

SAINT-GOBAIN

Flat Glass Decarbonization
The Challenge of Electrifying Glass Melting

Clément Robert

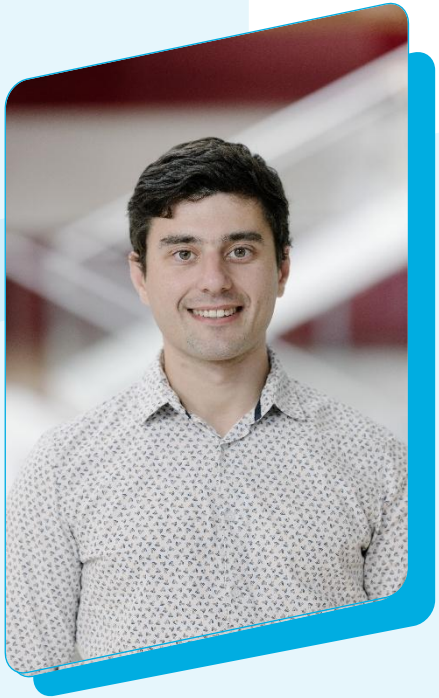
November 5th 2026

SAINT-GOBAIN GLASS

Who am I ?

Clément Robert

R&D & Process expert for hybrid furnace



- X2014 & KTH (Stockholm) in Chemistry
- PhD CIFRE in Hydrodynamics (Saint-Gobain-ESPCI-UPMC)
- R&D engineer in Glass Melting Process (Saint-Gobain Recherche)
- R&D & Process expert for hybrid furnaces since 2025

clement.robert2@saint-gobain.com

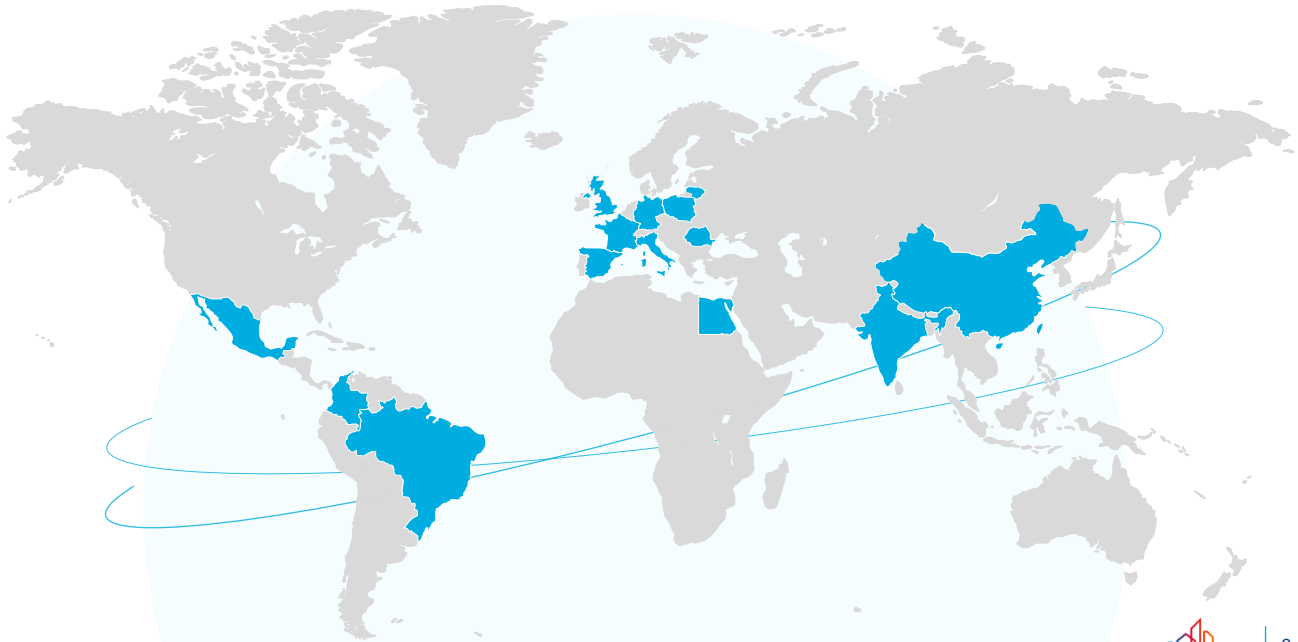
Our local footprint and International Network

Saint-Gobain Glass is the worldwide leader in flat glass for building applications, supported by **30** float production lines in **13** countries.

