H2frit:
Melting ceramic frits with H_2 is technically viable

Competitiveness and infrastructure



anffecc
Asociación Nacional de Fabricantes de Fritas, Esmaltes y Colores Cerámicos

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What is anffecc

ANFFECC is the National Association of Manufacturers of Frits, Glazes, and Ceramic Colours.

What is ANFFECC

- Business association that brings together nearly all Spanish producers of frits, glazes, and ceramic colours.
- The association consists of 22 member companies, most of which are located in the province of Castellón.
- They are situated very close to their clients — tile manufacturers — in what is commonly referred to as the “ceramic cluster” or “ceramic triangle” (Onda, Alcora, and Vila-real).



Sector data 2025 (1/2)

Spanish ceramic frits, glazes and colours producers remain
worldwide leaders in innovation, design, quality and service.

TURNOVER
1,363 M€
+1.5% vs 2024

DOMESTIC SALES
472 M€
34.6% of sales

EXPORTS
891 M€
65.4% of sales

MARKETS
worldwide
50+ countries

PRODUCTION
1.6 M t
+0.9% vs 2024

EMPLOYEES
4,006
+0.6% vs 2024

COMPANIES
22
22 companies

INTERNATIONAL PRESENCE – PRODUCTION PLANTS
Global
Europe · Asia · Africa
Americas

A highly specialized, export-oriented industrial sector concentrated in Castellón (Spain).

Sector data (2/2)

The **Spanish ceramic cluster** is formed by ceramic tiles producers, frits, colours and ceramic glazes producers and the manufacturers of ceramic machinery

It is **known world-wide** as the **ceramic "Silicon Valley"**, due to its innovation and know-how, that expands from Spain to the rest of the world

SPANISH CERAMIC CLUSTER FIGURES (2025)

6.573 M€
TURNOVER

- **73%** TILE SECTOR
- **21%** FRIT AND GLAZES SECTOR
- **6%** MACHINERY SECTOR

21.678
EMPLOYEES

- **73%** TILE SECTOR
- **18,5%** FRIT AND GLAZES SECTOR
- **8,5%** MACHINERY SECTOR

70% exports
>50 countries





ASCER
Asociación Española de Fabricantes de Azulejos y Pavimentos Cerámicos

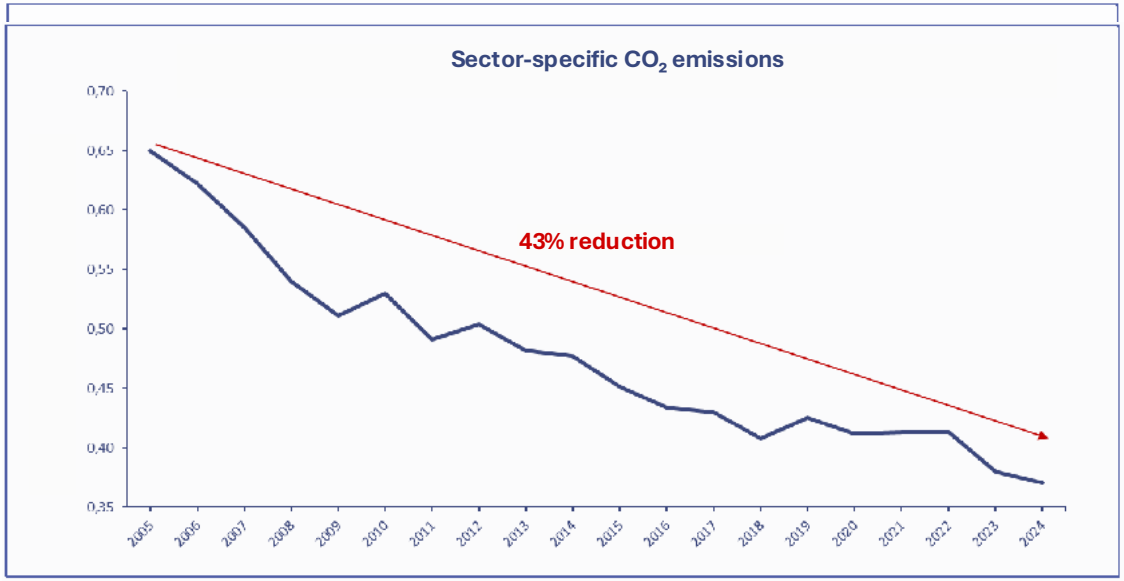
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Asebec
Asociación Española de Fabricantes de Maquinaria y Bienes de Equipo para la Industria Cerámica

