# LIFE Smart Oxy-Boost

# Replicability and transferability plan

*With the contribution of the LIFE financial instrument of the European Community*

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# Introduction

The aim of this document is to analyze the potential of the project to be replicated and transferred during and after its implementation by other stakeholders such as industries in the glass sector.

Flat glass industry has a turnover of 15 billion with 60 installations in 12 countries in Europe. Annual growth in flat glass output is about 2-3% on average because of growth in the automotive and construction industries. Considering the production of 10 million tons per year in Europe, there is a great potential in the flat glass sector to apply this technology to other furnaces.

# Methodology

Smart oxy-boost technology has achieved 15 % capacity increase with 4 % decrease in energy consumption in TGB. Considering the results of LIFE Smart Oxy-Boost project and the high replicability potential of the process, Smart Oxy-Boost technology can be implemented to other glass furnaces conveniently so that energy consumption and thereby GHG emissions of furnaces are decreased.

Communication and dissemination activities have an important role in enhancing the replicability and transferability strategy by enabling to reach a wider audience and by providing long-term dissemination tools. To achieve these objectives, Şişecam Group has defined several dissemination tools such as the participation in seminars and conferences, and the creation of a website. Şişecam also will publicize articles in specialized journals, elaborate and print information materials, such as brochures and flyers and organize meetings and events with potential clients and users to reach a large audience.

Results of the project will be disseminated in reputable industrial conferences and magazines via oral presentations and papers. In this scope, both partners Air Liquide and Şişecamintend to attend specialized conferences and seminars defined in E1 strategic dissemination plan. Such events are dedicated to professionals, academicians, researchers, and other stakeholders from the glass sector mainly.

After the technology has been validated, a plan for the transfer of the technology to other float glass furnaces and sectors has been prepared within the deliverable “replicability and transferability plan”.

There are three main phases of the replicability and transferability plan as summarized below.

- Phase 1 – Technology analysis and confirmation of addressable markets
- Phase 2 – Identification of relevant stakeholders for each addressable market
- Phase 3 – Scenarios development for each valorisation approach

**Phase 1:**

The target markets for priority deployment of Smart Oxy-Boost are the countries in which local environmental constraints on pollutant emissions (nitrous oxide or NOx) naturally promote the conversion from air combustion to oxy-fuel combustion. Smart Oxy-Boost is currently designed for the flat glass market but will be replicated to address the whole glass industry. Glass market is made of three main segments:
1/ the container glass linked to the resilient and basically local food industry
2/ the float glass for housing and automotive and
3/ the technical glass, the fastest growing segment (CAGR 6.5%).
The Smart Oxy-Boost has been developed by Air Liquide to address all the types of glass: flat glass, technical glass and container glass furnaces such as reinforcement and insulating fibers, Flat Display Panels (FDP), tableware and bottles. This new technology, particularly the e.Burner, is universal in that it can be applied to any type of glass and can be operated with many types of fuels and is suited to all types of glasses, this smart, comprehensive, flexible solution could also be easily implemented on many different types of furnaces.

It is estimated that 628 furnaces are operating in Europe with 43 M tons production capacity per year for every kind of glass. 490 furnaces of them are regenerative or recuperative, which uses liquid or gaseous fossil fuel for combustion. Today, about 35 furnaces are operating with oxy-combustion in EU, for fiberglass and technical glass production mainly.

Table.1 Number of EU glass furnaces

| Type of glass | Estimated number of EU-27 glass furnaces | Melting capacity (TPD) |
|---|---|---|
| Flat glass (float glass)* | 58 | 500-1000 |
| Container glass* | 175 | 200-600 |
| Domestic glass (tableware) | 300 | 10-200 |
| Technical and fiberglass and others | 95 | 20-250 |
| Total* | 628 | n/a |

*Source: Best Available Techniques (BAT)

Container and float glass division is 82% of glass production in tonnage, which means Smart oxy-boost technology can be implemented to nearly 293 units. Flat glass industry has a turnover of 15 billion with 60 installations in 12 countries in Europe. Annual growth in flat glass output is in the order of 2-3% on average because of growth in the automotive and construction industries. There is a great potential in the flat glass sector to apply this technology to other furnaces. Dissemination of this technology to other glass furnaces will provide a significant contribution to reducing energy consumption and emissions. Considering furnaces in Europe, it is possible to increase production capacity to 35-50 M tons per year with existing furnaces.

Şişecam Group has 50 furnaces operating in Turkey and abroad with total 4.9 M tons production per year in 2020. 46 of 50 furnaces are regenerative and 4 of them are oxy-fuel. 28 furnaces are operating in Turkey, others in foreign countries namely Russia, Bulgaria, Italy, India and Egypt.

