

Validating the impact of resource efficiency



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Responding to the **resource** challenge

When tackling the environmental challenges facing large industries, optimising resource use is critical to achieving more sustainable, low-carbon operations.

The difficulty is understanding the true carbon-saving potential of resource efficiency solutions in real-world conditions. This might include minimising waste, improving production processes, adopting new materials, or developing recycling and end-of-life strategies. These solutions have the potential to deliver significant carbon reductions, as they reduce the need to use energy to process new materials (embodied emissions), but the amount of savings realised can vary from the theoretical estimates to what can be achieved at meaningful scale in practice.

In response, the Department for Energy Security and Net Zero (DESNZ) and the Department for Environment, Food and Rural Affairs (Defra), in collaboration with Innovate UK, launched the 'Contracts for Innovation - Resource Efficiency Impacts Validation' competition in summer 2025. It invited innovators from across academia, research and technology organisations (RTOs) and industry to apply for funding to support the development of novel solutions to resource efficiency challenges.

The competition built on recent DESNZ and Defra research into 'Unlocking Resource Efficiency'¹, which highlighted key areas of potential focus, as well as barriers and drivers for efficiency measures in different resource-intensive industries.

¹ <https://www.gov.uk/government/publications/unlocking-resource-efficiency>

Introduction

Focusing on emissions, productivity and resource use benefits that would come from the redesign of materials and products, the competition offered support of up to £300,000 to projects, as part of a total commitment of around £5 million. The projects ran for up to five months, from November 2025 to March 2026, with the competition centered around three industries that could benefit significantly from resource efficiency:

- **Construction:** reducing embodied carbon, supporting retrofit and low-carbon materials, and enabling reuse and disassembly
- **Chemicals:** developing alternative feedstocks, reducing emissions and redesigning formulations
- **Automotive:** reducing material use for electric vehicles, supporting disassembly and increasing recycling potential

Under the competition, successful projects completed a relevant trial or demonstration of their solution in a representative environment, using their own operations or those of a potential customer. These trials then informed an impact validation report that was required to consider the environmental, economic and process efficiency benefits it could bring to affected industries.

This aligned with the focus on real-world solutions rather than theoretical applications. Projects were expected to demonstrate their solutions at Technology Readiness Level 7 (TRL7), equivalent to real operational conditions, in order to gather data for a life cycle analysis around their practical production and installation.

These requirements aimed to provide impetus towards the take-up of the solutions by industry, bringing them closer to market readiness. Crucially, these step changes could also be adopted by industry without the need for disruptive large-scale changes to infrastructure and processes. By focusing on strategic redesign or material substitutions, operational continuity can remain.

The projects highlighted in this brochure showcase just how new and exciting innovations can transform traditional products and processes across industries that face significant environmental and resource challenges. Whether focused on concrete mix and monitoring, chemical filtration and make-up, alternative materials, the recovery and reuse of critical metals, or digital technology to support the analysis and application of new products, each solution plays a key role in shaping a more resource efficient industry for the future.

Using these areas of opportunity, the competition aimed to bring solutions into practice to support the UK's position as a global leader, driving innovation and adoption of low-carbon, circular solutions in key industrial sectors.



“Contracts for Innovation has shown, and validated, the real world benefits of resource efficiency in carbon intensive industries. It has demonstrated the strong economic and environmental opportunities of the innovations. We have gained valuable policy and data insights from the projects, which will help shape government policy going forwards.”

Kate Robinson, Industrial Resource Efficiency Policy, Department for Energy Security and Net Zero



Department for Energy Security & Net Zero

“We recognise the need to support research, design and innovation to help industry transition to a circular economy and were pleased to co-fund the Contracts for Innovation programme. The projects have demonstrated, with robust evidence, how a focus on resource efficiency can help different industries in their moves towards more circular business models.”

Luke Ridley, Joint Head of Science for Circular Economy, Department for Environment, Food and Rural Affairs



Department for Environment Food & Rural Affairs

“Contracts for Innovation has been highly effective in moving resource efficiency solutions from theory into real-world validation. By funding robust Life Cycle Analysis and demonstrations, it has enabled credible sustainability claims while giving policymakers valuable, practical data on impact and accelerating industry adoption.”

Amy Peace, Innovation Lead Circular Economy, Innovate UK

Competition highlights



11 automotive projects



20 construction projects



9 chemical projects

40

projects backed

£5m

total investment



5-month project length (on average)



1 in-person cohort workshop (January 2026)



Demonstrations held across Northern Ireland, Scotland and England, reaching over 250 stakeholders

Preoptima

“This funding enabled us to move beyond development into real-world validation, helping us demonstrate the platform’s value for scaling whole-life carbon compliance in building planning.”

Newcastle University

“Building on the project’s success for demonstrating predictive modelling technology for high-value cement reuse, we plan to secure further investment and bring a commercial product to market within three years.”

Grand Bequest

“Through this funding, our proprietary platform has reduced feasibility assessments from two years to 20 weeks on empty buildings, making low-carbon reuse solutions faster, clearer and more viable.”

Plastometrex

“The support allowed demonstration of non-destructive testing technology and on-site validation of structural steel, providing a pathway to integrating key material data into life cycle analysis and workflows.”

Colas

“The project has enabled our teams to significantly expand the scale and scope of the trial to include multiple low-carbon material options, and expand our analysis to explore different methods and future scenarios.”

Efestos Hub

“The competition helped us move from a research and development (R&D) stage innovation to a TRL7 workflow tested in a live setting. We created strong market traction from the live demonstration, leading to new stakeholder engagement across the supply chain.”

Alive Labs

“The support allowed us to combine life cycle analysis with real-world deployment to show measurable environmental impact that aligns with net zero and biodiversity goals. It also opened doors to industry partners ahead of commercial rollout.”

Harcourt Technologies

“We benefited from the chance to validate and demonstrate new material designs that have boosted our competitiveness in an emerging industry both domestically and overseas, where operational efficiency is a key advantage.”

Agreka Build

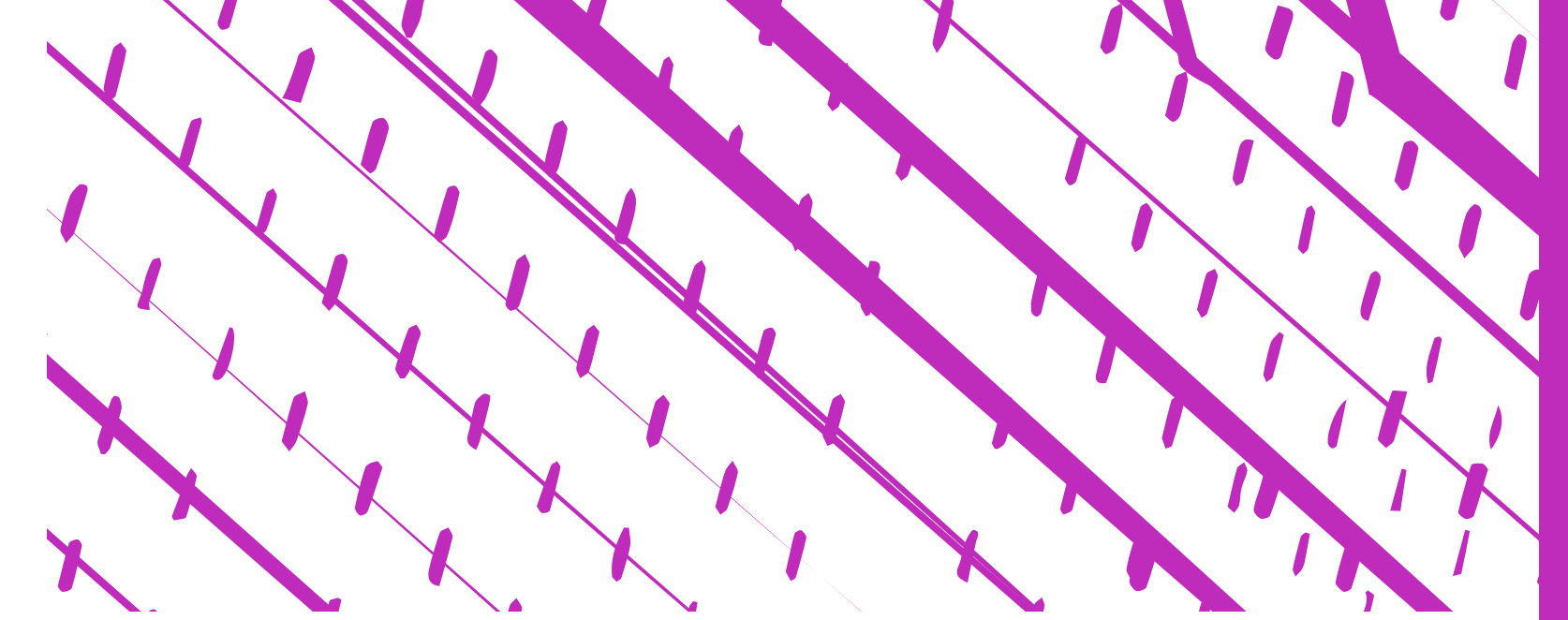
“The project accelerated our technology from TRL5 to TRL7, which enabled new technical hires for long-term growth, significantly reduced development time and unlocked collaboration with early adopter clients and industry enablers.”