CO_2 Emissions in the Sector

43% reduction in specific CO_2 emissions

Driven by process improvements and oxy-fuel combustion systems



Specific emissions (t CO_2/t produced)

Continuous reduction in specific CO_2 emissions since the start of the ETS (2005)

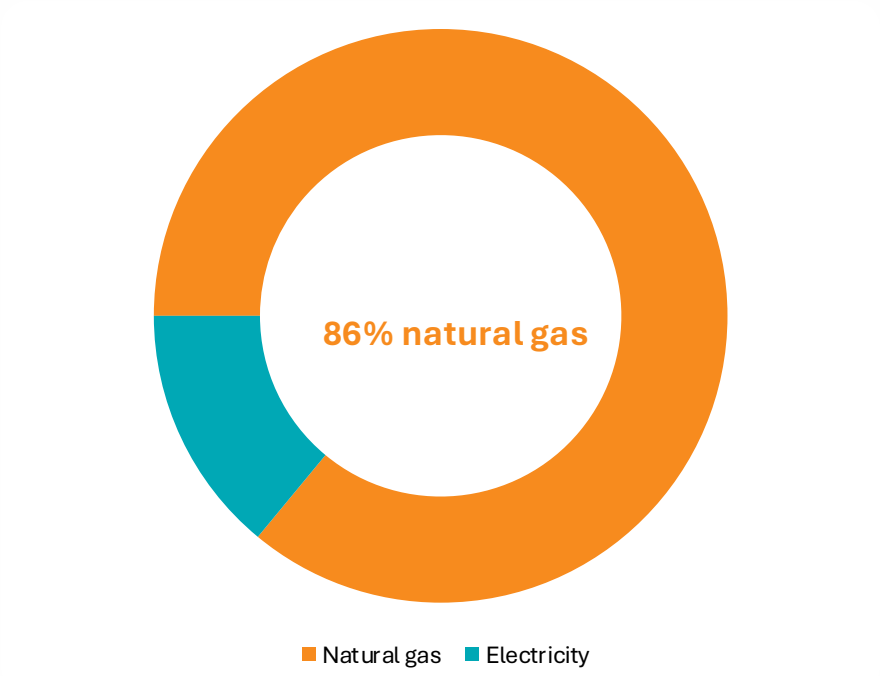
80%+
Energy consumption concentrated in melting

-55%
Target EU 2030

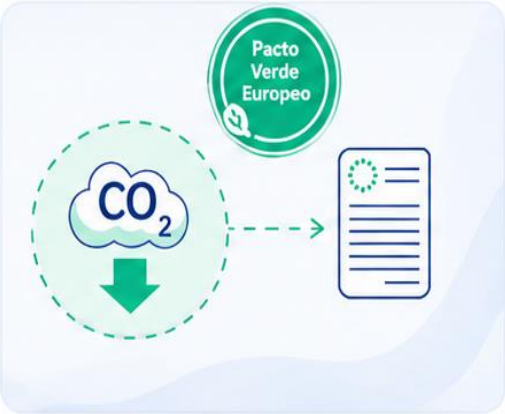
2050
Climate neutrality

CO_2 Emissions in the Sector: Energy data

The ceramic cluster consumes 8% of Spain's industrial gas (15 TWh)



H2frit: project scope and funding



The sector faces the greatest decarbonization challenge, posed by the European Union, consisting of a reduction of 55% emissions by 2030, with the objective to become net zero by 2050

- For the frit and glaze sector, **current technologies are mature** and, therefore, we have limited course for improvement to achieve relevant emissions reductions.
- The sector needs **disruptive production process technologies** that are not currently available on the market.

H_2frit was created to answer a specific industrial question:
Can H_2 replace natural gas in a real frit furnace, while maintaining process stability and product quality?

