RAPID DRY

WITH THE CONTRIBUTION OF THE LIFE
FINANCIAL INSTRUMENT
OF THE EUROPEAN UNION
LIFE19 CCM/IT/001243

LAYMAN'S REPORT

2020 - 2022

www.rapid-dry.eu

INDEX

THE EUROPEAN CERAMIC INDUSTRY

The European ceramic industry is **a world leader in producing high-quality ceramic products such as tiles, sanitaryware, and tableware**.

Ceramic manufacturers in the EU are mainly small and medium-sized enterprises (SMEs), often organized in districts, that can quickly respond to market demands and seize new opportunities. In the EU, the ceramic sector provides **more than 300 thousand jobs**, and its production value amounts to approximately 27 billion euros.

The ceramic sector is known to be an **Energy Intensive Industry** (EII) characterized by high levels of thermal and electric energy consumption along its production chain and an increased risk of carbon leakage.

The two main sectors that the Rapid Dry project focuses on, i.e., the sanitaryware and tableware markets, consist **in Italy of about 40 companies**, most of which are in Civita Castellana (VT).

As of today, the European ceramic industry faces three main threats:

THE COMPETITIVENESS OF EMERGING ECONOMIES, capable of producing large volumes of products at low-cost

The increasingly demanding **ENVIRONMENTAL LEGISLATION**, which conflicts with the characteristics of the traditional production process

THE GROWING ENERGY PRICES and the reliance of the ceramic sector on **RAW MATERIALS** from non-European countries

Thus, the main challenges that the European ceramic industry needs to face in the future are **to reduce its dependence on imported raw materials and decrease its energy consumption and environmental impact**.

CHAMBER DRYERS FOR CERAMIC PRODUCTS

The production of ceramic goods involves several phases, one of which concerns drying, that is, **when the not chemically bonded water is removed from the ceramic body by evaporation**. Drying is a particularly critical stage in ceramic manufacturing as it can provoke stress in the ceramic pieces as well as future damages during the firing procedure. The process must be slow to prevent the body pieces from warping and cracking while, at the same time, complete drying must be ensured.

If a part is not completely dry before the firing, it will break, warp, or even explode, risking ruining other pieces in the kiln as well. On the other hand, if the body has been dried too quickly in a drying chamber, cracks will form, and the piece will be destroyed during firing in the kiln.

Typically, a drying cycle in a traditional chamber can last around **14 hours**, during which the temperature gradually increases from 50°C to 90°C. Because it requires such long cycles, the drying process alone is responsible for about **23% of the total thermal power** needed for the whole production process.

Despite this, technological innovation to reduce consumption has focused more on the firing phase, leaving the drying process in the background. This situation is particularly evident in the sanitaryware and tableware fields. Unlike the tile sector, these two sectors have been less affected by the introduction of new technologies to reduce consumption, as human labour is prevalent and represents the first cost item. At the same time, energy costs are much lower and therefore do not generate a sufficient boost to innovation.

The main **critical points** that characterize **traditional dryers** are:

- Temperature is the only controlled parameter
- Absence of a drying curve
- Very low drying homogeneity
- Significantly long drying cycles
- The operation requires large fans and burners

THE RAPID DRY PROJECT

The RAPID DRY project aims **to optimize the drying process by reducing energy consumption and pollutants emissions** (such as CO_2, NOx, HF, and SOx) while preserving product quality.

To this end, the project has developed **a new, fully automated chamber dryer** that reduces energy consumption.

The innovative characteristics of this dryer allow its adoption in **all ceramic sectors except tiles**, promoting the renewal and increased competitiveness of the European ceramic industry.

The innovation process had three main objectives:

TO REDUCE THE ENVIRONMENTAL IMPACT of ceramic goods production thanks to reduced pollutants emissions, such as CO_2, NOx, HF, SOx, and particulate matter

TO INCREASE THE COMPETITIVENESS of the European ceramic industry thanks to lower production costs and greater flexibility

TO IMPROVE THE QUALITY OF THE WORKING ENVIRONMENT by reducing the noise and the duration of drying cycles, which strongly affects the shifts of the staff

The project complemented the new chamber dryer with **new ceramic slips**.

