



GREEN CASTING

Towards zero emissions in European ferrous foundries using inorganic binder systems



LAYMAN'S REPORT



GREEN CASTING LIFE project is co-funded by European Union's LIFE program under grant agreement LIFE21-ENV-FI-101074439.

THE CONSORTIUM - 16 PARTNERS IN 8 COUNTRIES:



Meehanite Technology Oy (Finland),
Project leader



Metalúrgica Madrileña S.A. (Spain)



Valumehaanika AS (Estonia)



Peiron Oy (Finland)



F.A. Engineering srl (Italy)



AZTERLAN Metallurgy Research Centre



PEAK Deutschland GmbH (Germany)



SAND TEAM, spol s.r.o. (Czechia)



OPSA Ltd (Poland)



A-Insinööri Teollisuus- ja talotekniikka Oy (Finland)



AGH University of Science and Technology (Poland)



Centre Techniques des Industries Mécaniques (France)



Foundry Association of the Basque Country and Navarre (Spain)



Voestalpine Railway Systems JEZ, S.L. (Spain)



Foundryteam Oy (Finland)



Dipartimento di Ingegneria Università di Perugia (Italy)

**LIFE21-ENV-FI-
101074439**
Project number

**Sep 2022 - Apr
2026**
Duration

€7.16 million
Total eligible budget

€4.30 million
EU contribution

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- **6 flagship foundries**
- **10 follower trials**
- **512 foundries contacted**
- **84 Dissemination events**

1. WHY CHANGE FOUNDRY MOULDING?

Iron and steel castings are often shaped in sand moulds. The sand needs a binder to hold its shape. Traditional organic binders work well, but they can burn when molten metal is poured into the mould. This creates smoke, odours and harmful gases, and it leaves residues in the used sand.



Three connected problems

- Air emissions: BTEX, PAHs, volatile organic compounds, particles and other gases can be released during pouring, cooling and shakeout.
- People: smoke and odours affect working conditions inside the foundry and can also affect nearby communities.
- Resources: contaminated used sand is difficult to recycle and is often sent to landfill.

The project response

GREEN CASTING LIFE tested mineral-based inorganic binders, mainly silicates and geopolymers. The aim was to prevent pollution at source, while keeping casting quality and production reliability.

Industrial emission measurements during casting. Photos: Green Casting LIFE consortium.

“Replacing organic binders with inorganic binders reduced BTEX emissions by over 90% under industrial foundry conditions”

— Industrial-scale tests at OPSA

Project at a glance

TOTAL ELIGIBLE BUDGET
€7,162,398

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EU CONTRIBUTION
€4,297,433

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The core idea

ORGANIC BINDER
Burns when metal is poured

CONTROL
Capture and treat the fumes

WASTE
Sand carries organic residues

INORGANIC BINDER
Prevents most organic emissions

CLEANER PROCESS
Less smoke, odour and exposure

CIRCULAR SAND
More options for reclamation and reuse

2. FROM SAND TO CASTING - WHAT CHANGED

An inorganic binder is a water-based mineral system that makes sand strong enough to form moulds and cores. Unlike organic resins, it does not burn in the same way when it meets molten metal. The change looks small, but it affects the whole production process.

1 MIX Sand + inorganic binder	2 SHAPE Make moulds and cores	3 CAST Pour metal and measure gases	4 REUSE Reclaim and return sand
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The project followed the full route from mould preparation to industrial casting and sand recovery.