Projects supported

Construction

Agreka Build Ltd	Circular construction materials validation: Demonstrating carbon-efficient performance and emissions reduction potential of Wheatex® natural fibre insulation in operational retrofit environments
Alive Labs Ltd	Alive: Carbon-negative modular façades for resource-efficient urban greening
Cambridge Electric Cement Ltd	Reclinker – Recycling cement at scale
Cloud Cycle Ltd	Towards net-zero construction: Leveraging novel in-transit monitoring tools to minimise overspecification and carbon emissions in concrete production
Colas Ltd	Decarbonising road construction and renewals through a tailored cold recycled asphalt material system with biogenic and waste-derived additives
Efestos Hub Ltd	High-quality AI-assisted Reuse for Next-generation Engineering Steel Supply (HARNESS)
Enji Technologies Ltd	Enji: transforming structural calculations for intuitive, resource-efficient construction design
FP McCann Ltd	Scalable production of graphene-enhanced concrete roof tiles for low-carbon housing
Grand Bequest Ltd	RegenerationOS in action: Circularity, feasibility and investment readiness for net zero cities

Harcourt Technologies Ltd	Resource-Efficient Construction with Lean Additive Integrated Method using 3D Concrete Printing (RECLAIM-3DCP)
I3D Robotics Ltd	IRIFIO: Digital sustainability
Material Index Ltd	Rapid classification of high value recycling streams from deconstruction of buildings and digital tracing to recycling partners
Newcastle University	R3-CEM: Recovering, refining, and reactivating cement from recycled concrete using advanced particle characterisation
Opovate Ltd	MYCOCORE - Development of a unique, sustainable, structural insulation core for lintels
Ove Arup & Partners Ltd	Wealth from waste - Revault prototype
Plastometrex Ltd	PLX-Beam: Accurate in-situ grade determination of steel beams to enable the re-use supply chain
Preoptima Ltd	Carbon Life cycle Evaluation for Authority Reviews (CLEAR)
Structural Panda Ltd	Accelerating the decarbonisation of UK construction with parametric analysis tools
Vistry Homes Ltd	Project VIC-E (Vistry Innovation and Circular Economy)
Vundahaus Ltd	Prefabricated heritage brick facades for low-carbon, resource-efficient construction



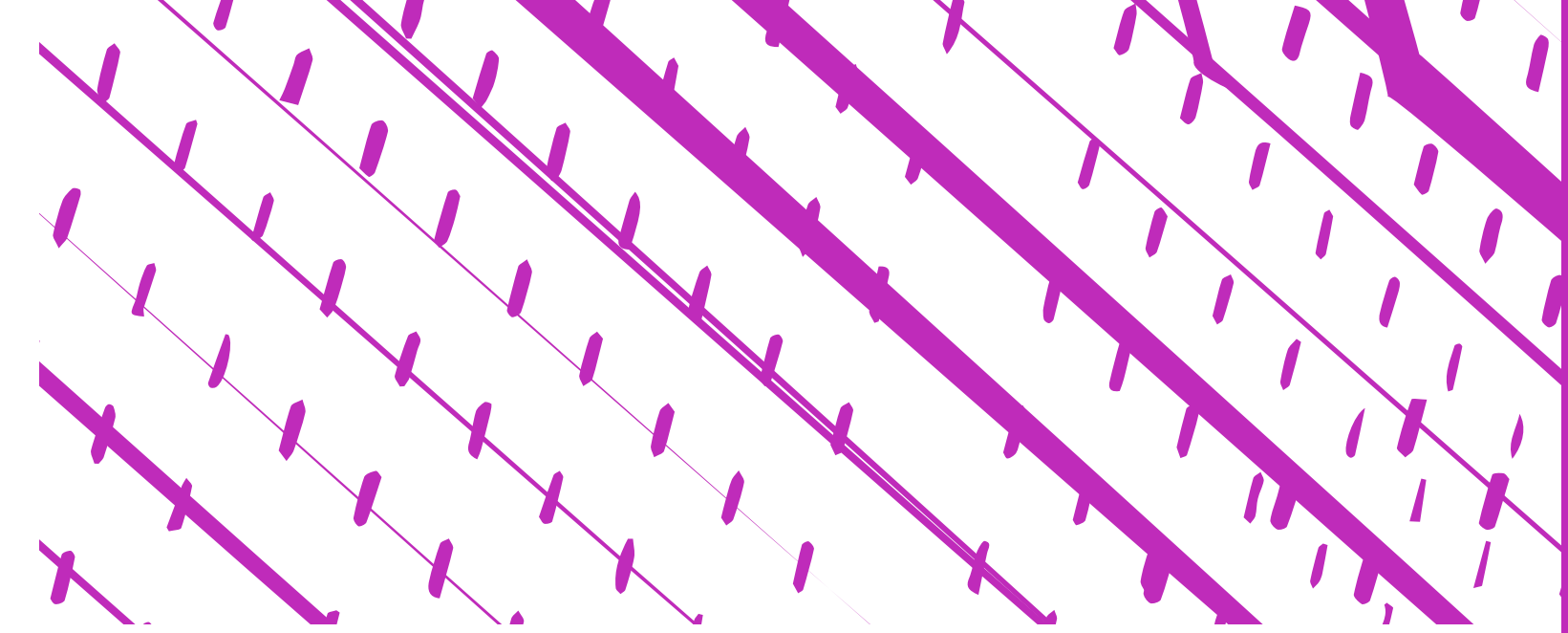
Projects supported

Chemicals

Biome Technologies PLC	BioPolyAce: Defossilisation – Final step process validation and pilot production of next-generation UK bio-based compostable polymers
Croda Europe Ltd	Next-gen filtration for natural product industries
Green Rose Chemistry Ltd	GoDissolve: Accelerating development of sustainable polymers with resource-efficient software
Halocycle Ltd	Impact validation towards industrialisation of novel microwave pyrolysis process for recycling end-of-life PVC
Imerys Minerals Ltd	Recycled anti-blocking additive for polymer films - a resource efficient solution
Nanomox Ltd	MAGnesium valorisation for Next-level Impact in Future Yield and sustainability (MAGNIFY)
Phos Cycle Ltd	Industrial impact validation of eutectic freeze crystallisation: Unlocking low-carbon fertiliser salts
R3V Tech Ltd	Defossilising green solvent production via electrochemical transformation
Stoli Catalysts Ltd	Energy and cost-efficient multi-ton scale hydrogenation

