permanently improve the sustainability within research labs. As a non-profit organization, My Green Lab focuses on joining and leading a broad community in the laboratory towards a world in which all research projects reflect the highest standards of social and environmental responsibility.

The organization, founded in 2013, has grown rapidly from a local non-profit organization to an international agent for change and improvement in respect to sustainability in laboratories worldwide.

Self-described as "Run for scientists, by scientists", My Green Lab develops standards for greener labs and lab products. These improved or new standards also need to be over-seen in respect to their implementation. One of the major challenges is the inspiration of the many behavioral changes that are needed throughout the scientific community. This lab community encompasses a broad range of people in various roles, including scientists, vendors, designers, energy providers, and others.

Eppendorf partnered with My Green Lab in 2017 and the CryoCube® F740hi ULT freezer (Ultra-Low Temperature freezers) was the first ACT-labeled ULT freezer worldwide and one of the first products with an ACT label. Since then, a lot of other products of Eppendorf gained the label but also other companies within the laboratory area joined the ACT label community.

The label can be read like a nutrition label or like the European performance card for a washing machine or dish washer. The ACT label shows how products 'rate' in different sustainability-related categories by value, which is supported by a color-code of red to green to indicate a high or low value.



ACT Environmental Impact Factor logo of My Green Lab® Organization

The Instrument – flexible usage

The Eppendorf ThermoMixer C provides reproducible heating, cooling, and mixing of almost any of your lab vessels. Reliable prevention of condensate formation in small vessels can be achieved with the optional ThermoTop® heated lid. A wide variety of Eppendorf SmartBlocks are available for the Eppendorf ThermoMixer C. These thermoblocks offer you a broad flexibility for use of nearly all common vessel and plate formats while still using the same instrument.

- > Fast and simple block exchange due to QuickRelease function
- > Optimized block design guarantees fast temperature transfer to the sample
- > Automatic SmartBlock recognition for automatic adaption of settings and block-specific calibration

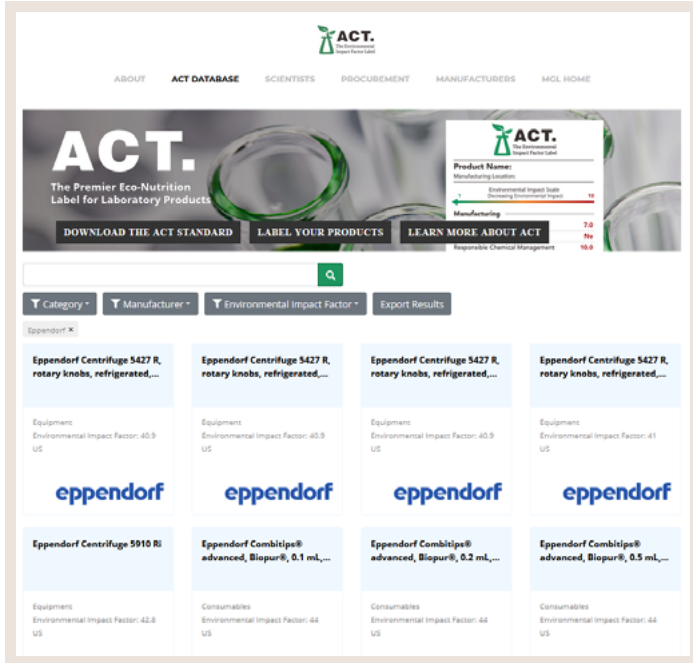


Figure 1: The complete ACT-labeled product portfolio is available at <https://act.mygreenlab.org/>

Combining accountability (A), consistency (C), and transparency (T) in respect to manufacturing, energy consumption, water usage, packaging, and end-of-life disposal, the ACT label provides an easy and intuitive way to evaluate the sustainability of a selected product. The product is validated and scored based on a number of different "Environmental Impact Factors" (EIFs). The scoring of the data is performed by an independent organization and then verified and published by My Green Lab. The total score is finally summed up. In principle, the ACT label is basically a scoring card about sustainability.