One project, four linked stages

UNDERSTAND Map the sector and define foundry needs WP1 + WP3	MEASURE Compare emissions and life-cycle impacts WP2	DEMONSTRATE Test and commission in six foundries WP4 + WP5	SCALE UP Follower trials, business and policy outreach WP6 + WP7 + WP8
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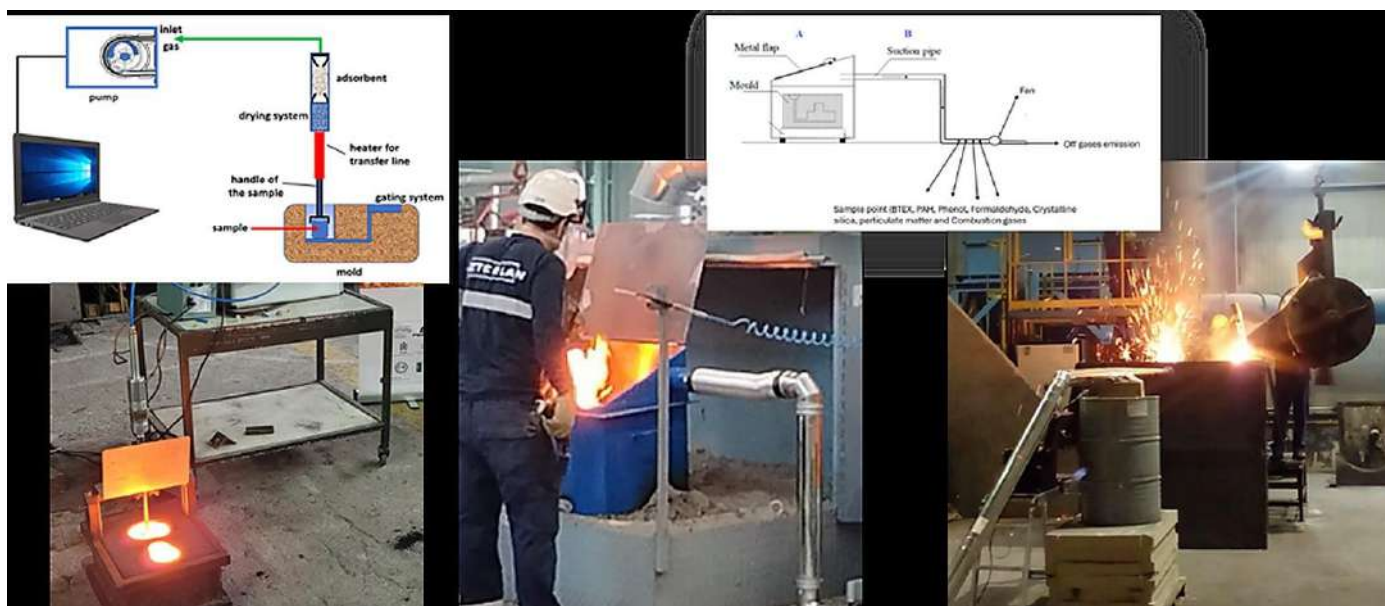
“Quality of the castings has been adequate. Surface quality has been very good, with no pinholes”
— Peiron project results

A European demonstration network

16 partners research, industry and foundries	8 countries from Finland to Spain	6 flagship foundries full industrial demonstrations	10 follower trials testing replication in new plants
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3. CLEANER AIR - EVIDENCE AT THREE SCALES

The same question was tested in the laboratory, in a pilot foundry and in full industrial production: what is released when molten iron is poured into moulds made with different binders?



Laboratory, pilot and industrial emission tests used controlled gas collection and comparable measurement methods.

>93% less BTEX pilot tests vs organic binders	>94% less PAHs pilot tests vs organic binders	>98% less particles pilot-scale comparison	>55% lower CO₂ impact life-cycle assessment
LABORATORY 150 g sand samples 10 binder combinations	PILOT FOUNDRY 110 kg moulds 9 mould/core combinations	INDUSTRIAL 500-1,500 kg moulds 7 full-scale measurements	
What this means in a foundry • Less smoke and odour during pouring and cooling. • Lower exposure to harmful organic compounds. • Lower risk of gas-related defects in castings.		Life-cycle results • The geopolymers binder reduced impacts in all 12 categories assessed. • The modified silicate binder reduced impacts in 10 of 12 categories. • The largest gains concerned toxicity, freshwater ecotoxicity and ozone formation.	

