Energy Flexibility in the German Glass Industry

Two-Pager

Diversity in glass production: The industry's heterogeneity does not allow for generalizations. Each location and each product in the glass industry has its own highly individual requirements and conditions for achieving the desired quality. It is particularly important to distinguish between the individual sub-sectors of flat glass, container/hollow glass, and speciality glass.

The **Research Association for Energy Economics (Forschungsstelle für Energiewirtschaft, FfE)** has conducted a study entitled "Energy Flexibility in the Glass Industry" for the **Federal Association of the German Glass Industry (BV Glas).** The study analyzes the technical and economic conditions for energy flexibility potential in glass production. This is in response to the planned phasing out of the German "base load regulation" in 2026.

The **„base load regulation" (Bandlastprivileg)** refers to a reduction in grid fees for electricity-intensive end consumers (>10 GWh/a). Consumers with a constant electricity consumption of at least 7,000 full-load hours are therefore eligible for a grid fee discount of up to 80 %.

The Federal Network Agency (BNetzA) is planning to revise network fee privileges to promote the integration of renewable energies into the energy system. One of the goals is to encourage flexible electricity procurement in response to fluctuating generation.

Energy flexibility is "the ability of a production system to adapt quickly and efficiently to changes in the energy market. Product quality must remain unchanged."

VDI 5207 Blatt 1 - Energieflexible Fabrik - Grundlagen. Version: 07/2020; Düsseldorf: VDI-Gesellschaft Produktion und Logistik, 2020.

The study aims to scientifically evaluate the energy flexibility potential of the glass industry, identifying the technical limitations and economic conditions that must be considered in the planned restructuring of grid fee reductions.

Methodology & Study Design

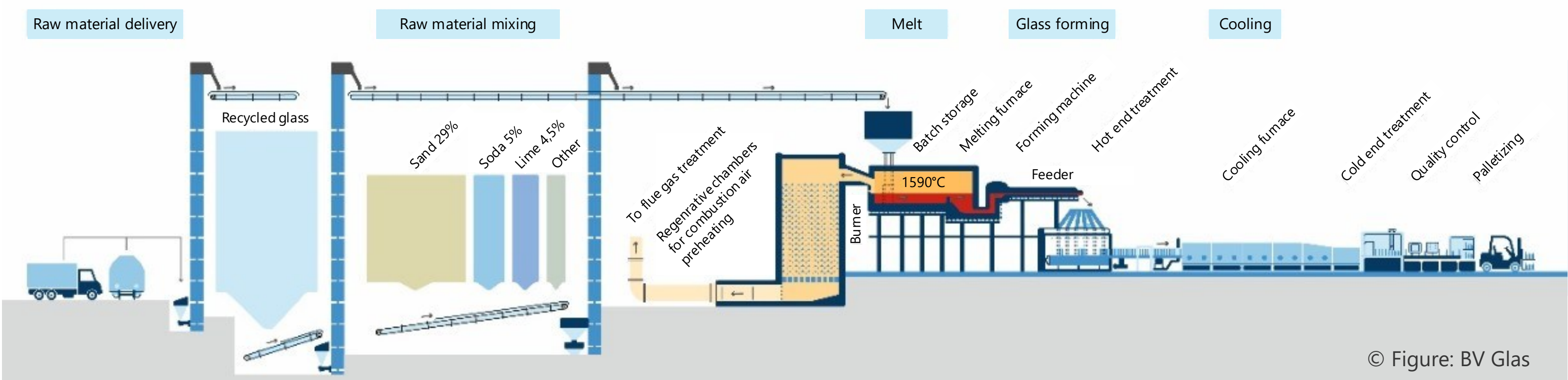
The study is based on practical interviews with melting tank manufacturers and glass producers, as well as on-site visits to production facilities in the sectors of flat glass, hollow/container glass and speciality glass. It examines the current situation as well as potential decarbonisation pathways.

The interviews with practitioners show:

Glass production is a diverse, complex, and continuous process (see figure) with highly individual, site-specific requirements.

Temperatures of up to 1,650 °C are reached in the energy-intensive **melting tanks,** which account for up to 80% of the total energy required for the manufacturing process. Production capacities range from a few kilograms (speciality glass) to over 1,000 tonnes per day (flat glass). They must be operated continuously and have a service life of up to 20 years. Product quality depends on the melting properties. Therefore, a **stable thermal equilibrium** is necessary to maintain the specified quality, ensure energy efficiency, and prevent damage to the melting tank. The subsequent shaping process, which follows immediately after melting is also partly determined by the melt. **After changing process parameters, it often takes several hours to days for a new thermal equilibrium to be established.** Then, a further few hours to days are required before the product can be manufactured to the required quality.

Therefore, energy flexibility options are severely limited due to process restrictions and cannot currently be utilized on a relevant scale.



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Energy Flexibility in the Glass Industry: Acknowledging technical limitations and product diversity while avoiding conflicting goals.

1

Technical reasons: Low energy flexibility potential in the manufacturing process

All glass production processes must run continuously in order to maintain the set thermal equilibrium in the process and thus the desired product quality, and to prevent equipment damage. Changes to the process have a direct impact on product quality and usually lead to production rejects. Due to the thermal inertia in the process and the sometimes long dwell times in the melt, it takes several days to weeks to adjust operating points and obtain a usable product that meets quality requirements.

2

Decarbonization: Rising electricity consumption, consistently low energy flexibility potential

The decarbonization of the glass industry is based on increased electrification through fully electric or hybrid melting tanks. While both technologies significantly increase the power consumption of production sites, they do not create relevant energy flexibility potential in the power supply. The elimination of band load privileges makes electricity procurement considerably more expensive and, in the case of hybrid melting tanks, makes the use of fossil natural gas the more economical option. The goal of decarbonization should also be prioritized and supported by appropriate incentives in the grid fee system.

3

Flexibility vs. efficiency, technical lifetime, and economic utilization

To operate economically, melting furnaces must produce continuously at full load for as long as possible. Any adjustment of the operating point reduces the energy efficiency and service life of the melting furnace. Hybrid furnaces offer theoretical scope to vary the electricity-gas ratio. However, they are designed and sized for maximum efficiency in terms of both the size of the furnace for the planned number of electrodes and the size of the top furnace for the associated gas flame in accordance with an optimum operating point. Therefore, adjustments are technically complex, time-consuming, and can only be implemented over a long period of up to several weeks. They are associated with product rejects and risks to efficiency and service life and do not offer any possibility of responding to short-term fluctuations in renewable energy generation..

4

Costs and economic risks in electricity procurement

The costs incurred by the elimination of baseload privileges cannot be offset by alternative revenue opportunities, such as conceivable marketing on the control energy market. The technically feasible energy flexibility potential for providing the corresponding power is too low. In addition, baseload supply is often secured several years in advance through long-term electricity purchases, depending on the risk appetite of glass producers, in order to hedge against price risks, with only a small portion being procured at short notice via the spot market. To be able to react to price signals, electricity procurement would have to be more strongly oriented towards the spot market, leadingt to a greater risk of dependence on short-term price fluctuations. Since the processes must be operated continuously and do not offer any relevant energy flexibility potential, electricity would still have to be purchased even if prices were high in the short term.

5

For regulatory incentives to be effective, they must take in to account the technical limitations of glass production

Regulatory incentives aimed at activating energy flexibility potential can only be effective if they take into account the technical limitations of glass production. Continuous, efficient, high-quality, and economically viable production remains the top priority. The individual location- and product-specific requirements of producers must be taken into account in the design of grid fee systems.

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