A close relationship exists between drying, the particle size of the granules, and their mineralogical composition.

Therefore, optimizing slip formulations is one of the best ways to improve drying. In addition, the creation of ceramic bodies still depends on virgin raw materials from mining, while the amount of recycled ceramic waste is still low.

The RAPID DRY project aims to produce **new ceramic body formulations** that are:

Capable of **OPTIMIZING THE DRYING PROCESS** by reducing its duration

Capable of **RESISTANCE TO BREAKAGE** of the ceramic pieces during the drying cycle

Using **RAW MATERIALS OBTAINED FROM RECYCLED CERAMIC WASTE**, therefore limiting the use of virgin resources, and reducing the amount of waste

01/06/2020
START DATE

31/12/2022
END DATE

31 MONTHS
DURATION

€ 1,350,447
TOTAL BUDGET

€ 709,250
EU CONTRIBUTION

SE.TE.C. srl
COORDINATOR

LIFE CYCLE ENGINEERING srl
PARTNER

THE NEW RAPID DRY DRYER

The Rapid Dry dryer combines several original technologies that **reduce energy waste and emissions**. The most innovative one is the **PLC** (Programmable Logic Controller) **software** during operation. This new software automatically adjusts the main parameters affecting the drying process, such as temperature, relative humidity, and speed of air recycling inside the chamber. In this way, it ensures a homogeneous drying process, thus avoiding the formation of warps or cracks on the dried pieces. In particular:

- The fully automated heat generator regulates the amount of heat supplied, significantly reducing methane consumption
- The automatic regulation of air flows reduces electrical power, hence decreasing the consumption of electric energy
- The setting of a drying curve permits controlling air temperature, humidity, and air flow in every process step, achieving perfect drying homogeneity
- The recovery of humidity and heat from the exhaust fumes allows air that is already partially warm to be introduced into the dryer, thus limiting the energy required to heat it in the early stages of the process.

THE NEW RAPID DRY SLIP

The new Rapid Dry slip formulations (Vitreous China and Fire Clay) optimize the drying process:

- By modifying the rheology and grain size, it is possible to improve the drying curve's efficiency and reduce the drying time
- Applying the new slip formulation increases the breaking strength of the pieces during the drying process
- Using recycled ceramic waste materials reduces the amount of virgin raw materials used for each piece and the amount of waste sent for disposal.