Evidence base

26 emission trials laboratory, pilot and industrial	10+ pollutants measured including BTEX, PAHs and particles	3 peer-reviewed studies methods and results published	>90% reduction confirmed for BTEX in industrial conditions
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4. SIX FOUNDRIES, SIX TAILORED TRANSITIONS

There was no universal recipe. Each foundry had different sands, cast alloys, mould sizes, equipment and production speeds. The project therefore used pilot trials, process adjustments and gradual investment.



New moulding equipment



Mould and core preparation



Industrial production

Industrial implementation included mixers, moulding lines, core equipment, process control and sand handling.

PEIRON - Finland

A new continuous mixer supported trials with iron and steel castings. Production with inorganic binders continues.

OPSA - Poland

A new inorganic moulding line was built together with a two-stage system to reclaim used sand.

FONDERIE DI ASSISI - Italy

A new core line uses CO₂ curing to make inorganic cores for demanding automotive and industrial castings.

VALUMEHAANIKA - Estonia

The existing process was adapted for full-scale trials and commissioning with self-setting inorganic binders.

METAMSA - Spain

The inorganic line was expanded with mixing and demoulding systems.

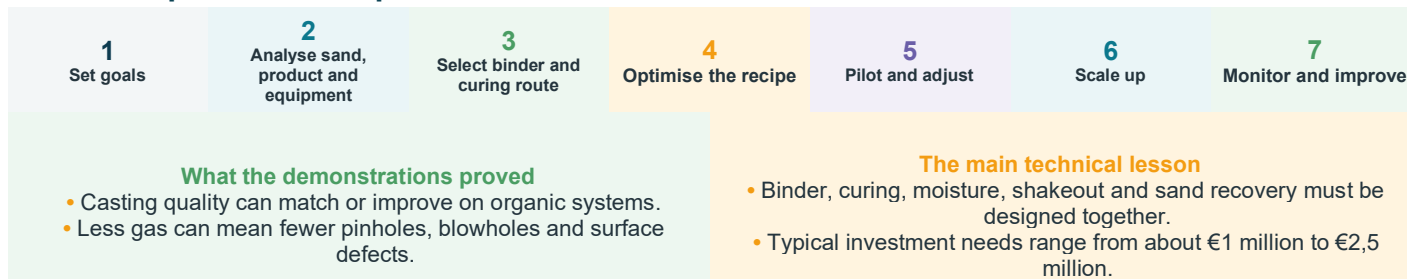
JEZ - Spain

Core and mould trials were successful. A full mixer investment is planned after the project.

“The technology shows promising potential for our production processes, and while viable on its own merits, grant support would reduce investment risk and enhance its competitiveness”