Figure 2: ThermoMixer C with selection of different SmartBlock options



An Eppendorf product developed based on the PhysioCare Concept provides a comprehensive approach for the user.

Ergonomics

Ergonomics is part of the sustainability concept and it is far beyond the »ergonomically designed chair«. Eppendorf started to optimize the laboratory devices regarding ergonomics already in the early 1970s. In 2003, we started the PhysioCare Concept, focusing on ergonomic liquid handling devices like our pipettes. Nowadays, the Eppendorf PhysioCare Concept® is broadened up to include further laboratory products as a holistic solution to harmonize the workflow in your laboratory with your health and well-being, e.g. for the Eppendorf ThermoMixer:

e.g. for the Eppendorf ThermoMixer:

- > Eppendorf QuickRelease for easy block exchange within seconds
- > Insulated SmartBlock for safe gripping / no burning of fingers
- > Direct keys for convenient handling
- > Program keys for fast and simple access to the most frequently used mixing / temperature parameters
- > Small footprint to enable position in direct arm reach at your bench
- > Standardized »user-interface concept« for intuitive handling of devices



Figure 4: Eppendorf QuickRelease for easy and fast block exchange within seconds

ACT label factors of scoring

The ACT label takes a broad range of aspects into account. Although not representing a complete and real life-cycle-analysis, ACT provides a lot of indications regarding the life cycle.

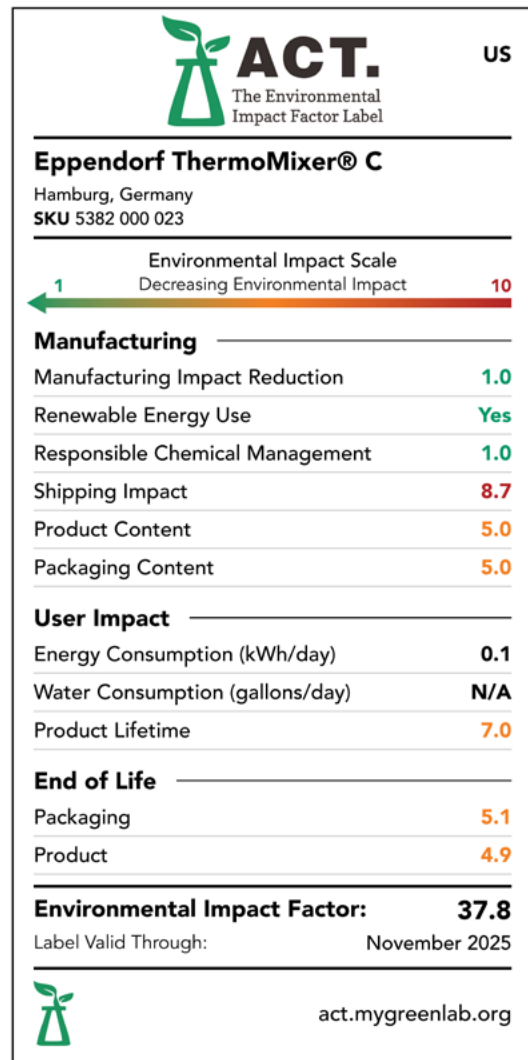


Figure 3: ACT Label of ThermoMixer C. This overview provides knowledge about the different steps in a life cycle of the ThermoMixer, e.g. the renewable power in assembly or the long transportation from the factory in Germany to the USA (ACT label with US reference)

Further information about the Eppendorf PhysioCare Concept: www.eppendorf.com/physiocare

Manufacturing impact reduction

The Manufacturing Impact Reduction considers activities and initiatives within the production facility in recent years to reduce the environmental impact. This can include modifications of buildings, new heating systems, new production machines, or even educational advancements of the staff. The handling of waste is also addressed.



Figure 5: Since 2018, Eppendorf has changed most of the global power contracts to renewable energy. In 2024, we have received ca. 90% of our electricity coming from renewable sources

Renewable energy use

Renewable Energy Use is related to the power supply contract of the manufacturing facility. In our mixer facility, we already use 100% renewable power contracts (since 2019), similar to most of our Eppendorf locations. This is significantly reducing our Scope 2 emissions but also improving your Scope 3 emissions.