PROJECT OUTCOMES

INDUSTRIAL OUTCOMES

14
TEST CYCLES

around
7000
SANITARYWARE PIECES
successfully dried

around
1200
TABLEWARE PIECES
successfully dried

RAW MATERIALS CONSUMPTION
-6%

GAS CONSUMPTION
-67%

ELECTRICITY CONSUMPTION
-86%

DRYING CYCLE IN TRADITIONAL DRYER

14h
WITH TRADITIONAL CERAMIC BODY

DRYING CYCLE IN NEW RAPID DRY DRYER

8h WITH TRADITIONAL CERAMIC BODY

7h WITH RAPID DRY SLIP

0 DAMAGED OR BROKEN PIECES

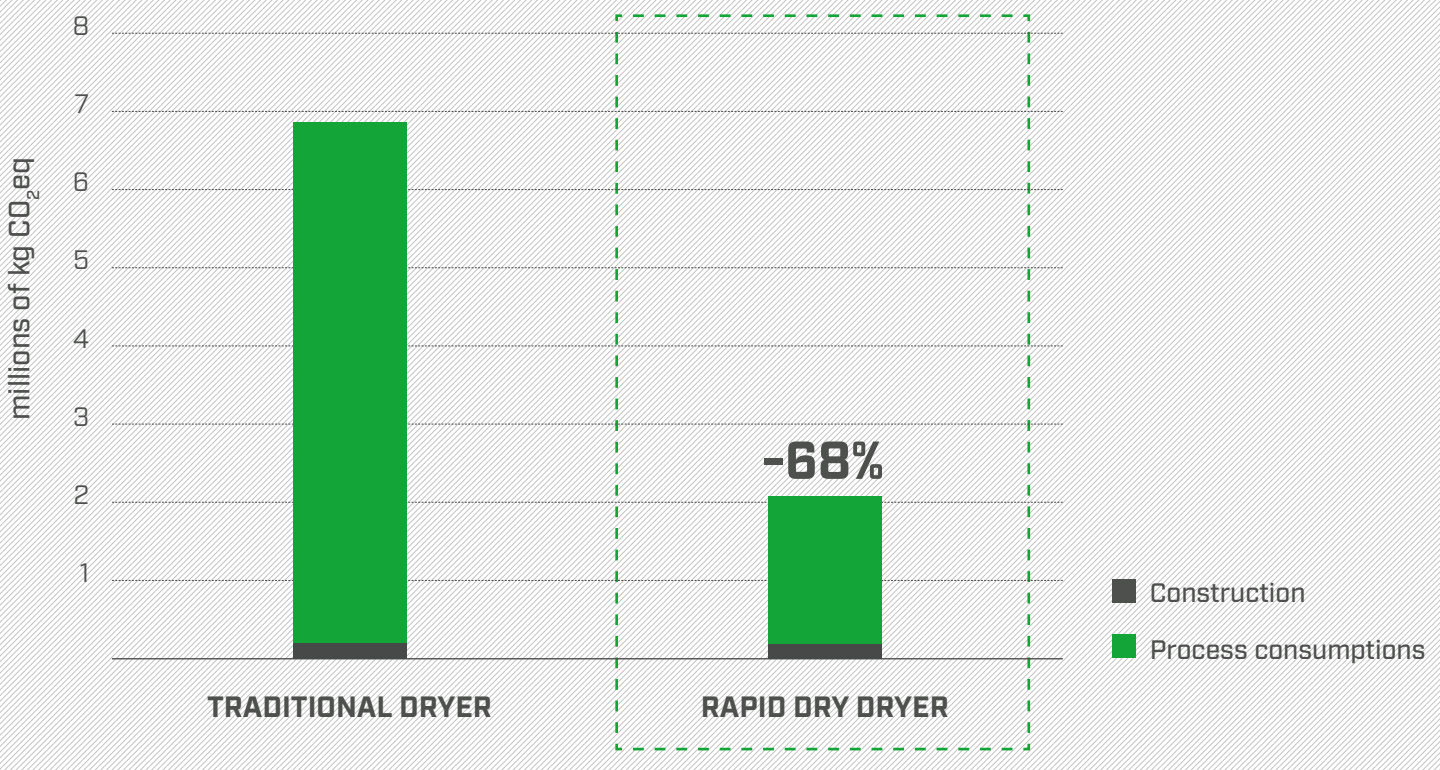
ENVIRONMENTAL OUTCOMES

A Life cycle Assessment study (LCA) allowed us **to compare the environmental impacts generated along the life cycle of a traditional dryer and slips with those of a Rapid Dry dryer and slips.**