H2frit

H2frit: project scope and funding

CHOSEN PROJECT:

H2frit – "DECARBONIZATION OF THE CERAMIC FRITS SECTOR THROUGH THE USE OF HYDROGEN IN THE MELTING PROCESS FOR THE MANUFACTURE OF CERAMIC FRITS"

H2frit

CALL FOR STRATEGIC PROJECTS OF THE VALENCIA REGION

– June 2023 –

- **TOTAL BUDGET:** € 2.188.117,64
- **GRANT AWARDED:** € 1.314.111,61
- **Execution period:** 2023, 2024, and 2025

GENERALITAT VALENCIANA
Conselleria de Innovación, Industria, Comercio y Turismo



H2frit: objectives and participants

H_2frit Project Objectives

- Change in melting technology, by replacing natural gas with hydrogen for the fusion of ceramic frits.

H_2frit Project Participants

- **Led by ANFFECC**
- Participation of Esmalglass, bp, ITC, and Carburos Metálicos

-- KNOWLEDGE TRANSFER TO THE SECTOR --

H2frit Project













https://www.anffecc.com/es/i+d+i/innovacion-y-sostenibilidad#

H2frit: project objetives

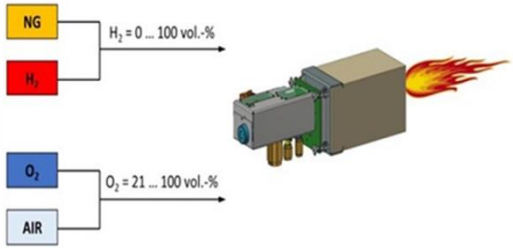
FROM CONCEPT TO INDUSTRIAL VALIDATION

H2frit

Technical objectives of the project

- Totally or partially replace natural gas with H2 in frit melting
- Maintain operational stability, production capacity and furnace control
- Verify that frits and glazes retain their quality and performance
- Identify adaptations in burners, safety and control
- Generate technical knowledge transferable to the sector





H_2frit Project Activities

- ✔ Engineering requirements and plans
- ✔ Hydrogen platform
- ✔ Technological adaptation of the process:
  - – Burner and control panel
- ✔ Pilot plant testing
  - – 20%, 50%, 75%, and 100% H_2
  - – Influence on furnace atmosphere
  - – Process optimization
- ✔ Technical and economic feasibility study





H2frit: Validation (1/2)

TECHNICAL QUESTION	H2FRIT RESULT
Can H_2 be used in a real furnace?	Yes: stable operation in a 1.2 MW industrial oxy-combustion furnace.
Can full or gradual substitution be achieved?	Yes: tests with 20%, 50%, 75% and 100% H_2.
Is process control maintained?	Yes: integration of skids, PLC, safety systems and a multi-component burner.
Does it affect frits and glazes?	Not significantly: properties and quality are comparable to those obtained with natural gas.
Can it be transferred to the sector?	Yes: a sectoral project that generates technical knowledge applicable to existing furnaces.

H2frit value: Transforming critical process uncertainties into demonstrated technical answers that can be transferred to the sector

H2frit project: Validation (2/2)

Budget €2.2 M
60% grant
2023–2025

TECHNICAL AND ECONOMIC FEASIBILITY STUDY

H2frit

- ✓ Cutting emissions by **50%** would require blends containing **80% H_2**
- ✓ An electrolyser of around **250 MW** is required, at an estimated cost of **over €500 M**

253 MW Electrolysis for 100% H_2	**2,000 GWh/year** Associated electricity	**1,333 MWp** Solar PV capacity (935 football pitches)	**321 swimming pools** Annual water consumption
38 MW Electrolysis	**297 GWh/year** Electricity	**198 MWp** Solar PV (139 football pitches)	**48 swimming pools** Water/year

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anffecc

esmalglass grupomogllaresa

bp

ACE

jtc

CARBUROS METÁLICOS Grupo Air Products

H2frit: Awards received

RENMAD Hydrogen Awards 2025

Innovation Award in H_2



COPE Castellón Awards 2025

Innovation Award



AeH2 Project Census

H2frit registered in the Spanish Hydrogen Association project census.