Scope 1: Direct GHG emissions refer to emissions from sources that are owned or controlled by the company, like the generation of electricity, heat or steam, transportation of materials, products, employees by company owned.

Scope 2: Indirect emissions refer to purchased electricity.

Scope 3: All other indirect GHG emissions which occur in a company's value chain, like extraction and production of purchased materials, product use, disposal of waste, or employee business travel.

Responsible chemistry management

Responsible Chemistry management covers the handling of chemical reagents during production. As the assembly is performed in the factory in Germany, working instructions and safety guidelines comply with the high German and EU-law. The product needs to be EU RoHS/ REACH compliant, and Eppendorf as company but also the dedicated factory is ISO 14001 certified. Chemical substances must be free of CMR (carcinogenic, mutagenic, and toxic to reproduction), PBTs (persistent, bioaccumulative, and toxic), HCFCs (hydrochlorofluorocarbons), GHS Category 1 Hazards (Globally Harmonized System of Classification and Labelling of Chemicals), and red list chemicals. Eppendorf happily checks all of these boxes.



Image source: by Konstantin Faraktinov/shutterstock.com

Figure 6: Global transportation of goods should mainly based on cargo ships to save carbon emissions

Shipping impact

The Shipping Impact describes the transportation of the product from the production facility (in this case, Germany) to the country of usage, e.g. USA. The concept is based on reduction of shipment distance. Especially for food, this "preferred local production" concept makes sense. For specialized products like lab equipment, there are only a few facilities worldwide which are able to produce this equipment. Shipment, including long-distance shipment, is a necessity as the equipment is needed globally. The type of shipment has an impact as well: Shipment by cargo ship is preferred. Transportation by cargo plane is neither environmentally (CO₂) nor economically (cost) sustainable.

Product content

In the Product Content category, My Green Lab analyses the recycling quotes of raw material. Recycling quotes of metal work are especially challenging: Copper and steel are melted in big reservoirs which are supplied with material from both sources: iron/ copper ore (= new steel/ copper) and recycled steel/ copper. It is difficult to ascertain exactly what percentage of new or recycled materials end up in the metal sheets for a particular product. Averages and assumptions are needed as the actual value is variable. As of 2015, more than 50% of the produced steel in Europe was based on recycled material, and 90% of the steel in products was collected at the end of the product lifetime. The European copper demand is based on 44% recycled sources and 70% of the copper in products is collected (<https://eu-recycling.com/Archive/26491>).

Due to complex delivery chains, we can currently only document for 11.8% of the total instrument weight a recycling source of the raw material.

At least 30% of the parts (weight-wise) are obtained from regional suppliers in a 500 km circle around the factory. In some countries, the term “zero-waste-to-landfill” is used to describe an environmental improvement from landfill (waste-to-dump) to incineration (waste-to-energy) and/ or recycling (waste-to-raw material). The limited waste of the Eppendorf mixer manufacturing facility is not sent to any landfill but is being recycled or incinerated.

Packaging content

The Packaging Content addresses the footprint of the packaging and its recyclability. Our mixer packaging cardboard material consists of ca. 60% recycling material due to different sub-sources for the materials.

A significant reduction of material is very challenging, since the instrument must safely arrive at its destination without any damage to the instrument or the logistics team. Potential environmental savings are higher ratios for recycled material in the cardboard or a source for the low-density polyethylene (LDPE) dustcover foil with recycling content.

Power consumption

The power consumption of devices is one of the sustainability components, but it should not be your only decisive factor. The advantage of power consumption is the clear value, it is comparable. But power consumption is only one factor on a long list.

Imagine your desired instrument has a very low power consumption value, but it takes forever to reach the set temperature. There should be a balance between savings of resources such as power and impacts on the performance and safety of the samples.

We therefore strongly recommend keeping an eye on the overall sustainability picture.