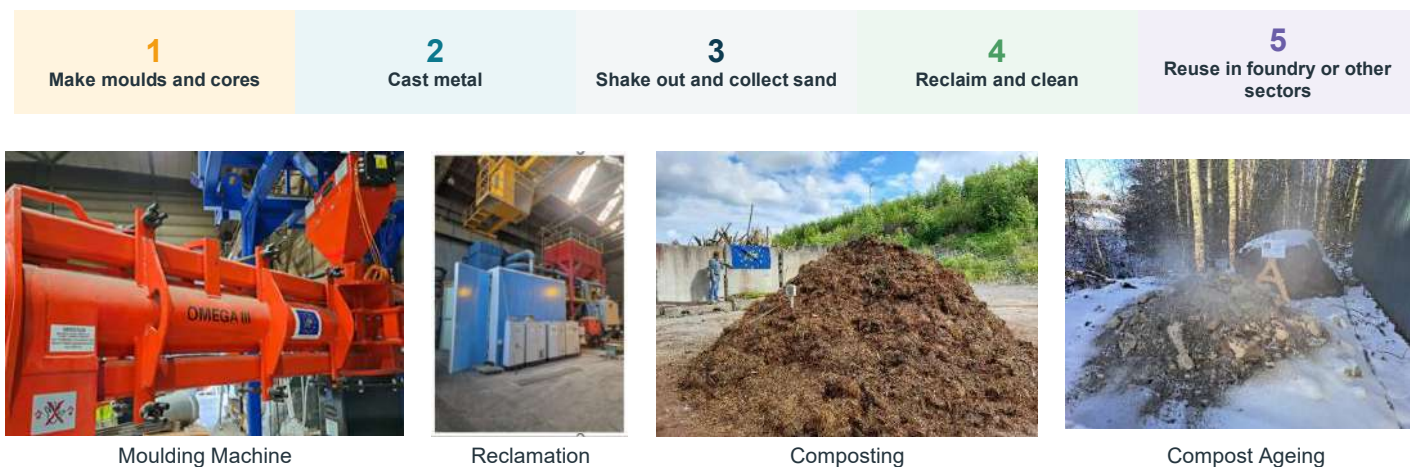
— voestalpine Railway Systems JEZ

A practical implementation path



5. KEEPING FOUNDRY SAND IN THE LOOP

After a mould is broken open, the sand can become waste - or it can become a resource. GREEN CASTING LIFE tested how inorganic sand can be cleaned and used again inside the foundry or in other applications.



Moulding machines, Mechanical reclamation, composting and ageing were tested at laboratory and industrial scale.

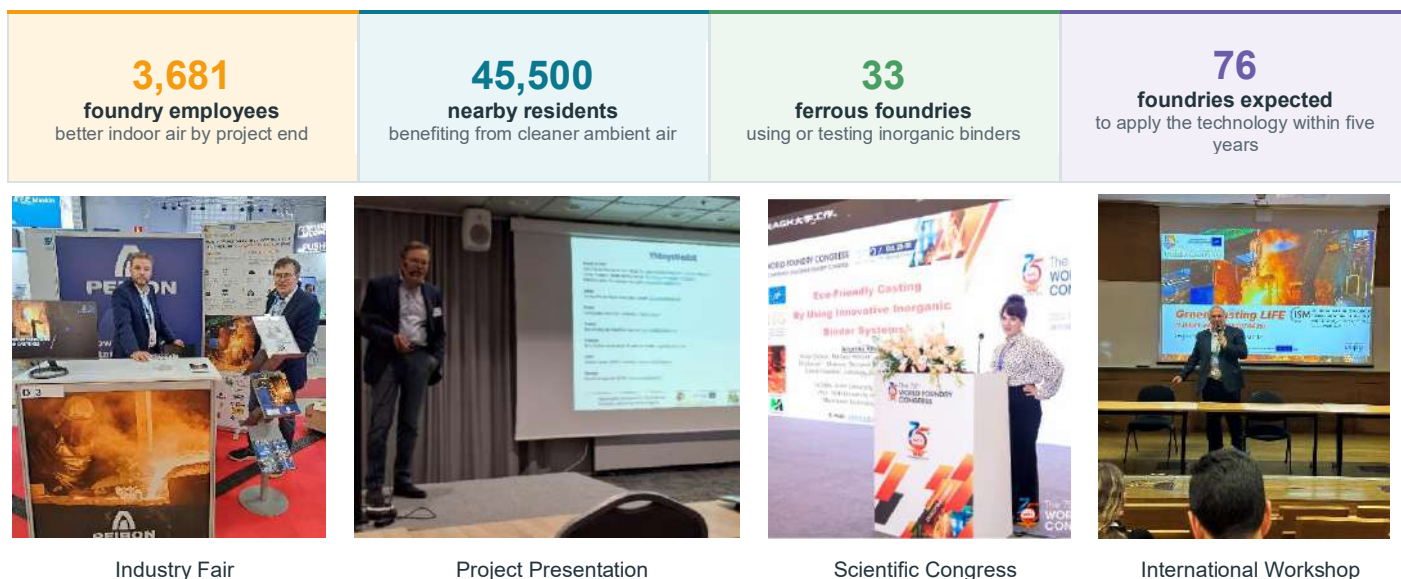
85-100% reclaimed sand used in successful sand mixtures	1.6-2.2 MPa bending strength achieved with reclaimed mixtures	21,400 t sand reused estimated at project end	151,450 t potential reuse five years after the project
Inside the foundry Primary reclamation improves sand quality. Secondary mechanical treatment removes more binder residues and supports high levels of reuse.		Outside the foundry Composting, ageing and construction uses can avoid landfill. The tested samples did not show the hazardous waste properties HP14 or HP15.	
“<i>The use of inorganic binder allows a drastic reduction in the level of contamination of the residual sand, which allows its valorization, after sand waste characterization, in the manufacture of bricks</i>” — METAMSA project results			