Automotive

Altilium Metals Ltd	Demonstration of sustainable production of EV battery cells with recycled cathode and anode materials
Aqdot Ltd	CLEAR: Circular Low-Emission Advanced Remediation for high-quality recycled plastics in automotives
Electrify Everything Now Ltd	ResiCharge
Fidelis AI Ltd	EVES project: Efficient-resource virtual AI testing for lightweight autonomous VEHICLE Sensor design
Go Rolloe Ltd	Development and validation of an integral brake dust capture and recycling platform for public transport vehicles
Hive Composites Ltd	Design for Lightweighting, Material recovery, And disassembly Technologies (DeLiMAT)
Ionic Recovery Ltd	Project AutoInks
Multi-X Solutions Ltd	Self-learning high-efficiency intelligent simulation platform for sustainable hot stamping in EV manufacturing
RecyclaTech Group Ltd	Green Rubber: Validating continuous processing of uncured tyre scrap for reuse
Taisan Motors Ltd	Lightweight and compact sodium batteries for automotive
TRL9 Ltd	automotive Waste Avoidance and Reuse Project using Smart Programmable Electrical Energy Dismantling (WARPSPEED)



FP McCann

Scalable production of graphene-enhanced concrete roof tiles for low-carbon housing



Meet the innovator

Based at several sites around the UK, FP McCann is one of the leading manufacturers and suppliers of precast concrete products for the construction sector and a range of other industries. A key focus for the company is the development of sustainable products that provide solutions to environmental and production challenges for customers, working in partnership with cement producers and materials companies.

The resource challenge

Traditional concrete roof tiles are manufactured using CEM I, a carbon-intensive cement caused by high clinker content. Although alternatives are being explored to help reduce the carbon footprint associated with high-volume tile manufacturing, challenges remain in achieving the strength and durability performance required to meet construction regulations.

As a result, there is a need for a solution that tackles these challenges, but crucially also makes use of existing infrastructure and processes to avoid costly production downtime and machinery changes that could limit adoption.

The solution

The approach put forward by FP McCann looks to further develop the concept of graphene-enhanced roof tiles that addresses both performance and environmental challenges, while also being economically viable to support wider efforts for sustainable building. By incorporating graphene nanoplatelets into the cement, the enhanced structural performance enables the use of lowercarbon CEM II cement in place of CEM I, without compromising tile quality or requiring changes to onsite manufacturing processes.

Supported by First Graphene, NCC and Breedon, the project undertook the development and manufacture of graphene-enhanced concrete tiles at full-scale demonstration level. It also utilised an AI-driven quality detection system to monitor surface quality and consistency in a production setting. Valuable assessment and life cycle analysis work was also undertaken that focused on areas such as durability testing, aesthetic matching, long-term carbonisation potential, cost comparison, and the issue of graphene leaching.

Case study

FP McCann

Scalable production of graphene-enhanced concrete roof tiles for low-carbon housing

Impact and results

The project effectively demonstrated the integrity of the tiles for building use, while also achieving environmental and resource use benefits that set the design apart from traditional products in the market.

Due to the effects of the graphene's improved bonding and strength capabilities, analysis showed the reduction in cement required for each tile led to a 14% reduction in embodied carbon.

The manufacturing trial tested the defect rate for production, achieving the target of being equivalent to current processes. Those produced under the project have since been used for the roof of an on-site office, providing a live demonstration for durability monitoring.

Dr. Jacek Kwasny, Lead R&D Engineer – Sustainable Materials at FP McCann and principal investigator for this project, believes the industry is ready for change that minimises disruption in production:


“Carbon savings and new sustainable products cannot always be focused solely on long-term results and making sweeping changes to infrastructure, especially when immediate benefits can be achieved through novel adaptations. The construction sector is open to innovation that supports a move to a more sustainable and lower-carbon industry, especially where replacement of products can be achieved seamlessly.”

“The funding helped us a great deal in moving beyond the lab into real-world demonstration and industry engagement. This vital support played a key role in speeding up our progress towards further testing on the path to potential commercialisation.”

What's next?

FP McCann is now looking to use the project results to inform further testing and economic analysis to ensure that a market-ready product can be comparable on cost for customers. Greater engagement with construction firms is also planned to identify commercial opportunities.

There are also plans to begin lab trials for different sized tile products. These are not only aimed at replacing existing tiles in other applications, but also to investigate the potential for making tiles thinner and lighter if structural strength can be maintained by the presence of graphene. This would then bring further resource saving and carbon level benefits.



The reduction in cement required for each tile led to a **14% reduction** in embodied carbon.

Cloud Cycle

Leveraging novel in-transit monitoring tools to minimise overspecification and carbon emissions in concrete production



Meet the innovator

Cloud Cycle is a specialist construction-focused technology company, leveraging their experience in the sector to develop AI-driven monitoring technology to help solve key resource and sustainability challenges in the concrete supply chain.

Their expertise and research commitments are centred around the development of proprietary digital hardware and cloud-based analytics that enable in-transit monitoring of concrete. These provide real-time insight into material performance, variability and associated emissions.

The resource challenge

The core challenge with concrete production is uncertainty, which in turn can lead to inefficient practices and waste. Limited visibility from batching through to placement leads to conservative practices, including over-specified mix designs and excess material use. This results in unnecessary cement consumption, increased carbon emissions and avoidable waste.

Solutions are therefore needed that will help bring greater efficiency to the process as a whole and better communication along the supply chain. This will help producers and users better understand material behaviour and support more accurate use of cement.

The solution

The Cloud Cycle concept is based around an integrated system of in-transit monitoring tools that provide continuous, real-time feedback on concrete performance during delivery and prior to placement. By capturing data on mix behaviour and site practices, the system identifies trends, variability and opportunities for targeted intervention. This data-driven feedback loop allows producers to refine mix designs based on actual delivery conditions rather than conservative assumptions.

This project reached TRL7 demonstration phase in collaboration with Holcim South UK at the Bow batch plant, focusing on refining mix optimisation functionality and integrating outputs into the Cloud Cycle reporting platform. Combined analysis of in-transit and batch plant data enabled identification of opportunities to reduce cement content while maintaining compliance with performance specifications. One particular area of focus was to minimise safety margins by improving confidence in material quality during transport and on-site practices such as water addition.

In addition to the system validation, life cycle analysis was also undertaken to quantify avoided emissions and support the case for the digital solution through analysis of carbon reductions, cost savings and cement reductions. These calculations were independently reviewed by the Carbon Trust to ensure alignment with best practice guidelines for avoided emissions accounting.

Case study

Cloud Cycle

Leveraging novel in-transit monitoring tools to minimise overspecification and carbon emissions in concrete production

Impact and results

The key impact of the project was in the system's ability to show real-world feedback, enabling reduction in safety margins for cement content. While relatively small in percentage terms, these reductions are significant when scaled across the UK industry.

The study showed that around a 3% reduction in cement content can deliver approximately 2% emissions savings, which at a UK scale of 90 million tonnes of concrete annually equates to approximately 0.13 million tonnes of CO₂e avoided each year. This highlights the substantial impact of incremental efficiency improvements when applied at scale.

The key with the technology is to demonstrate real value for users believes Emeso Ojo, Principal Scientist at Cloud Cycle:

- “ It's important that monitoring actually drives change and brings benefits for producers and customers alike, rather than simply providing numbers on a screen that never actually translate into action or changes to processes in reality. ”
- “ The potential efficiency savings are clear, bringing with them real environmental impact given the sheer scale of concrete production across the UK. We're looking forward to continuing work to demonstrate how live data can help the sector modernise its approach to resource use. ”

What's next?

Cloud Cycle will continue to engage more concrete producers and to work alongside them to demonstrate the system's capabilities and suitability for monitoring supply and resource challenges.

Additional projects are also planned to develop the system further by gathering more data around product specifications, use cases and other variables. This will help inform discussions and create a greater body of results that will help bring confidence to customers over the benefits of the system.

The study showed that around a

3% reduction

in cement content can deliver approximately 2% emissions savings... at UK scale is

0.13 million

tonnes of CO₂e avoided each year.