Manufacturing sites in **13** Countries

30 float production lines

Global sales operations in **100+** countries



We belong to Saint-Gobain

Worldwide leader in light and sustainable construction, Saint-Gobain designs, manufactures and distributes materials and services for the construction and industrial markets.
Its integrated solutions for the renovation of public and private buildings, light construction and the decarbonization of construction and industry are developed through a continuous innovation process and provide sustainability and performance.

Saint-Gobain was founded more than **360 years ago**

Operating in **81 countries**

8 cross-functional R&D centers worldwide

162,000 employees

€46.5 billion in sales in 2025

We are committed to achieve net zero emissions **by 2050**

Saint-Gobain

Sustainability Commitments

WE ARE COMMITTED TO CONTRIBUTING TO NET ZERO EMISSIONS BY 2050.

-35%

CO_2 emissions vs. 2017 (scope 1 and 2).

57%

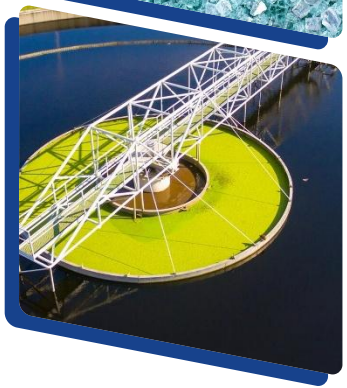
57% of Saint-Gobain products are subject to life cycle analyses in 2025

(Target: 100% in 2030), excluding trading









WE ARE COMMITTED TO REDUCING NON-RECOVERED WASTE BY 80% BY 2030.

9.2 million tonnes

We avoid extracting 9.2 million tonnes of virgin raw materials by using recycled content in our production processes.

-26%

Water withdrawals (2025 vs 2017).

Process electrifications

Different processes, one main lever

Placo (plasterboard)

3 net zero carbon (scope 1&2) production sites

Norway (electricity) – 1st in the world
Canada (electricity)
India (biomass)
Spain (project)



Pont-A-Mousson (piping)

Largest low-carbon electric furnace in Europe



Isover (mineral wool)

Development of electric furnace for glass wool melting since the 80s

Electric melting of stone wool (Project in Spain)



Saint-Gobain Glass

Hybrid melting development





REDUCING GLASS MANUFACTURING EMISSIONS

SAINT-GOBAIN

DECARBONIZING FLOAT GLASS MELTING

FLOAT GLASS CO_2 EMISSIONS

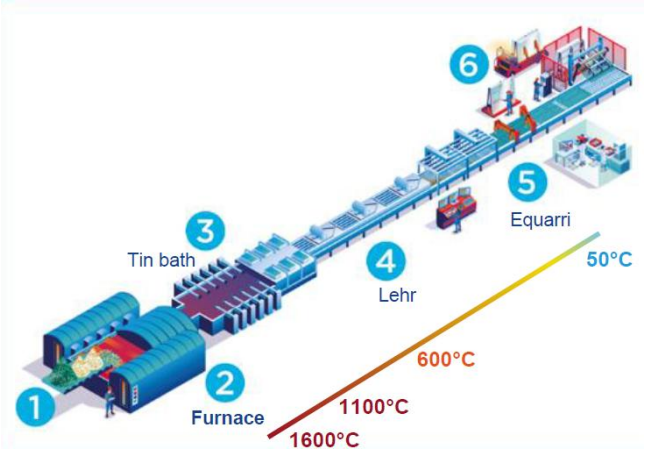
100kt CO_2eq/year

Per float glass furnace
Direct CO_2 emissions (Scope 1)