Table.2 Number of Sisecam Glass Furnaces

| | Float | Packaging | Tableware | E-Glass |
|---|---|---|---|---|
| Turkey | 9 | 12 | 6 | 1 |
| Abroad | 6 | 12 | 4 | - |

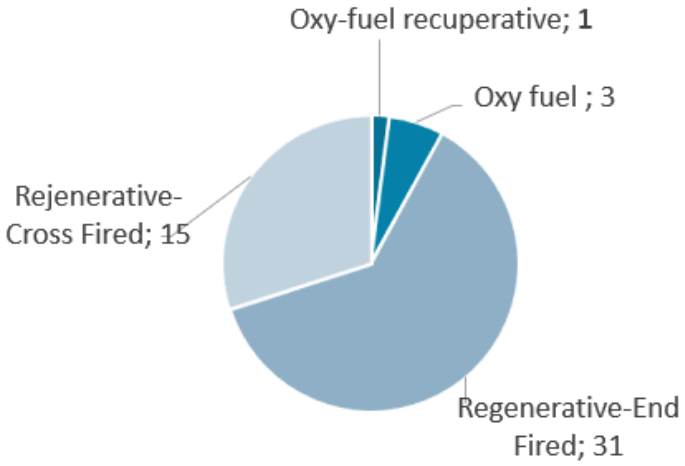


Figure.1 Şişecam furnaces' types

**Phase 2:**

Stakeholders are defined as Şişecam Group, public authorities and the glass industry. Şişecam Group is responsiblefor validating the technology provided by Air Liquide in the pilot furnace and for transferring and for replicating the technology to its other furnaces worldwide. Stakeholders should agree with environmental regulations implemented by public authorities. Other glass producers are pressured to carry out similar technologies to coordinate with the new environmental norms set by the project. They should get involved through targeted dissemination and replication actions.

Glass industry and other industries using combustion in their processes (steel, cement manufacturers, etc.) can be considered as target groups for replication and transfer of results in order to keep pace with innovation of the process for environmental reasons.

Stakeholders aim to replicate and to transfer this technology to the following furnaces, respectively.

- Application of this technology in other Şişecam flat glass furnaces
- Application of this technology in other companies' flat glass furnaces in Europe and worldwide
- Application of this technology in other types of glass furnaces (container etc.)
- Application of this technology in other sectors (steel, cement etc.)

Based on the business plan and the dissemination activities performed by the partners during and after the project, Şişecam would replicate the process in other float furnaces of the Şişecam Group. In 2021, discussions already started locally between Şişecam entities and Air Liquide entities in Russia, India and Turkey for feasibility studies to implement the Smart Oxy-Boost technology. All new furnace investments of Şişecam are designed in accordance with the Smart Oxy-Boost system.

**Phase 3:**

Smart Oxy-Boost enables the glass industry to comply with and to go further current climate regulations thanks to the reduction in fuel and oxygen and in CO2 compared to widespread air combustion. It is in line with the EU climate policy on energy and greenhouse gas intensive industrial production (glass industry being an EII) and can lead to the development of stricter Union policy and legislation.

Consequently, besides GHG savings, economic viability of the proposed innovative technology is key to contributing to EU climate objectives through wide replication after demonstration. Hence the contribution of the project to the development and demonstration of an innovative climate change mitigation technology suitable for being replicated and transferred to other energy intensive industries.

It will also improve the knowledge base for the implementation of effective climate change mitigation actions. This knowledge will be disseminated in order to be applied in practice.

Today, about 35 furnaces are operating with oxy-combustion in EU, for fiberglass and technical glass production mainly. Tank capacity in container and float glass production, represent both nearly 82% of glass production in tonnage. Those account for 293 units and can be potentially converted to Smart Oxy-Boost. e.Burner could be implemented with all of these furnaces when rebuilt, since it could work with any type of glass and every fuel type.

At the end of a furnace's usual lifetime (7 to 12 years), when the investment decision is made to renovate, oxy-combustion with e.burner can possibly be implemented. Then, in 15 years, a major part of air glass furnaces could be converted to oxy-combustion with e.burner. With further development to adapt the e.Burner design, it will be extended to other manufacturing «high temperatures» processes such as melting and heat treatment, for steel and non-ferrous metals, foundries and non-ferrous recycling processes as well, but also for cement and other 'Basic mineral non-metallic Materials'. In this industry, potential CO2 and energy savings will depend on fumes temperature and process characteristics resulting in an average estimated reduction of about 50% of CO2 coming from direct combustion in the process.

On the Air Liquide side, several actions have been undertaken before the Smart Oxy-Boost project ends in terms of replicability & transferability of the technology.

Air Liquide has started promoting the technology to customers for the non-ferrous metal market (one customer based in Taïwan and one in Turkey).

For the Glass market, Air Liquide has started several discussions with local Şişecam entities (Turkey, Russia and India). In parallel, Air Liquide is also working on potential replications in Japan and in Italy (other types of glass).

From a general perspective, Air Liquide is working on the referencement of the newly-developed technology. This is a solution that Air Liquide is proposing to its customers to reduce their carbon footprint and increase the energy efficiency of their furnace.

# Conclusion

The knowledge and data acquired during the LIFE Smart Oxy-Boost project is very valuable for other glass furnaces as well as steel, cement, enamel, frit or any other industry requiring the use of high quantities of energy for melting purposes in small or medium size furnaces. Therefore, some R&D activities (pilot scale) would be necessary as a first step in order to adapt the technology bricks (smart burners) to the particularities of other targeted furnaces (batch cycle, special pollutant in fumes, etc.). Then an industrial demonstration would be implemented with partners to validate the transferability and launch the deployment.

These replication and transfer projects will be ensured by financial viability of the technology demonstrated through the LIFE Smart Oxy-Boost project due to the expected low CAPEX.