Opovate

MYCOCORE - Development of a unique, sustainable, structural insulation core for lintels



Meet the innovator

Opovate is a specialist sustainable materials technology company and venture builder, supporting the development of innovative new products and companies for the construction sector and beyond.

Their focus is on transforming waste into high-performance composite materials, reducing the reliance on fossil fuel-derived products, and offering environmental-focused research and development activity to bring novel solutions towards commercial application.

The resource challenge

Lintels are a staple product in almost every construction project. Their role in supporting doors and windows within buildings means that strength and durability are paramount, but there remains an environmental and resource use issue with current products on the market.

Many lintels currently have a polystyrene or foam core, manufactured using fossil fuels and representing a significant embodied carbon problem for the construction industry. As these lintels are commonly non-recyclable, there is a further end-of-life challenge in a sector looking for more circular and lower-carbon alternatives to meet net zero demands.

The solution

The MYCOCORE product looks to deliver a low-carbon lintel solution that not only meets the essential structural performance requirements, but also delivers on environmental and resource replacement benefits as a longer-term sustainable alternative to polystyrene use.

The concept focuses on using mycelium, naturally grown around waste hemp shivs within a 3D mould that matches typical lintel size specifications, in order to create ready-to-use blocks. Following previous studies that had shown impressive compression strength but further work required on tensile strength, natural additives to create stronger bonds within the MYCOCORE lintel were researched and added during the mycelium growing stage.

Under this project, the work centred around achieving strength thresholds through testing of the lintels in order to meet regulatory compliance for use in buildings. In-depth life cycle analysis was also completed that looked at the carbon negative potential of the product. This work considered things like water and power use, supply chain effectiveness, the product formulation and economic viability when compared to existing lintels.

Case study

Opovate

MYCOCORE – Development of a unique, sustainable, structural insulation core for lintels

Impact and results

The demonstration held under this project exceeded the required compression and tensile strength thresholds needed for use within the UK construction industry. It also demonstrated relevant standards for thermal and structural performance.

The IP generated from moving out of the lab into real-world demonstration has also enabled Opovate to look at further improving the mycelium solution through feasibility studies for both the formulation and manufacturing processes for further scaling. But, it's this sustainability message that's at the heart of the solution, says Robert Allen, CEO at Opovate:

“ We're always looking to redefine what materials can do, so the opportunity to demonstrate the success of a natural and innovative product as a direct replacement for a fossil fuel-derived one is an important achievement. ”

“ The construction sector has a particular challenge where strength and reliability cannot be compromised, so the physical performance of the MYCOCORE lintel has been essential for backing up the obvious environmental benefits when it comes to the message for market and potential uptake. ”

What's next?

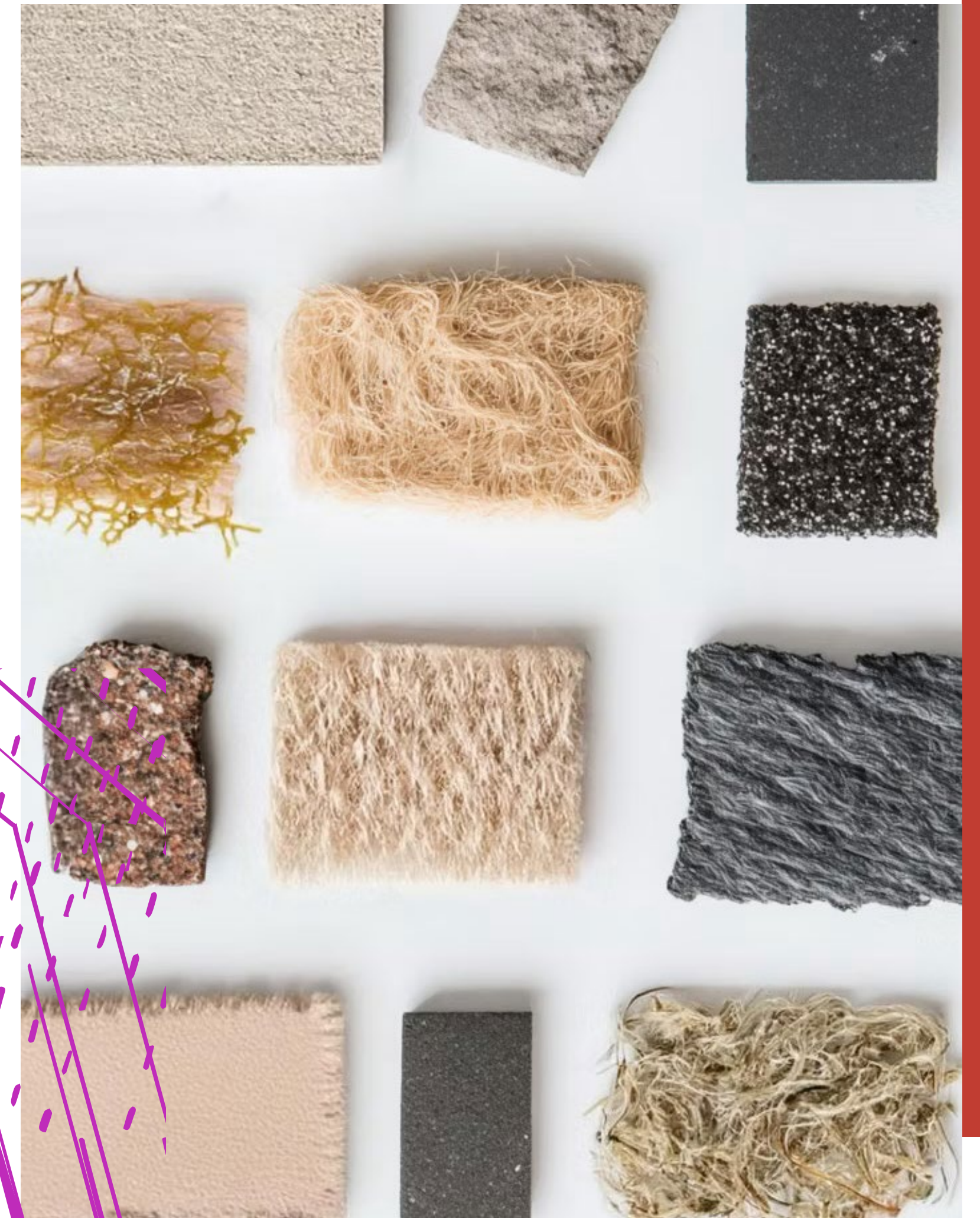
Opovate now plans to continue growth within its factory as they look to complete next-stage work to understand areas of impact such as growing conditions, resource use and the potential for testing new mould sizes for different lintel types and purposes within construction projects.

Focus will also be on the economics of this product to make it more cost-comparable with current alternatives as they look to move the concept towards commercialisation. Once achieved, the MYCOCORE story around environmental benefits, improved end-of-life recycling and disposal, and the circular reuse of waste products will then become key differentiators.

147% increase

in tensile strength achieved, which resulted in an overall strength increase by 46%,

achieving 17.82kN and passing the standard lintel test.



Case study

Croda Europe

Next-gen filtration for natural product industries



Meet the innovator

Croda International is a specialty chemicals company that creates high-performance ingredients and solutions principally for consumer care and life sciences markets. Established in 1925 and headquartered in the UK, Croda is a FTSE 100 company with over 5,900 employees across 91 locations in 36 countries.

As the name behind some of the world's most successful brands, Croda combines knowledge, passion and entrepreneurial spirit to develop and supply innovative ingredients relied on by industries and consumers worldwide. Its smart science is found in everyday products ranging from sun protection to life-saving pharmaceuticals and crop-enhancing formulations.

“We have a shared purpose to use smart science to improve lives,” says Philippe Stafford, Lead Engineer at Croda Europe. “With the majority of our organic raw materials already derived from bio-based sources, Croda is committed to becoming climate, nature and people positive by 2030.”