As part of the ACT labeling of the Eppendorf ThermoMixer C, we decided to develop a combined approach with My Green Lab for power measurements of laboratory mixers. Three typical different temperatures were defined: 16°C, 37°C, and 65°C. Further conditions are RT = 21°C – 23°C, usage of a block for 1.5 mL tubes (in this set-up the SmartBlock 1.5 mL), a pre-set mixing frequency of 1,000 rpm, and 5x tubes (1.5 mL, filled with 1.5 mL water) mimicking samples.

Description	Wh
cool 21 °C -> 16 °C	1.2
37 °C, 0 rpm	7.6
37 °C, 1,000 rpm	12.8
heat 21 °C -> 37 °C	4.9
37 °C, 0 rpm	11.3
37 °C, 1,000 rpm	16.1
heat 21 °C -> 65 °C	13.2
65 °C, 0 rpm	21.8
65 °C, 1,000 rpm	28.9

Table 1: Power consumption of Eppendorf ThermoMixer C, different run parameters, based on three independent units

Based on three units from different production batches, the power consumption was measured and averaged. Compared to other instruments like centrifuges with hundred or even several hundreds W per hour, the mixing/ heating instruments requires a very low amount of energy (see Table 1). An one hour incubation of e.g., a restriction enzyme at 37°C consumes 11.3 W. Additional mixing at 1,000 rpm ends up with 16.1 W in total per hour.

Due to a very efficient mixing motor and well-designed temperature control technologies, the ThermoMixer C has a minor impact on your Scope 2 emissions in the laboratory.

The ThermoMixer C requires no energy-consuming standby function. The main power switch at the back of the instrument is switching off the device. When the unit is switched off, there is no power consumption. The device is ready to use within 10 s after switching it on.

Water consumption

Water consumption is zero for mixers during usage.

Product lifetime

The Product Lifetime is a topic of much discussion, as proof is challenging: A 10 year-old instrument can be boxed for 9.5 years and only used for the last 6 months, so it looks like new in year ten. In contrast, a workhorse that has performed its job for 10 years and may now be showing the first signs of wear.

During R&D time, the instrument is tested with long term load tests. High-quality thermomixers, combined with maintenance and service, can easily run for 10 years or longer.

Longevity, service & repair

The longer the life of an instrument, the more favorable for you as the user and for the environment. Price often plays a decisive role when purchasing a new piece of equipment, but it is important to keep in mind the expected lifespan of the instrument and the potential total cost of ownership over the years.

Longevity of an instrument is very important for the sustainability backpack. The longer a (well maintained) instrument runs in the laboratory, the less resources you need to use per year, the less CO₂-eq. are listed on your score card. A long lifetime is supported by regular preventive maintenance done by qualified service technicians. A reminder for the next service can be set directly at the device.

As with other Eppendorf instruments, the Eppendorf ThermoMixer C can be supported with spare parts for at least seven years after purchasing the equipment. This approach goes also beyond a future production and sales stop of a product.

The technical concept of the Eppendorf ThermoMixer is designed in a way that most of the parts can be replaced. That means, an absolute minimum of parts is glued but primarily fixed by screws or clamped together. This design increases the chances that the service life can be further extended through repair.

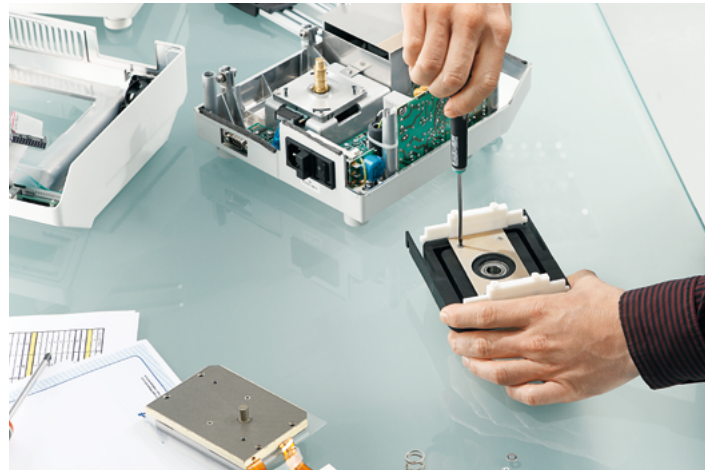


Figure 7: Instrument dismantling is simplified by less gluing but more screws and clamps