EnerAgen Awards 2026

Runner-up award for best private initiative supporting the energy transition.



H2frit: Conclusion (1/5)

MAIN CONCLUSIONS OF THE H2frit STUDY

1

TECHNICAL FEASIBILITY DEMONSTRATED



The technical feasibility of producing ceramic frits with hydrogen, while maintaining the same quality as those produced with natural gas, has been demonstrated.

2

KNOWLEDGE TRANSFER TO THE SECTOR



Knowledge transfer to the sector as a whole.



H2frit is a collective project that generates knowledge and drives the sector's industrial transition.

H2frit: Conclusion (2/5)

3 DEPLOYMENT DEPENDS ON KEY ENABLING CONDITIONS

STABLE REGULATORY FRAMEWORK
Clear, long-term and predictable regulation is essential to give visibility to investments and provide confidence to the industry.

SECURE AND GUARANTEED SUPPLY
A reliable, continuous and affordable supply of renewable hydrogen is essential to ensure industrial continuity and plan capacity.

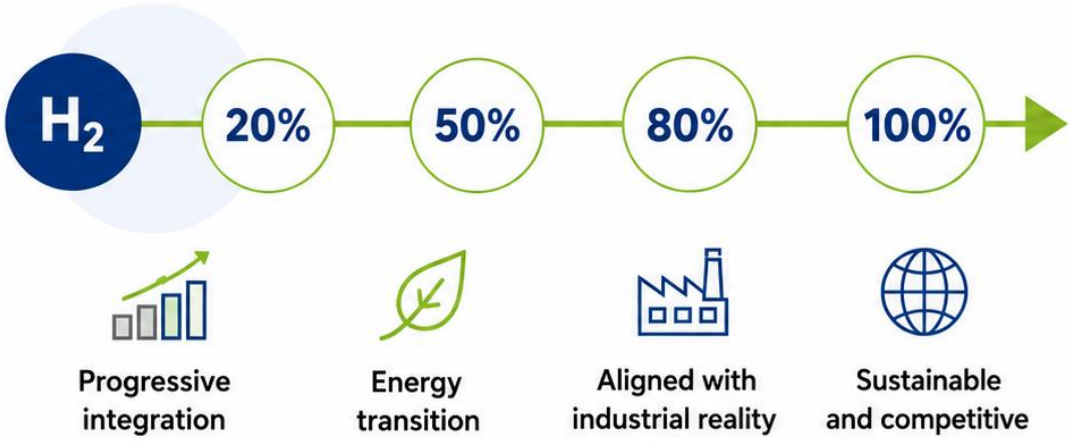
SUITABLE INFRASTRUCTURE
Ports, storage, distribution networks and industrial connections must be developed to make hydrogen available at competitive conditions.

COMPETITIVE PRICE VS. NATURAL GAS
Hydrogen must reach a cost level that allows it to compete with natural gas, ensuring the economic viability of the transition.

These four pillars are essential for the real and competitive deployment of hydrogen in the sector.

H2frit: Conclusion (3/5)

4 GRADUAL INTEGRATION FOR A BALANCED TRANSITION



Hydrogen can be integrated gradually, using increasing percentages of H_2 to enable a balanced and sustainable energy transition aligned with the sector's industrial and economic reality.

A step-by-step approach reduces risks, optimizes investments and ensures competitiveness.

H2frit: Conclusion (4/5)

5 THE TRANSITION NEEDS SUPPORT AND COLLABORATION



- Institutional and financial support will be essential to reduce investment barriers and promote clean technologies.
- Close public-private collaboration will accelerate innovation, share risks and ensure the successful deployment of hydrogen solutions.

Only through joint effort can we achieve the decarbonization of the sector and maintain industrial leadership.

H2frit: Conclusion (5/5)

The sector is committed to decarbonisation and confident in overcoming the major challenges ahead.



The transition must be technologically feasible, economically viable and compatible with industrial competitiveness.



H2frit is a key milestone: it proves what is technically possible and identifies what is still needed for real industrial deployment.

H2frit

THANK YOU FOR YOUR ATTENTION

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