The resource challenge

Consumer demand for natural and sustainable ingredients in consumer care products continues to grow, but the effective processing of these bio-based materials still faces challenges when it comes to inefficiencies in current methods.

Often water and energy intensive, traditional processes struggle to consistently capture natural materials from different feedstocks

due to limited filtration success and lifespan, and technology not optimised for maximising yield and quality. Given this process challenge, there is a clear demand for innovation that would overcome these barriers through the application of novel technology and techniques with real potential in creating valuable productivity, environmental and financial benefits.

The solution

Croda Europe sought to address these challenges through a project looking at the use of novel filtration membranes, tested against special ingredients used in consumer care. On-site trials were undertaken to deliver TRL7 for the demonstration phase using both a static and vibrating membrane concept.

Filtration processes were tested for increasing material recovered and reducing the volume of water and energy typically required. The project also aimed to demonstrate the effectiveness of the advanced membrane designs in enabling filtration without the common issues of clogging and the loss of valuable materials through degradation of the filter materials.

Life cycle analysis work was also completed alongside the product trials to determine the potential carbon savings of employing membrane technology and the wider benefits that could be achieved from their use.

Case study

Croda Europe

Next-gen filtration for natural product industries

Impact and results

From initial results, the project identified that while the static membrane showed it could bring around a 10% increase in potential product yield, the vibrating membrane could achieve an average of 60%. This vibrating membrane therefore became the greater focus of the study as the project developed.

The filtration system used with the vibrating membrane also demonstrated lower water and energy consumption than traditional methods, and is a simpler process that can reduce the loss of valuable material. Supporting analysis work showed how achieving an improved yield for the same material input, as well as more consistent results from these filtration techniques, could bring commercial benefits through greater supply security and certainty of orders.

Philippe believes the project has showcased a range of benefits beyond the simple change of process:

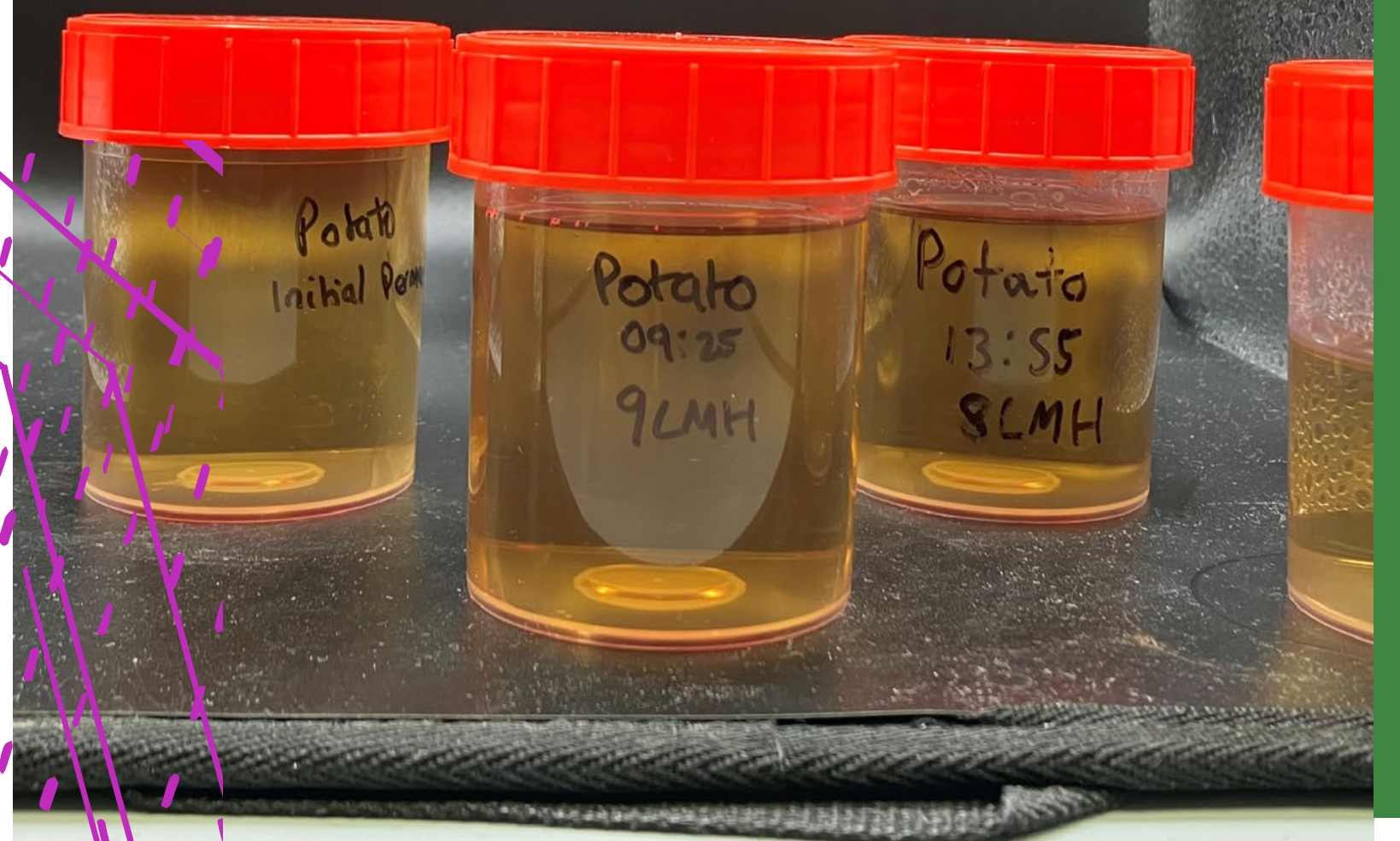
- “ The study has demonstrated the opportunity that exists to bring manufacturing back to the UK by finding efficiencies and novel technologies to improve processes and product manufacture. ”
- “ Making everything faster and simpler is so valuable when looking for resource efficiency improvements within key processes, and this project has enabled us to identify real potential for advances in product quality on top of reductions to waste, carbon and energy use. ”

What's next?

Croda will use the results of the project to inform future internal investment into new filtration technologies. Work will therefore be undertaken to quantify the benefits of these solutions, and to prove the value and sustainability opportunities that may exist from their installation.

While the demonstration project has already proven the effectiveness of the membranes with full-scale equipment, further analysis will be completed to identify the potential for use on site and in future Croda infrastructure developments.

The vibrating membrane could achieve an average of **60% increase** in potential product yield.

