POSITION PAPER

SEPTEMBER 2023

CIRCULARITY IN THE EUROPEAN CONTINUOUS FILAMENT GLASS FIBRE MANUFACTURING

Toward zero internal glass waste going to landfill

EXECUTIVE SUMMARY

The European glass fibre industry is committed to working toward a drastic reduction of waste generation in its installations. The ultimate objective is that zero internal glass waste ends up in landfill. The intrinsic properties and qualities of the glass fibre products - such as its mechanical strength, low thermal conductivity or durability - and manufacturing process make waste reduction a challenging task, whereas Glass Fibre Europe's members are implementing solutions to overcome these barriers.

Between 2010 and 2021, the industry has reduced the share of internal glass waste sent to landfill from 11% to 6.9%. This was made possible thanks to the identification and implementation of various measures within the European installations, and in line with the European Union Waste Framework Directive:

1. **To avoid losses** by continuously improving the material efficiency in manufacturing processes.
2. **To reuse** glass fibre losses as by-product[1] in certain alternative reinforced plastics applications or, after further dedicated processing, in other alternative applications.
3. **To recycle** in own production streams by collecting and preventing contamination of glass losses, while allowing their further preparation for recycling (e.g., shredding, grinding, drying, sieving, etc.), and investing in internal recycling units and/or contracting external recyclers.

Several economic, technical, and regulatory barriers are still to be overcome by the European producers to achieve the zero internal glass waste to landfill objective, and the legislator can help overcome them. The last section of this paper presents measures that would help support the industry.

OBJECTIVE ZERO GLASS WASTE TO LANDFILL

Sustainability has taken a prominent position both socially and politically in Europe. In recent years, there has been a rise in environmental consciousness and increased awareness among companies and consumers about the consequences of their choices on the environment. This led the European continuous filament glass fibre industry to evaluate operational practices. Over the last decade, the glass fibre industry has implemented measures to reduce its environmental footprint while continuing the development and manufacturing of new products and solutions enabling the European Green transition in key sectors of the economy.

In 2022, the European industry agreed on the ambition to be climate neutral by 2050, while ensuring the common objective of zero internal glass waste ending up in landfill.

The two objectives are intrinsically linked. If glass waste can be refed as input material in the glass batch, it will reduce both the energy consumption and CO_2 emissions for melting the glass. As is the case in other glass sectors using cullet[2], it is estimated that the energy consumption to melt glass is reduced by 2 to 3% per 10% of recycled glass in the batch. In addition, using less virgin raw material reduces Scope 3 emissions associated with their extraction, processing, and transport.

The reduction in emissions is one of the benefits identified by the industry, which are manifold. In addition to reducing the impact of continuous filaments glass products on global warming by eliminating internal glass waste, it could also deliver both environmental benefits and economic opportunities.

[1] As defined in the Waste Framework Directive (Article 5).
[2] European Commission, 2012, *Glass BREF*.

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WHERE DO GLASS LOSSES OCCUR IN THE INSTALLATIONS?

Overall, 86% of glass fibre output of the European installations[3] meets the customers' product specifications (figure 1). Significant variations can be observed from one installation to another[4]. These variations are primarily due to the sensitivity of the process, the filament diameter of the glass fibres (the smaller the diameter, the higher the risk of breakages) and integrated downstream activities. Other factors can also influence the efficiency rate, such as variations in the composition and quality of the raw materials used, and (micro)disruptions in the energy supply.

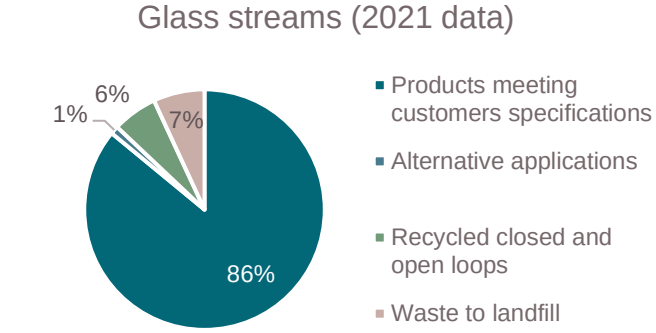

Figure 1

Glass losses occur at different stages of the manufacturing process:

1. **Drain glass**: (see figure 2, step 1) In some cases, a small fraction (usually <= 1%) of molten glass (where some unmelted heavy particles may be present) is drained from the bottom of the furnace channel to minimize the risk of filament breakage at the fiberization step. Drain glass is collected in the basement.
2. **Fiberization**: (see figure 2, step 2) Molten glass reaching the "bushings" (special metal alloy devices fitted with several thousands of calibrated holes and maintained at a precise temperature) is pulled (extruded) at constant high speed to form continuous glass filaments; the glass filaments undergo a rapid cooling (by water sprays and high-volume air flows) and a surface treatment ("sizing") is applied to the filaments before they are assembled into glass strands. Fiberization is the most critical step generating the main share of glass losses: any minute inhomogeneity or impurity in the molten glass can cause glass filaments to break requiring a repair of the process during which glass continues to flow by gravity and is collected in waste bins in the basement of the workshop.