Maintenance in the laboratory

Often underrated in its relevance for supporting a long lifetime, a well-written operating manual combined with an intuitive user interface supports correct use and maintenance of a device. For example, this ensures that the device can be properly disinfected (wiping with 70% Isopropanol) without negatively impacting the function of the device e.g., by spraying, wetting or using aggressive chemicals that may be applied for other tools in the lab.

Regular cleaning of the surfaces prevents summing up of dust and eventually contamination.



Packaging material and broken instruments are no waste but can act as valuable resources for new products

Packaging end of life

The Packaging End of Life is usually reached after the shipment. Collection and recycling of all parts of the packaging is recommended. The packaging of the mixer contains different materials, this includes cardboard, a plastic dust cover, and some foam parts. Recycling of materials becomes more and more important every day: Are you aware that nearly all cardboard material is recycled in Europe? Please support the global sustainability initiative of recycling valuable

raw material by also collecting the thermomixer cardboard packaging material and disposing of it in the appropriate collection container at your organization. In respect to the plastic dust cover made of Low-density polyethylene (LD-PE) and the foam parts, we recommend to select a dedicated recycling partner where PE material can be recycled. We suggest you contact your local waste hauler or facility management team to understand the available recycling options for your organization.

Instrument end of life

Our mixers last for many years, but if they need to be replaced, we kindly ask you to fulfill local requirements for disposal of these instruments. We strongly recommend a certified local recycling partner with experience in instruments with electronics. Keeping it “local” reduces the impact of transportation, and the “certified” aspect is recommended due to the safe and sustainable removal of specific parts.

About 4,600 g of the total 6,300 g of the instrument are aluminum, steel, or alloy. All of them can be easily recycled, symbolizing ca. 70% of the device (in weight percentage).

Decontamination

This piece of equipment was used in a laboratory and/or was used to handle biological samples. Please keep in mind to adequately decontaminate the equipment which needs to be disposed. Check local requirements. For more information, get in contact with your local biosafety officer and/or waste officer. Check if your local recycling partner has special instructions and/or documentation requirements. You may also use the Eppendorf decontamination form sheet as guidance.

Summary

Sustainability in the laboratory is attracting more and more attention. There is a growing demand for data on equipment. Eppendorf has decided to follow and to support this pathway.

The ACT certification process requires an in-depth review of a company’s sustainability programs and an examination of all the environmental factors related to a selected product. With the certification of the ThermoMixer C, Eppendorf remains more committed than ever to supporting the planet and its people through Accountability, Consistency, and Transparency in its efforts to reduce its environmental impact.

But there is more to do. Eppendorf recognizes what it means to “go green”: The marketing slogan “green” must be based on facts. More sustainable products require focusing on the continuous development of new features and technologies, to reduce raw material usage and energy consumption and to minimize the environmental impact of the business and its products.

None of these challenges can be solved quickly or easily. But all of them demand a community approach and a consistent effort to listen to one another and work together. Supporting organizations like My Green Lab is an important building block of this journey. A focus on the environment ultimately provides a more sustainable future for everyone.

About Eppendorf

Since 1945, the Eppendorf brand has been synonymous with customer-oriented processes and innovative products, such as laboratory devices and consumables for liquid handling, cell handling and sample handling. Today, Eppendorf and its more than 5,000 employees serve as experts and advisors, using their unique knowledge and experience to support laboratories and research institutions around the world. The foundation of the company's expertise is its focus on its customers. Eppendorf's exchange of ideas with its customers results in comprehensive solutions that in turn become industry standards. Eppendorf will continue on this path in the future, true to the standard set by the company's founders: that of sustainably improving people's living conditions.

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