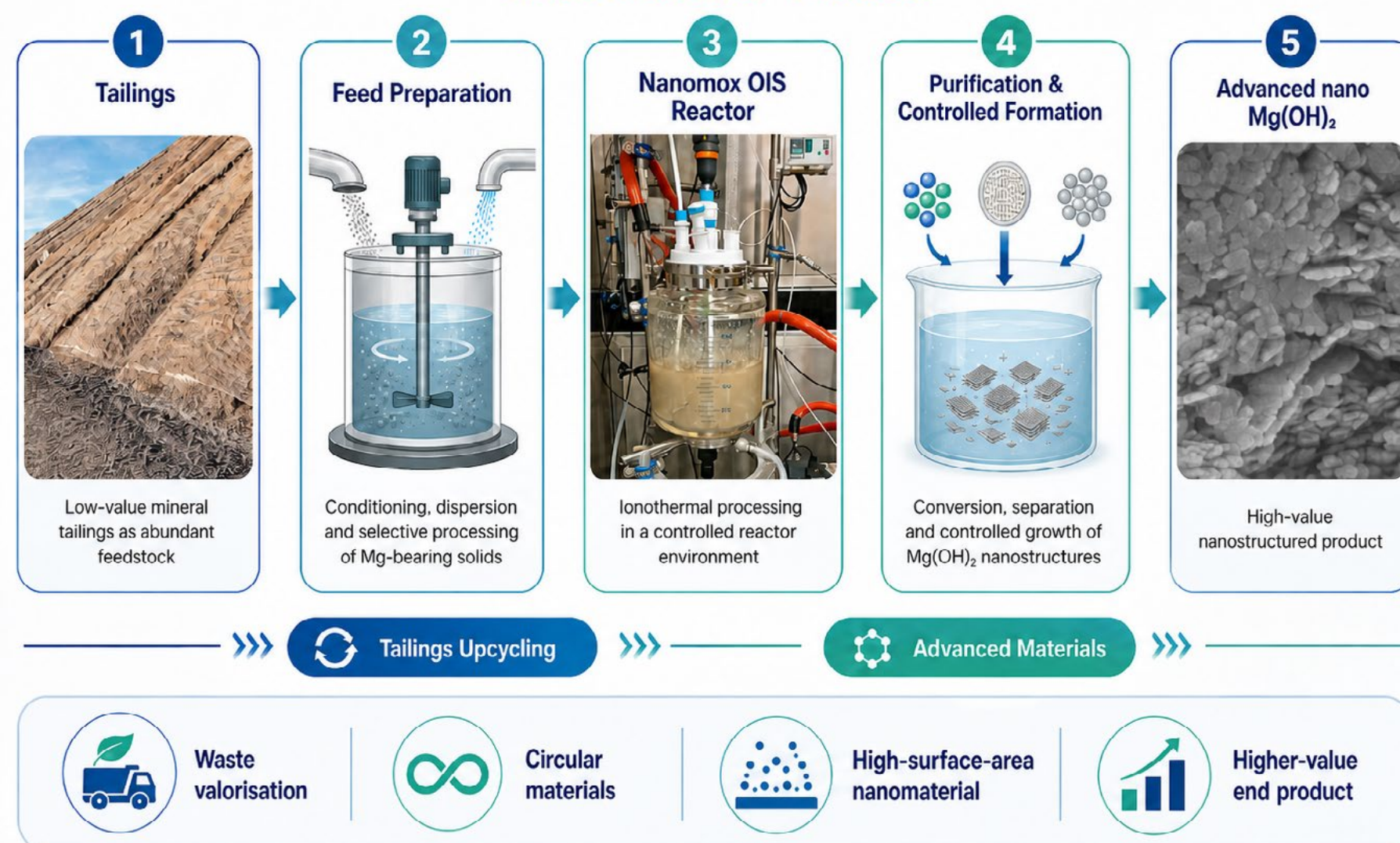


Nanomox

MAGnesium valorisation for Next-level Impact in Future Yield and sustainability (MAGNIFY)

From Tailings to Advanced nano-Mg(OH)₂

Nanomox OIS[®] Process



Meet the innovator

Nanomox, a spin-out from Imperial College London, is a specialist developer of innovative advanced materials. Their work includes novel processes to secure the recovery of metals such as copper, zinc and magnesium from complex mixtures from waste streams, mining tailings, ores and end-of-life products.

Through their own platform, Nanomox design and develop new technologies relating to nanoparticles, using specialised ionic liquids as a cost-effective replacement for more energy-intensive recovery methods.

The resource challenge

Magnesium has been identified as a critical mineral, noted as a priority resource across the UK and Europe for a variety of applications, including emerging battery technology. With no significant domestic magnesium production capabilities and few effective recycling and recovery methods in use, new solutions are needed to source sufficient magnesium without relying on import alone. When it comes to recovery opportunities, the challenge comes through the need to adapt traditional methods that are typically inefficient. Existing processes often offer limited extraction quality and rely on acids that struggle to specifically target the

magnesium within waste products. All of this means large volumes of potentially reusable metal are left unrecovered and even disposed of.

The solution

Building on previous research projects with Canadian partners, the Nanomox solution focuses on the production of nanoparticles, in this case for magnesium oxide (MgO) from mining waste. Using a proprietary wet chemical process to selectively dissolve the target metal, high purity magnesium nanoparticle compounds can be effectively recovered. It can then be prepared for reuse in applications benefitting from its heat and electrical insulation and flame-retardant properties, such as high-tech cabling, battery production and high-performance ceramic architectures.

The innovation was trialled at a TRL7 stage during the project, using small versions of industrial reactors and filters to prove its viability in a relevant environment at the BioRenewables Development Centre in York.

The trial focused on data gathering around its success with the particular mining feedstock for creating MgO that can be effectively purified and recycled. Further analysis was also completed to confirm the wider circular and waste reduction benefits of the process in offering reuse for the ionic liquids, as well as lower chemical consumption than traditional methods.

Nanomox

MAGnesium valorisation for Next-level Impact in Future Yield and sustainability (MAGNIFY)

Impact and results

The project demonstrated the ionic liquid process, including the recovery of substantial levels of MgO from the test feedstock. These results now allow Nanomox to move their design onwards to demonstration level on a larger scale.

The process also highlighted areas of focus for further research into improving the performance of the process and how to derisk the technology solution further to improve its effectiveness and cost efficiency. The results now give real potential for a route to valorising mining waste through a more effective solution that can help improve the recovery of a valuable resource.

Overall, the technoeconomic and life cycle assessments found that Nanomox OIS[®] routes could reduce production costs by up to 43%, whilst simultaneously achieving a 78% reduction in net greenhouse gas emissions compared to baseline hydrometallurgical routes producing similar nano-grade MgO/Mg(OH)₂.

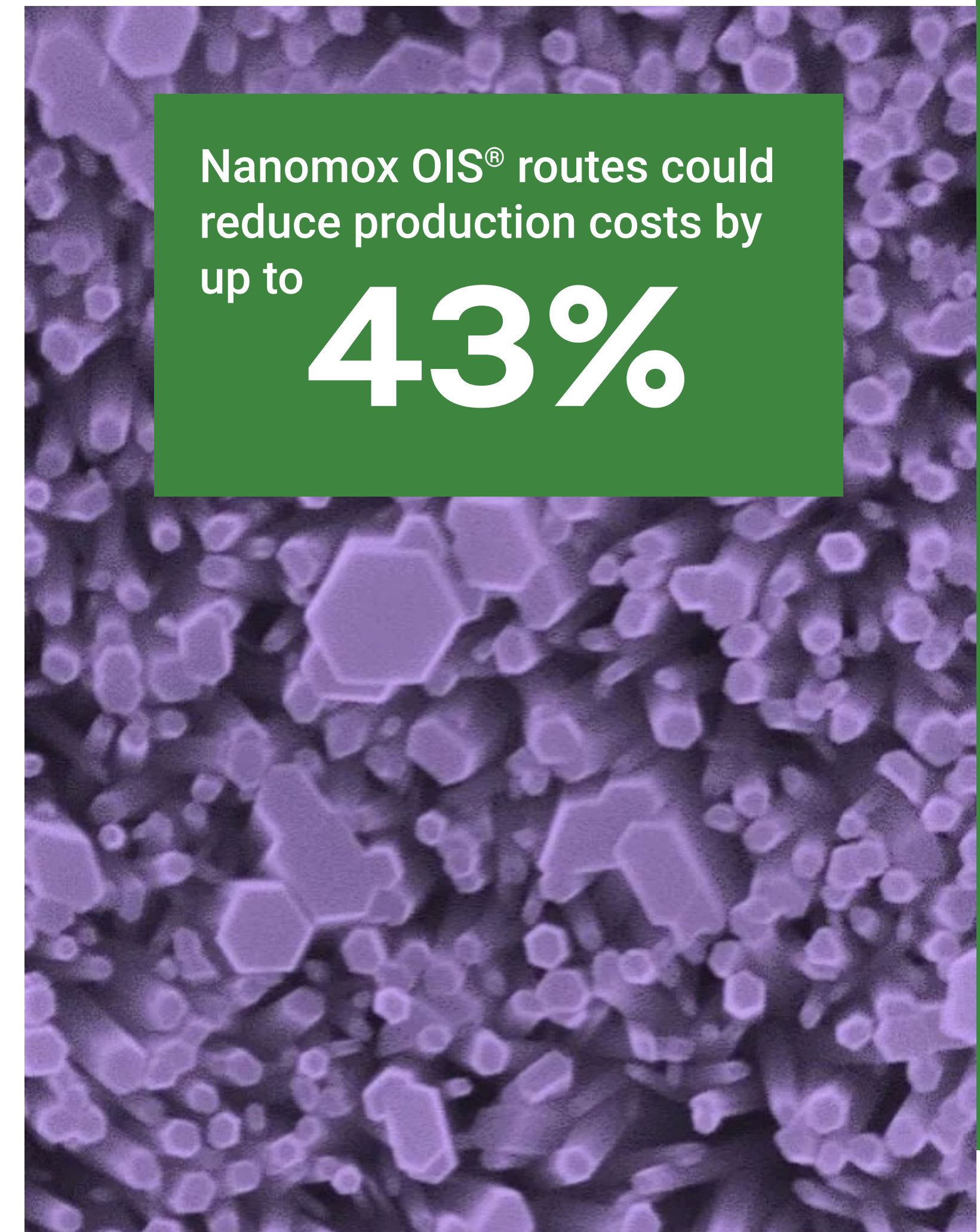
Francisco Malaret, CEO and co-Founder of Nanomox, believes the success comes from the circular solution that the process provides:

- “Critical metal recovery is essential to meet the growing demands for many products - including batteries, cables, alloys and other novel components - but the true environmental value can only really be seen by optimising processes to minimise waste.”
- “When resources are scarce, being able to recover and reuse the ionic liquid solution, the metallic nanoparticles, and the non-metallic waste for other applications, are all essential for a truly sustainable solution to the issue. This project has been valuable in supporting our research as we move the concept through to larger demonstration.”

What's next?

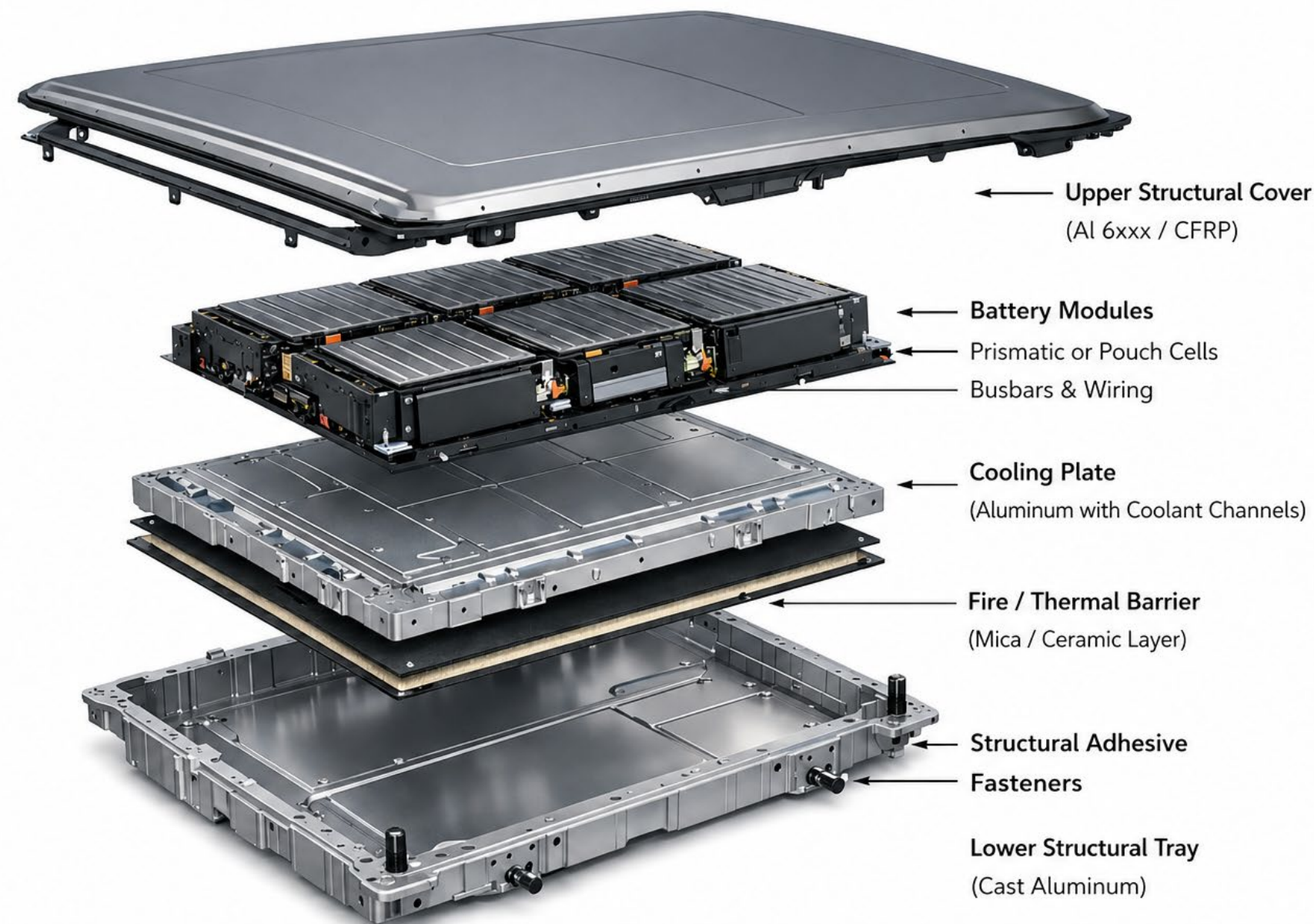
Nanomox plan to use the results of the project to help inform and develop similar opportunities for other metal recovery with different feedstocks and for different applications. Market mapping work was completed as part of the project and has identified where demand may lie in different regions, and which waste streams may provide the best opportunity for scaling and commercial success.

Using the same proven core technology, Nanomox will also continue to investigate where metal recovery and nanomaterial production would be more beneficial than bulk metal products, for uses including coatings where applications may be easier.



TRL9

automotive Waste Avoidance and Reuse Project using Smart Programmable Electrical Energy Dismantling (WARPSPEED)



Meet the innovator

TRL9 is a leading research and development company dedicated to working with new technologies and concepts in advanced coatings and specialised industrial materials. Based in the North East of England, TRL9 are experts in supporting new technology from research to market readiness. In addition to metal refinery, steel and energy research around surface engineering, TRL9 also run a number of projects across the naval, aerospace and automotive sectors, looking at how technical innovation can solve industrial and societal challenges.

The resource challenge

The demand for aluminium across the transport, energy and construction sectors, as well as for many net zero-driven technologies, has led to its formal status as a critical mineral for the UK. With a reliance on imports and insufficient high-grade recycling potential in the UK, the need for solutions for aluminium recovery and reuse has never been greater, in order to ease the requirement of further primary aluminium production.

For the automotive sector, the rapid expansion of the electric vehicle (EV) market has created a need to tackle end-of-life waste and material recovery issues for the growing number of batteries both already in use and that will be needed in future.

However, with current inefficient disassembly processes and contamination from bondings within the battery compartment, a solution is needed that will enable the recovery process to become simpler, more cost-effective and with a greater success rate for the reuse of critical aluminium content.

The solution

The WARPSPEED solution tackles this issue with the novel use of conductive media added to the commonly used adhesive within vehicle manufacture. The particles within the formula enable controlled electrical disbonding on command upon end-of-life for the vehicle's battery compartment, allowing entirely clean separation of the surfaces for the purpose of recycling and reuse. By adding an electrical current, the novel adhesive is safely heated to destruction within seconds, enabling complete removal of the coating with no contamination or damage.