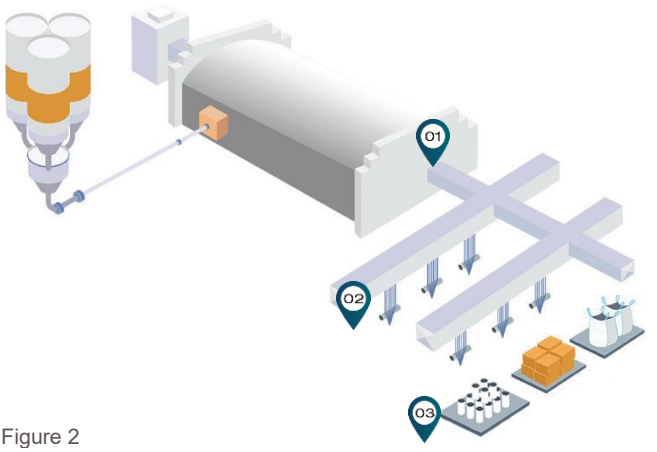

Figure 2

3. **Fabrication & downstream processes**: (see figure 2, step 3) Glass strands undergo further treatments (e.g., drying, winding, twisting, chopping, mat edge trims, quality control, etc. and finally packaging) to obtain end products suitable for customer applications, namely: Rovings, Yarns, Chopped Strands, Mats, etc. These various process steps are also generating some losses. Although limited in quantity, these losses are generally unavoidable because it is necessary to remove the portion of the process output that does not meet the specification of the final product.

[3] To be understood as the percentage of molten glass transformed into product meeting quality specifications. The estimate is based on data collected in Glass Fibre Europe's membership in 2023.
[4] European Commission, 2012, *Glass BREF*, Waste fibre and "drain glass" represented between 10 and 30% of process inputs.

WHAT PROGRESS HAS BEEN MADE BETWEEN 2010 AND 2021?

It is challenging to divert glass fibre losses from the waste to landfill stream. Not all losses occur at the same stage of the process, and the glass losses can only be used in the mineral batch input by means of significant further processing. Glass fibres are treated with a "sizing" (organic chemistry mixture) which must be removed, and the material must be shredded/grinded to an appropriate granulometry to prevent disturbing the process and increase the share of glass losses. Only specific measures taken at the plant level can successfully divert these waste fibres into recycling streams.

The progress made by the European installations can be seen in the three main streams of non-intentional glass output (figure 3)[5]**. Between 2010 and 2021, the share of glass losses sent to landfill has reduced from 68% to 49%, while the share of glass losses recycled in closed and open loops has increased from 23% to 43%.**

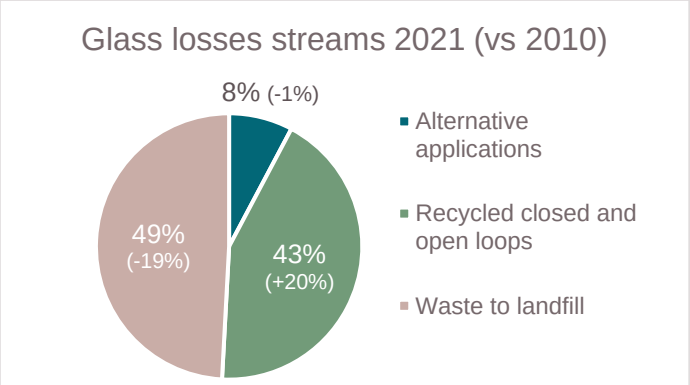

Figure 3

This positive evolution goes beyond glass losses only. In a recent Life Cycle Assessment report of continuous filament glass fibre products by *PwC*[6] the share of recycled industry production waste [7] increased from 26% to 44% (2015-2021).