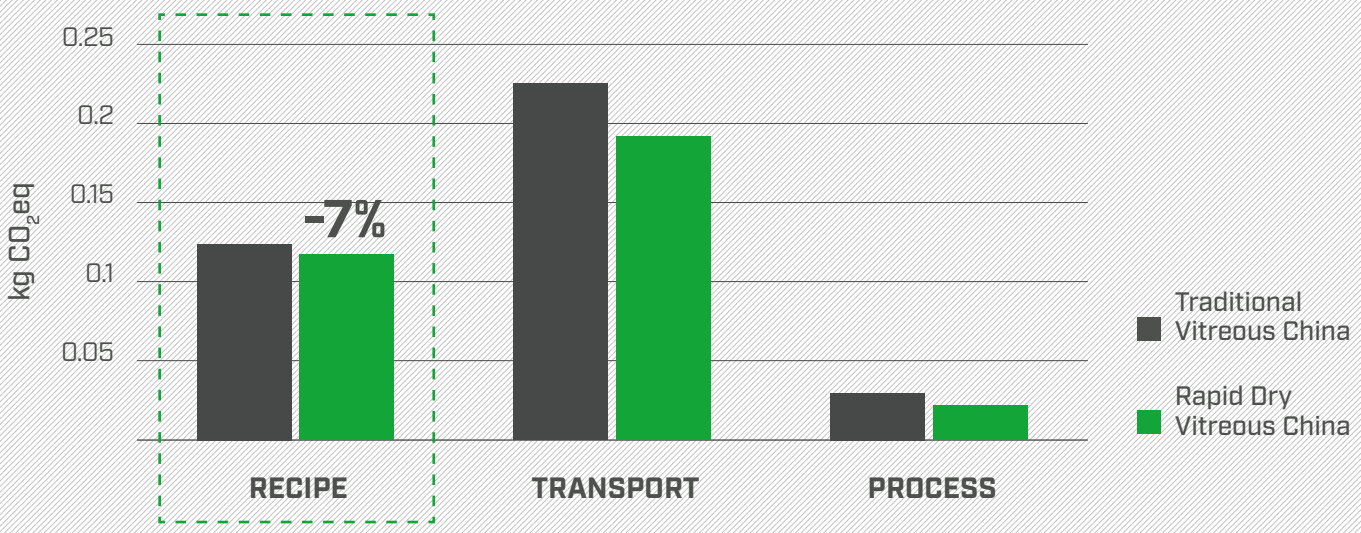
This study has shown that the industrial results are matched by positive environmental results.

The shortening of the drying cycle and the selection of raw materials in the dough led to changes in greenhouse gas emissions, highlighted in the graphs below.

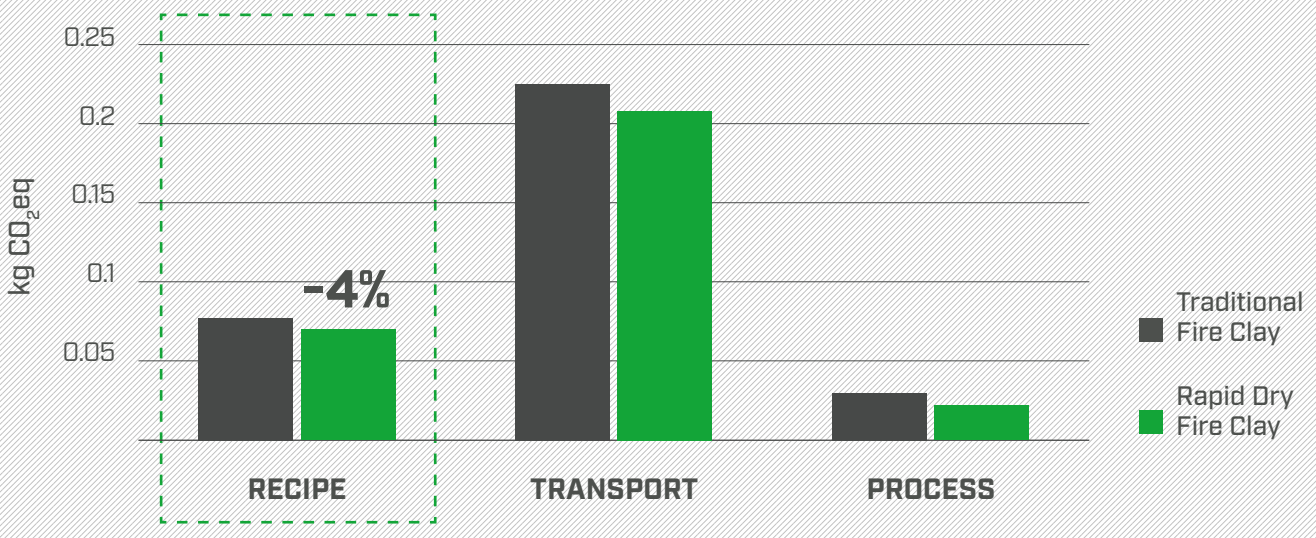
GREENHOUSE GAS EMISSIONS IN THE LIFE CYCLE OF A DRYER (30 YEARS)



GREENHOUSE GAS EMISSIONS PER 1 kg OF VITREOUS CHINA



GREENHOUSE GAS EMISSIONS PER 1 kg OF FIRE CLAY



SOCIAL OUTCOMES

The Social Life Cycle Assessment analysis was carried out on the new RAPID DRY dryer and the new mixtures to identify the main social benefits resulting from the introduction of the technologies developed by the project. In particular, the results highlighted a significant **reduction in noise and dust levels**, thus improving the worker's condition near the dryer.