Raw material batch
30% direct CO_2 emissions

Main Levers
Recycled material (cullet)
Alternative raw materials





Melting energy - Natural gas
70% direct CO_2 emissions

Main Levers
Alternative Fuels
Electrification

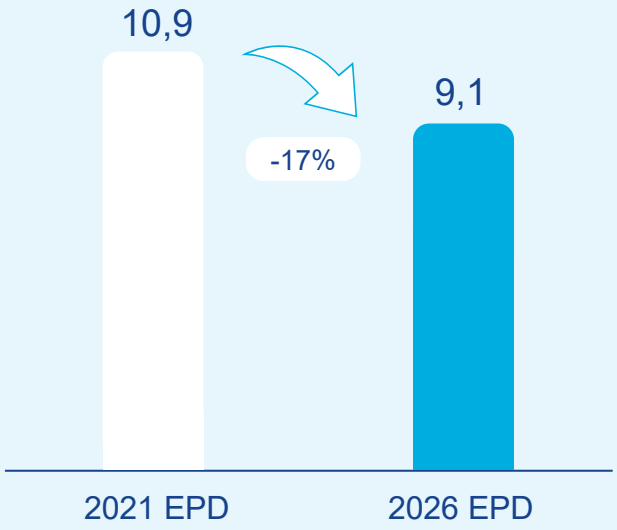
Our Circularity Journey



NEW PLANICLEAR® EPD DELIVERS –17% CO_2 (A1–A3)

Europe – New data (2023–2024)

kg CO_2e/m² - 4mm substrate (A1-A3)



Based on 10 European float plants
(FR, DE, IT, ES, UK, PL, RO)

Driven by **OPERATIONAL AND ENERGY IMPROVEMENTS** across our float plants

IMPROVED FURNACE EFFICIENCY

Operational excellence & recent furnace repairs

INCREASED SHARE OF LOW-CARBON ELECTRICITY

+45% of electricity coming from renewable energy

HIGHER RECYCLED GLASS CONTENT

21% recycled content in European float

ORAÉ®: PIONEERING LOW-CARBON GLASS SINCE 2022

A breakthrough that accelerated the transition of the glass industry

first
low-carbon float glass
at industrial scale (2022)

designed
for real projects
industrialized and available at scale

set
the benchmark
and accelerated market adoption

ORAÉ®: PIONEERING LOW-CARBON GLASS SINCE 2022

A breakthrough that accelerated the transition of the glass industry

first

low-carbon

float glass

at industrial scale (2022)



ORAÉ®: PIONEERING LOW CARBON GLASS SINCE 2022

5.88kg

CO_2 eq./m^2 for 4mm
ORAÉ® (A1-A3)

-35%

carbon footprint
vs standard glass
(PLANICLEAR®)



SAINT-GOBAIN

THE DRIVERS BEHIND ORAÉ'S LOW CARBON FOOTPRINT

Combining circularity, clean energy and industrial optimization

64%
RECYCLED CONTENT
(pre-consumer + post-consumer)

+

RENEWABLE ELECTRICITY

+

OPTIMIZED INDUSTRIAL PROCESS
(energy efficiency & process control)

TODAY: A PROVEN AND SCALABLE SOLUTION

Already deployed in real projects across multiple regions



ORAÉ®



INDUSTRIALIZED
Produced in multiple plants

ADOPTED
in numerous projects worldwide

7+ plants | 100+ processors | 35,000+ tons

Melt Glass differently



SAINT-GOBAIN GLASS

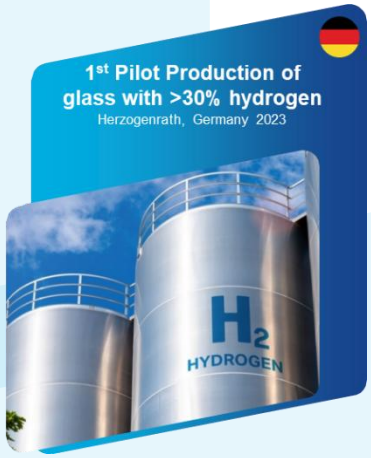
Alternative Fuels

Serious option for short term

Many challenges:

- Green- H_2: is it available at a competitive cost? What about furnace compatibility?
- Biogas/bioliquids: easiest technical options: what about availability and cost?
- Other: syngas? E-fuels?