Under this project, TRL9, with support from the University of Loughborough, undertook a range of demonstration trials hosted by Jaguar Land Rover at their Solihull facility. Activity focused on showcasing the process for the successful disbonding action, as well as further testing to avoid issues around stray current and heat reaching the battery itself during the process. Testing was also required to ensure structural and strength compliance in comparison to the existing adhesive formula, in order to confirm its effective and safe use across the vehicle's lifetime.

TRL9

automotive Waste Avoidance and Reuse Project using Smart Programmable Electrical Energy Dismantling (WARPSPEED)

Impact and results

The impact is clear to see, with the potential for significant aluminium recovery of between 70% and 95% among the components, helping avoid the disposal of this critical material. Analysis also showed lifetime carbon savings of around 50% for each unit when factoring in this aluminium recovery potential and the reduction in waste and contaminated materials.

The results also demonstrated the ability of the concept to solve the disbonding problem at source. They also showed little impact on the manufacturing process around the replacement of machinery and infrastructure by successfully using existing dispensary equipment and processes.

This element was key, said Bryan Allcock, CEO of TRL9:

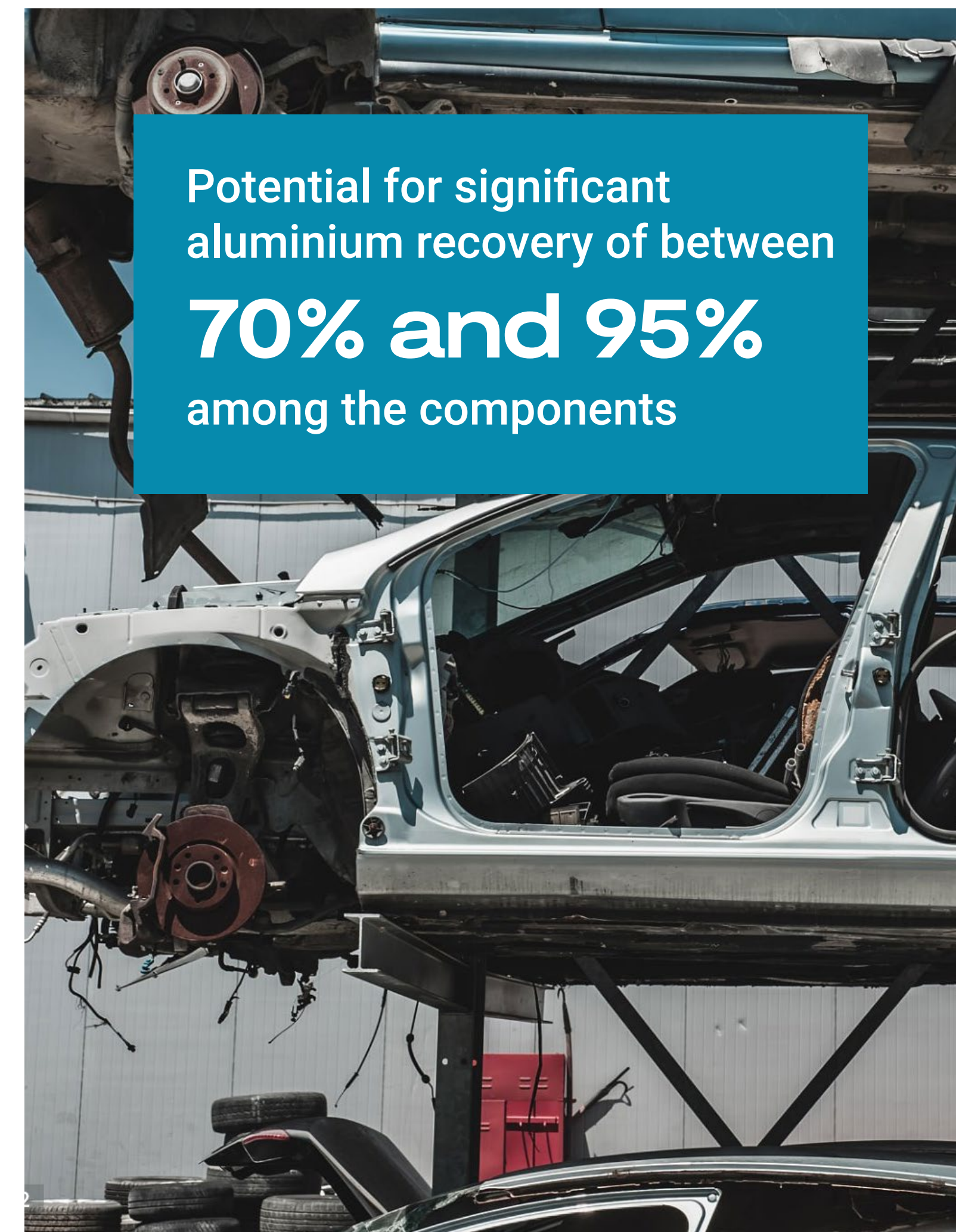
“There is a real need for step change solutions in the sector that can solve a problem without the need to completely change a whole manufacturing process. By supplementing existing adhesive products and methods, we were able to demonstrate the feasibility and economic case for the concept as well as the recovery and environmental opportunities we knew existed. This has been essential in our conversation around adoption routes that would need to be practical and financially viable for the market.”

“The support we’ve had for the demonstration through the project has been invaluable in showing the incredible potential that the solution has for tackling a real issue for the sector – and in critical mineral recovery and resource security more broadly.”

What’s next?

Having demonstrated both the feasibility and opportunity itself, next-stage scaling and development is planned from investigating potential partnerships with major adhesive firms. This would focus on making use of their existing infrastructure and supply chains to support more effective adoption of the solution.

Further discussions with manufacturers will also take place after initial engagement during this project, in order to identify a broader opportunity for the WARPSPEED technology to be assessed for use in other adhesive-bonded vehicle components and processes. TRL9 are also looking at the potential for replicating this success by taking the concept beyond the automotive sector into rail, air and space use cases with similar challenges.



The findings and the future

The scope of the projects, and the results they were able to achieve in a short time, demonstrate the clear space for innovation around resource use in industry. Making step changes in processes, systems, materials, waste and energy use, alongside the introduction of new technology, has shown they can bring valuable efficiencies and productivity benefits. These changes can support the development of the construction, chemicals and automotive sectors, and help tackle their net zero challenges.

There are also significant economic benefits. Reducing waste and material use can lower operational time and costs, enabling companies to redirect resources into job creation, research and new business development. More efficient processes and the adoption of alternative materials can reduce reliance on imports. This helps deliver cost savings, while also strengthening supply chain resilience and limiting exposure to volatility in global markets.

Focusing on life cycle analysis through the competition has also brought critical thinking about longer-term impact and end-of-life outcomes, ensuring these innovations can offer more than instant results. Whether it's alternative materials, process improvements, monitoring and measurement, or reuse opportunities, looking at the full end-to-end benefits of these novel solutions is an important part of changing industry mindsets.

Beyond the direct impact on customers and their supply chains, the projects have also sought to play a role in informing standards, regulations and best practices across the sectors more broadly. This will help unlock opportunity by validating new ideas and guiding innovation to succeed now and for the future of these industries.

The findings and the future

Their findings and future plans will form part of evidence to shape further support mechanisms across these sectors and beyond. From future government policy and focus areas, to next-stage funding and R&D backing, these projects will provide valuable insights into UK industry and opportunity in this space.

The competition also highlights the importance of backing later-stage innovation. Support for novel concepts to get off the ground and move from idea to bench testing is essential for the continued flow of innovation. However, it's also important to continue backing projects and products as they scale through to live demonstration and commercial application.

Solutions with real-world impact are moving the needle for industry around what is possible, rather than simply where potential could be. When it comes to improving the efficiency and effectiveness of how we use valuable resources, and what the long-term impact from cradle to grave will be, it's clear the real-world impact from redesigning the current industry model can be significant.



For more information

Resources

[Department for Energy Security & Net Zero](#)

[Department for Environment, Food & Rural Affairs](#)

[Innovation Funding Service](#)

Get in touch

[Innovate UK](#)

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