ECONOMIC OUTCOMES

-25%
costs over the life cycle of a dryer using **RAPID DRY VITREOUS CHINA BODIES**

-31%
costs over the life cycle of a dryer using **RAPID DRY FIRE CLAY BODIES**

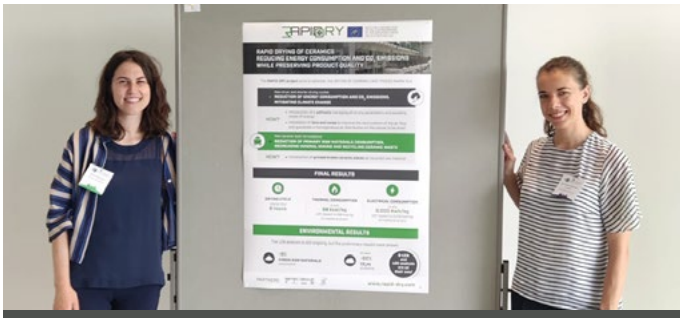
-than 1 year
the time needed to repay the higher investment due to the purchase of the **NEW RAPID DRY DRYER**

DISSEMINATION

Brochures, newsletters, posters and fact sheets were distributed, also through LinkedIn, among the project's target groups and made available on www.rapid-dry.eu. The results were shared with the industry, local authorities, and students through trade fairs, conferences, and visits to the prototype.

Prototype presentation event
26 May 2022

CERAMITEC (Munich)
21-24 June 2022



3rd Life Cycle Innovation Conference (Berlin)
29 June - 1 July 2022

Seminar at the University of Tuscia
5 July 2022

TECNA (Rimini)
27-30 September 2022

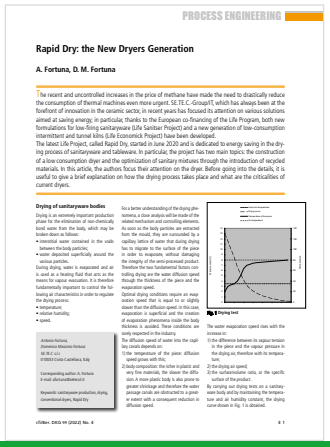
Conclusive event of the project (Civita Castellana)
6 October 2022

PUBLICATIONS

TECHNICAL-SCIENTIFIC

Ceramic World Web
(13/04/2022)

Ceramic World Review
(146/2022)

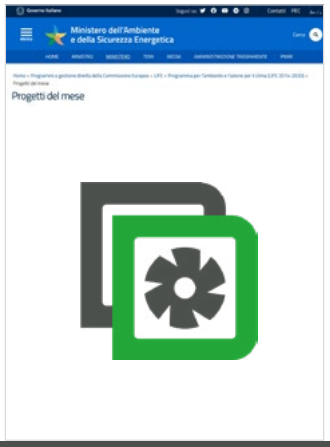


Ceramic Forum International
(cfi/Ber. DKG 99 (2022) No. 4)

POPULAR

The journal **Il Messaggero**
(18/05/2022)

The journal **Il Messaggero**
(29/10/2022)



"Progetto del Mese", website of the Ministry of the Environment

EXPLOITABILITY AND LONG-TERM BENEFITS

The results achieved can be used to produce all ceramic products except tiles, covering 60-70% of the entire ceramic market.

Although the new rapid dry dryer is slightly more expensive than a conventional one, it allows **more production cycles** while **reducing the staff's working time**. Overall, in addition to the savings achieved thanks to the reduction of energy consumption, it results in lower expenses.

Thanks to the innovative formulas of ceramic slips, the sanitaryware sector would save **7-8% of virgin raw materials** in the long term.