Bioliquids



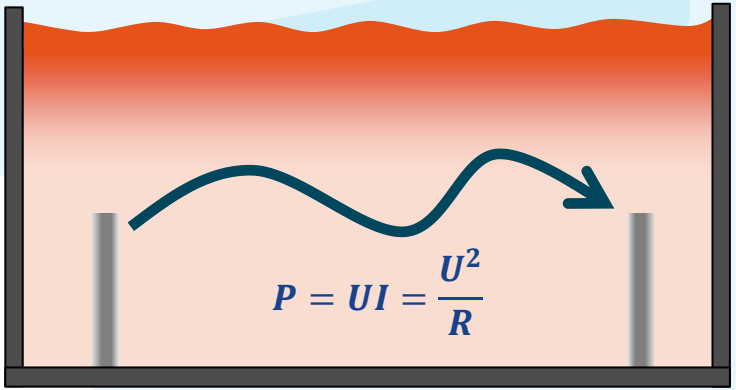
Biomethane

40+ years of electric melting experience

Melted glass conduct electricity
Glass acts as a resistance

By Joule's effect, >95% of the energy is dissipated directly inside the glass

- Better efficiency than gas combustion
- Possible to reach high temperatures



Joule's effect

40+ years of electric melting experience



Pyramide du Louvre

1982

1989

2012



Saint Gobain (France)

Electric Furnace producing « Pyramide du Louvre » glass



Isover Orange

Largest electric melter in the world

MAIN PAIN POINTS

- Glass quality
- Furnace size
- Economic balance

How to have flat glass without bubbles ?

Competition between Archimede & viscous drag

How to remove bubbles ?

Increase residence time : slower pull rate

Heat (decrease viscosity) : more € and CO2

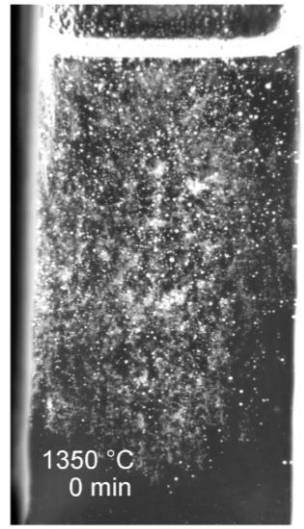
Inflate bubbles with another gas → Add sulfate !

$$Na_2SO_4 + n\ SiO_2 = Na_2O\text{-}nSiO_2 + SO_2 + ½\ O_2$$

height viscosity

$$t = H \frac{3\eta}{R^2 \rho g}$$

radius density



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radius density



SAINT-GOBAIN

Interaction gaz-verre à haute température

Lors de la production du verre, des bulles de gaz issues de la fusion des matières premières ou de réactions avec les matériaux réfractaires peuvent rester piégées dans la matrice vitreuse et réduire les rendements de production. L'analyse de leur composition gazeuse permet d'en identifier l'origine dans le procédé de fabrication. Cependant, les coefficients de diffusion et de solubilité, ainsi que les concentrations des gaz dans les liquides silicatés, restent mal connus et limitent la portée de l'interprétation des mesures.

OBJECTIFS DU STAGE

- Générer et faire évoluer des bulles de gaz dans des conditions contrôlées en laboratoire.
- Interpréter les analyses par spectrométrie de masse afin d'identifier les paramètres qui régissent l'évolution des bulles dans le verre.
- Analyser les données à l'aide d'un modèle numérique décrivant les flux entre les bulles et le verre.
- Mettre les résultats en perspective avec le contexte industriel.

PROFIL SOUHAITÉ

Étudiant(e) en deuxième année de master (M2) ou en dernière année d'école d'ingénieur généraliste.
Compétences : physico-chimie, mécanique des fluides et science des matériaux. Goût pour l'expérimentation et l'analyse de données. Esprit d'initiative, adaptabilité et bon relationnel.

DURÉE : 6 mois

LIEU : Saint-Gobain Research Paris, 39 quai Lucien Lefranc, 93303 Aubervilliers Cedex.