Environmental assessment of sand recovery

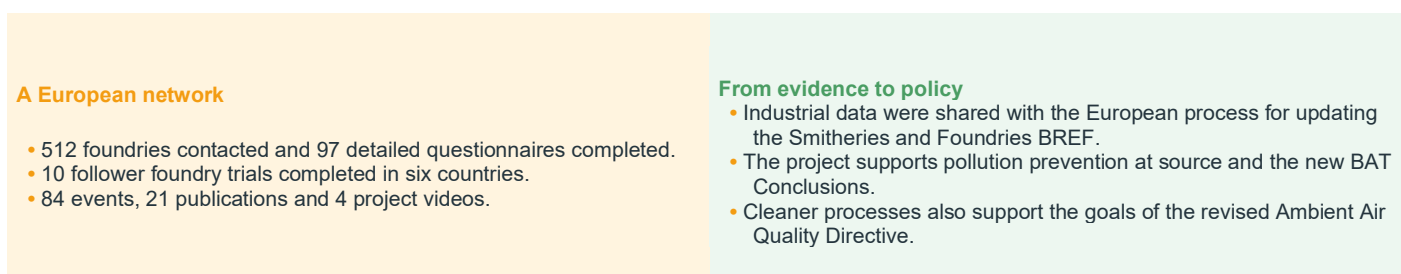
MECHANICAL Generally lower impacts because it uses less energy and no process water.	WET TREATMENT Can clean inorganic sand well, but wastewater and transport must be managed.	END OF LIFE Construction use and composting provide clear benefits compared with landfill.
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6. BENEFITS BEYOND THE PILOT FOUNDRIES

The project combined industrial evidence, support for follower foundries, scientific work and public communication. The benefits extend to workers, nearby communities, the wider foundry sector and European environmental policy.



The consortium shared results at industry fairs, scientific conferences, workshops and the final seminar.



Long-term environmental benefits



“
The tests showed clear workplace benefits: less odour and emissions.
 — Valumehaanika project results

7. WHAT HAPPENS AFTER LIFE?

The project ended in April 2026, but the transition continues. Partners will use their own resources to support additional foundries, publish results, take part in industry events and keep the project website available.

2026 6 additional pretests 2 in Italy, 3 in France, 1 in Poland	2026-2027 Events and publications continued sector and scientific outreach	5 years 76 foundries expected to apply inorganic binders in Europe
After-LIFE actions - Support the flagship and follower foundries during day-to-day use. - Continue trials with new foundries and binder suppliers. - Share guidance, scientific papers, videos and industrial case studies.		A transition that can be replicated - Start with a technical and environmental feasibility study. - Run pilot tests on the foundry's own products and equipment. - Plan the binder, curing, shakeout and sand reclamation as one system.

“*Replication must be approached as a structured transition process rather than as a simple binder system substitution*”

— GREEN CASTING LIFE business and replication plan

Contact and project information

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Layman's Report prepared under WP8 by the University of Perugia on behalf of the GREEN CASTING LIFE consortium.



Project results

Read, watch and use the results

READ Short implementation guide technical lessons in plain language	WATCH 4 project videos follower trials and foundry experience	USE Public reports and papers data for industry, research and policy
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