In addition, the **new dryer** would save **about 67% of gas and 86% of electricity, plus 68% of CO_2eq emissions**.

RAPIDRY

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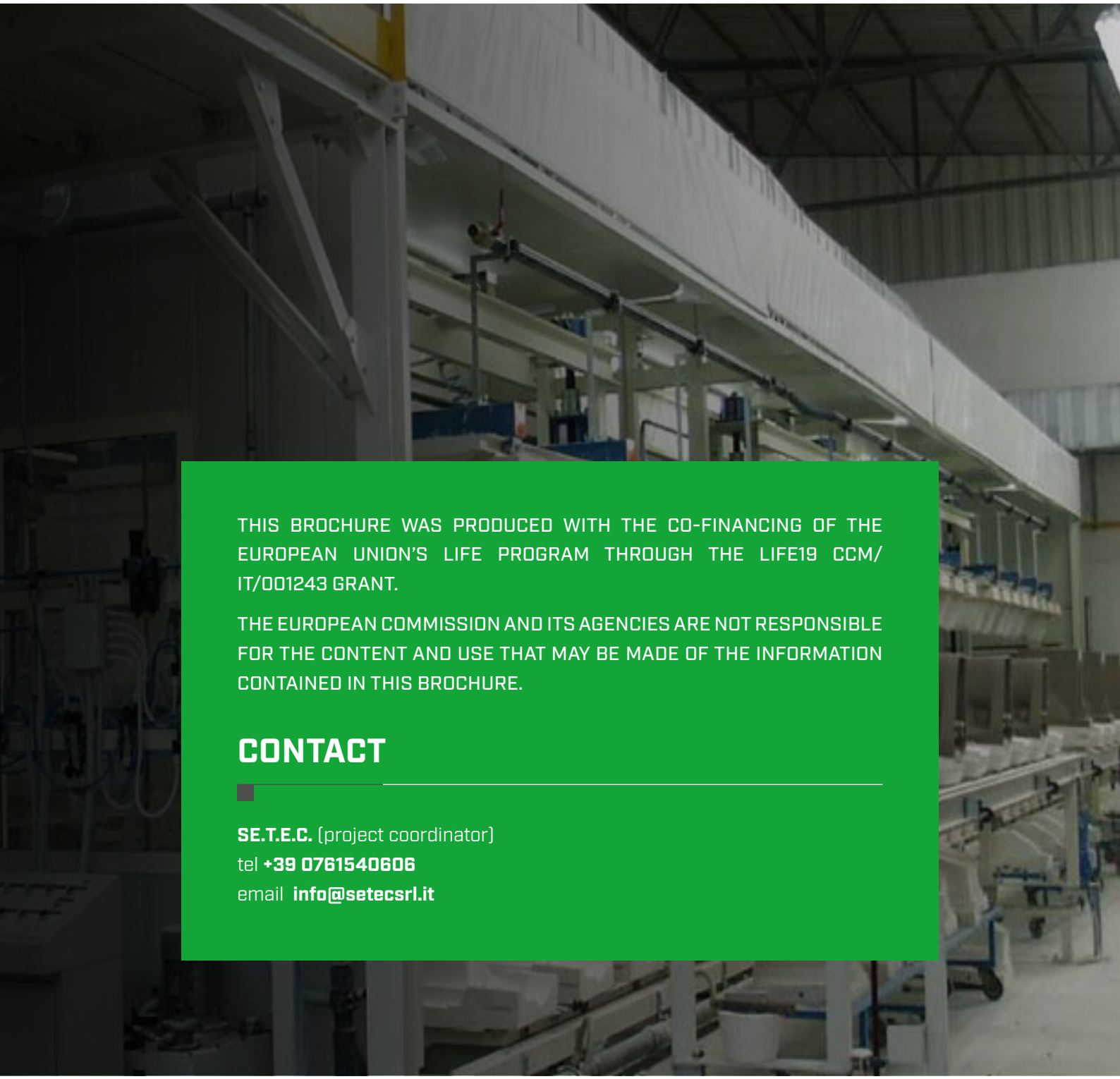

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