CONTACT : **Eric Janiaud**, eric.janiaud@saint-gobain.com

À PROPOS DE SAINT-GOBAIN

Leader mondial de la construction durable, Saint-Gobain conçoit, produit et distribue des matériaux et services adaptés aux marchés résidentiels, non-résidentiels et des infrastructures. Ses solutions intégrées et innovantes apportent durabilité, performance et confort à ses clients. Le Groupe est guidé par sa raison d'être « MAKING THE WORLD A BETTER HOME ».
46,5 milliards d'euros de chiffre d'affaires en 2025.
162 000 collaborateurs, présence dans 31 pays.
Engagé à être zéro émission nette en carbone d'ici 2050.
Pour en savoir plus sur Saint-Gobain, visitez http://www.saint-gobain.com et suivez-nous sur LinkedIn.

Saint-Gobain Innovation Hub Europe est l'un des cinq Innovation Hubs qui servent toutes les activités de Saint-Gobain. Pour en savoir plus, consultez https://www.linkedin.com/company/saint-gobain-innovation-hub-europe/

40+ years of electric melting experience



Pyramide du Louvre

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Isover Orange

Largest electric melter in the world

NEW PERSPECTIVES

- Decarbonization of production as a priority
- Green electricity prices
- Raise of low carbon offers

ORAÉ

40+ years of electric melting experience



Pyramide du Louvre



Joined Development Agreement Saint-Gobain AGC



1982



Saint Gobain (France)

Electric Furnace producing « Pyramide du Louvre » glass

1989

2012



Isover Orange

Largest electric melter in the world

2023

2025



Volta Project (Czechia)

Medium Scale Pilot
Hybrid Furnace

2027

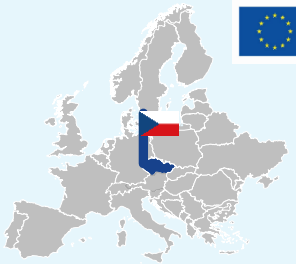
FurHy Project (Spain)

Full Scale
Hybrid Furnace

Funded by the European Union
Emissions Trading System
Innovation Fund

Volta industrial pilot line

Joint development Saint-Gobain/AGC



Funded by the European Union
Emissions Trading System
Innovation Fund
12 M€



SAINT-GOBAIN AGC



2023 : Joint development agreement Saint-Gobain & AGC

3 years collaboration
90t/day AGC pattern glass production line

New furnace design with 50% electricity:
Combining experience of AGC & Saint-Gobain for:

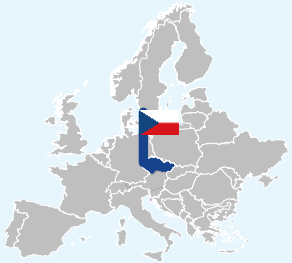
- Saint-Gobain electrical melting expertise
- AGC oxy-combustion expertise

Advantages:
Production line → Lower R&D opex cost
Intermediate size → Lower technological gap
Pattern glass → Lower quality requirement
Two companies → Cross expert competencies & costs

Development objectives:
Validate concept & glass quality
Evaluate equipments
Build competencies

Volta industrial pilot line

Joint development Saint-Gobain/AGC







2023 : Joint development agreement Saint-Gobain & AGC

3 years collaboration
90t/day AGC pattern glass production line



2024 : Engineering & cold repair

Full novel technology
Availability of electricity
Strong civil engineering
Complexity & duration are **challenge**



2025 : Start-up & trials

More than one and half year of continuous operation
No losses due to new technology
Robust and **trouble-free** performance

Volta industrial pilot line

Energy & CO_2

Energy & temperature in line with the design

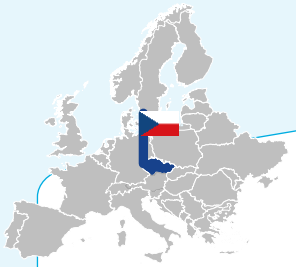
Large range of operation

- Cullet : 15-90% cullet and short duration test **@100% cullet**
- Strong pull variation

Strong CO_2 emissions reduction

-53%

Scope 1 CO_2 emissions
At iso cullet (40%)