To **reduce the glass waste** in its installations, the continuous filament glass fibre industry has implemented various **measures**:

1. **Improved process and material efficiency** to reduce and/or eliminate the generation of material losses. Preventing losses is the priority measure pursued by the industry in the drive of Zero Waste to landfill[8]. Nevertheless, it is generally considered that even with the current most advanced manufacturing technologies, some process losses are (still) unavoidable and additional measures are needed to meet the goal (see below).
2. **Measures to prevent contamination** of the glass losses to facilitate their recycling and/or repurposing. The fiberizing process is extremely sensitive and requires the highest purity level and absence of contamination of input materials used. Therefore, it is imperative that the recycling route avoids as much as possible any contamination of the recovered material. This is also the case for selected glass streams separately collected and dedicated to targeted alternative applications.
3. **Recycling external (open loop)** glass losses are reprocessed (either on-site or externally) for added value use in products other than glass fibre.
4. **Recycling onsite (closed loop)** to use glass losses in manufacturing operations and products. It is important to note that only continuous filament glass fibre waste can be recycled into continuous filament glass fibre to comply with glass composition applicable standards (e.g. ASTM D578, DIN 1259, etc.). The high alkali content of soda lime silica glass originating from other glass sectors (e.g. bottles or windows) as well as the specific manufacturing requirements make their recycling in the continuous filament glass fibre industry impossible[9].
5. Identification and development of **alternative applications** to divert glass waste from landfill. The industry has already built partnerships to develop added value use of glass losses in alternative applications (e.g. certain parts in automotive industry). Other alternative applications can be found in other industries without any processing other than normal industrial practice, such as filler in paints or secondary raw material in construction. Some of these alternative applications could be referred to as "by-product" in European regulation[10].

[5] The figures are based on data collected in Glass Fibre Europe's membership in 2023.
[6] PwC – Sustainable Performance and Strategy, *Life cycle assessment of CFGF – Continuous Filament Glass Fibre Products*, January 2023
[7] These figures cover all waste in the industry (glass, sludge, dust, plastic, paper and card board, metals,…).
[8] Significant progresses have been achieved when considering the level quoted in the Glass BREF "*waste fibre and "drain glass" can be between 10 and 30% of process inputs*" (p.122).
[9] The glass composition for continuous filament glass fibre varies depending on the specific properties required for some applications. The continuous glass fibre families can be E-glass, A, C, D, R, AR, ECR and S glass, each characterized by a various composition standards.
[10] As defined in the Waste Framework Directive (Article 5).

HOW CAN THE INDUSTRY BE SUPPORTED IN ITS EFFORTS?

Despite the ongoing efforts and investments made over the last decade towards the objective of zero internal glass waste to landfill, it is necessary to solve some technical, economic, and regulatory challenges.

The legislator can support the glass fibre industry in its efforts to eliminate landfill waste disposal in the glass fibre installations. While acknowledging that the need for support may differ from one installation to another, the glass fibre industry faces the same regulatory barriers when dealing with glass fibre losses. In this respect, the following items would help supporting the glass fibre industry transition towards its objective of zero internal glass waste to landfill:

- **A formal clarification that the output material of the internal recycling process** (requiring further processing other than "normal industrial practices") **can be accounted as "recycled content"**. This will contribute to promoting the circularity practices and recycling in the industry and in downstream supply chains.
- **To add glass fibre waste to the waste shipments "green list"** to reduce administrative burden and facilitate shipments. When considered as waste, transport is made unnecessarily difficult and more expensive (e.g. special licences and equipment are required).
- **Financially support investments in recycling units in the installations.**
- **Invest or support investments in efficient recycling infrastructures**, as well as for the **collection, sorting infrastructure and facilitate their access** to industries like glass fibre installations.
- **Support research and development** in projects for innovation in recycling technologies and manufacturing processes that promote the efficient use of resources.
- **Facilitate collaboration between industries, recyclers and other stakeholders**, e.g. by establishing platforms or creating industry alliances.

It is crucial to allow the necessary flexibility to the glass fibre industry in terms of actions to achieve the zero internal glass waste to landfill objective. The environmental impact of the circularity options (e.g., energy consumption and related emissions of certain recycling processes and transport) will differ from one installation to the other, and the optimal solution (from a life cycle perspective) may vary according to plant specific and/or local factors. Ultimately the objective should be to achieve an overall positive balance over the whole life cycle of the products and applications, as compared to current baseline supply chain practices.

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About Glass Fibre Europe – EU Transparency Register n°635608817518-09.

Glass Fibre Europe, founded in 1987, is the voice of the European continuous filament glass fibre industry. It is composed of 8 companies: 3B the fibreglass company, Envalior, FYSOL SAS, Johns Manville, Nippon Electric Glass, Owens Corning, Valmiera Glass, and Saint-Gobain Vetrotex. Glass Fibre Europe represents all the major producers of continuous filament glass fibre in Europe. The continuous filament glass fibre industry is the cornerstone of the glass-based composite materials and technical textiles value-chains.

Glass fibre's unique properties enable the production of wind energy, electric and electronic devices, and the development of sustainable solutions in a wide range of applications, such as transport and construction.