VOLTA INDUSTRIAL PILOT LINE

Challenges

Change management for this new technology

With local authorities, EHS, experts, plant team



Learning from this disruptive technology

Challenge our habits, models and understanding of glass melting

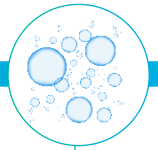


Evaluate glass quality

Find the correct method for bubble evaluation with pattern glass



Master finning and reach float-glass quality



Validation of concept and float glass quality in terms of stones, bubbles and seeds

FurHy project

The result of a long R&D Journey

Academic Research:

Mixed unit SG-CNRS SVI; CIFRE PhD; Chaires

Transversal R&D:

Saint-Gobain Innovation Hubs

Cross-business learning

Applied development:

SGCV (numerical simulations - Aubervilliers)

Business research centers

Pilot line:

Already an industrial environment… but with strong R&D background!

First of a kind:

Based on the full R&D journey, economical balance, and management decision !



Further R&D will be essential to run this new line, optimize the design, develop the next generation

FurHy project

Find the right asset

Furnace end of life

Electricity availability & cost

- Possibility to connect to high voltage line
- Cost ratio electricity vs gas vs CO_2
- Availability of renewable energy

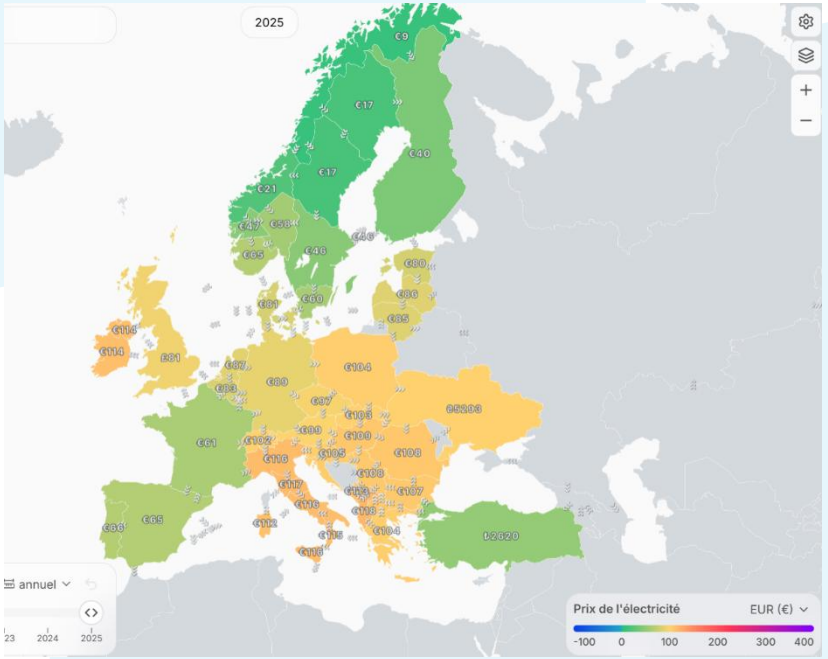
Technical challenge of switch

- Many civil work and new equipments

→ Important investments at the switch

Market

- Local reglementation
- Market demand



Funded by the European Union
Emissions Trading System
Innovation Fund
42 M€

FurHy project

First-Of-A-Kind Hybrid furnace for float glass

SAINT-GOBAIN AND AGC PARTNER TO INNOVATE WITH LARGE-SCALE HIGHLY ELECTRIFIED FURNACE TO CUT CO_2 EMISSIONS FROM FLAT GLASS PRODUCTION

08/06/2026



- Cold repair of Saint-Gobain float line in Avilés (Spain) in 2027 in technology partnership with AGC
- Largest electric furnace ever built for flat glass:
  - **75%** of electrification
  - Renewable low-carbon electricity



- Compared to a conventional gas furnace
  - **Low-carbon glass at the same glass quality**
  - **80% of natural gas consumption reduction**
  - **50% CO_2 emissions reduction**

Recycling projects

- Circular economy is essential to the glass decarbonation journey. We want to make it happen for real.

FurHy

- Strong commitment from SG toward decarbonization through a full R&D Journey
- Our new Hybrid Furnace is being built in 2027, and it will be **75% electrified**



FurHy team in Avilés



THANK YOU !

SAINT-GOBAIN