

# Cleaner, greener, self-charging trains of tomorrow to revolutionise British rail travel

- self-charging trains and pioneering batteries among projects to be funded by Department for Transport
- cutting edge innovation will create the trains of tomorrow leading to a greener, cost-effective railway
- government committed to supporting UK ideas and design, improving our railways and leading the world in innovation

Self-charging trains could make their way onto Britain's railways, transforming the future of transport after receiving government funding.

Top innovators and inventors have won prize money to bring their innovations to life, as part of the First of a Kind 2022 competition. This year's competition, in partnership with Innovate UK, focused on new concepts that will transform rail travel for passengers and decarbonising the network.

FOAK 2022 saw 24 innovators receive a share of more than £5 million with grants of up to £400,000 each. From technology making our railways greener than ever before by removing harmful emissions from train exhausts to research into powering our railways with renewable energy, this year's successful bidders will revolutionise the future of train travel for generations to come.

Transport Secretary, Mark Harper said:

The UK has a long history of leading the way in railway innovation and the First of a Kind competition is getting the great brains of today to create the trains of tomorrow.

Through millions of pounds worth of government funding, we are breathing life into ideas that will revolutionise our railways and make them greener than ever before.

This is just the beginning and, as Transport Secretary, I am determined to support British innovation and create a cutting edge, green rail industry that delivers even more benefits for passengers and freight.

Mike Biddle, Executive Director for Net Zero at Innovate UK, said:

The innovations funded through this competition will help to deliver a greener, lower-emissions railway carrying increasingly higher proportions of the UK's freight.

Delivered by Innovate UK, on behalf of the Department for Transport through the Small Business Research Initiative, it seeks the best and brightest ideas.

Companies from all over the UK have demonstrated the quality of their innovations in previous rounds of this scheme. Now we will support even more innovations to help deliver a greener railway that benefits passengers, employees and customers for rail freight.

This year's winners include:

Varamis who, working closely with DHL and Fedex, are revolutionising parcel delivery in the UK by repurposing former passenger carriages and putting rail right at the heart of the online shopping boom to create high-speed, non-letter delivery services.

Echion Technologies, another successful bidder, is developing batteries that will charge from overhead wires and use that charge to 'leapfrog' across unelectrified section of track and, effectively, create self-charging trains – truly, 'the first of a kind'.

Thales Ground Transportation Systems have developed new sensors which will detect people approaching tracks, pin down their location, and give an early warning to staff – lifesaving technology that will reduce disruption and could act as suicide intervention or even stop protestors getting on the tracks.

Other winning projects include:

- automatic systems that detect and stop track flooding
- cutting edge electric drivetrains that replace polluting diesel engines
- new tech to instantly relay track information to improve and modernise rail safety

Winners with a track record of success will have the opportunity to progress for further funding next year as projects move from concepts to realisation.

The First of a Kind competition has already helped launch over 100 projects that are having a transformative effect across the entire industry. Previous winners have included Riding Sunbeams, which power railways with sunlight, and 4Silence's sound bending walls which cancel out noise pollution from the railway.

## **Rail Freight winners**

### **Decarbonising Auxiliary Load in Freight Today**

Lead organisation: G-Volution Ltd

Project grant: £378,513

Working with COLAS Rail, the team will demonstrate high energy-density fuel

cells and a carbon neutral bio-liquid petroleum gas fuel system to power auxiliary electric power requirements which account for up to 10-15% of the total power demand on freight trains, covering engine and traction motor cooling, safety and signalling systems and locomotive control systems. This will remove the need for diesel powertrains to remain powered up or idling during dwell times, which can cause up to 20% of freight locomotive fuel consumption and emissions.

## **Levelling up Freight**

Lead organisation: 3squared Ltd

Project grant: £393,271

Working with OpenTrainTimes, Pragmatex, Network Rail, Eddie Stobart and Solent Stevedores, an innovative freight planning solution (PathPlanner) will improve the planning process to reduce the time required to find new freight paths (slots in the timetable which can accept a freight train) into and out of their port at Southampton, thus increasing capacity and allowing the transfer of containers from HGVs to trains.

## **Transforming high-speed rail logistics**

Lead organisation: Varamis Ltd

Project grant: £396,467

Working with Steer, Eversholt Rail, FedEx, Network Rail and DHL, the team will transform high-speed rail logistics combining a repurposed all electric passenger unit with adapted containerised consignment devices to support the conveyance of parcels, which is new to rail. This technology, offering a new approach to using space at stations to create easily accessible city-centre distribution hubs, will enable the operation of a new high-speed non-letters parcels service.

## **Automating freight access rights management and spot bidding using novel and modern software to drive modal shift from road to rail**

Lead organisation: Hack Partners Ltd

Project grant: £322,420

Supported by Great British Railways Transition Team and Network Rail, the project will focus on giving freight teams a bespoke and novel system that will automatically calculate conflicts in access rights against the timetable and real-world operational working and enable freight operators to spot bid for access to the rail system.

## **“Freight Skate” a self-powered freight bogie and platform**

Lead organisation: TDI (Europe) Ltd

Project grant: £400,000

Working with LB Foster, GB Freight and Eversholt Rail Group (ERG), the team will design and manufacture a self-powered semi-autonomous bogie which will improve operating flexibility as it can move 1 or 20 containers, operated by 1 person, who can then divide and track the containers to different locations, saving time, reducing noise pollution, and improve air quality both within the terminal and in the wider community.

### **A rapidly deployable rail stress sensor for next generation freight monitoring**

Lead organisation: Peak to Peak Measurement Solutions Ltd

Project grant: £264,749

With support from the University of Sheffield, UniPart Rail, KT Precision Engineering Ltd, PCB Train, Techni Measure Ltd and Murgitroyd, European Patent & Trade Mark Attorneys, National Research Council Canada, LB Foster Rail Technologies, the team aims to further develop and demonstrate a small under-rail sensor that reports key rail and freight vehicle operating parameters with system benefits such as reducing possession duration, reducing inspection/maintenance downtime and providing rail operators with easy access to the data streams.

### **Low emissions and a greener railway winners**

#### **ECML Net Zero Traction Decarbonisation Demonstration**

Lead organisation: Siemens Mobility Ltd

Project grant: £59,983

Working with British Solar Renewables, University of York, Network Rail, DB Schenker, and East Coast Mainline operators, the project will provide the research, development and pilot for installation and testing of a prototype converter on the East Coast Mainline, making renewable energy compatible with powering UK railways.

#### **UBER – Ultra-high power Battery for low Emission Rail**

Lead organisation: Echion Technologies Ltd

Project grant: £59,917

Supported by Transport Design International, Horiba Mira and DB Cargo, the team aims to demonstrate its XNO battery chemistry for certain classes of battery electric trains. Specifically, it aims to demonstrate its suitability for passenger trains that can be powered by the AC overhead electrification and charge a battery from the overhead wire (or another form of 'standard' trackside power, for example, third rail), to then run in battery-only mode on unelectrified sections of a route.

## **ZERRCI – Zero Emissions Repowering of Railway Construction Infrastructure**

Lead organisation: Eminox Ltd

Project grant: £59,852

Working with VoltSport, CLEC and HS2, the team's solution covers the development of an electric motor and battery system, with controller, using commercially available products, which can be retrofitted into existing construction plant, replacing the traditional diesel engine with a quieter, cleaner, zero emissions drivetrain. These pieces of plant and equipment will be used as direct replacements for diesel machines in the construction and maintenance of railway infrastructure.

## **Axle mounted motor for retrofit to diesel multiple units (DMUs) to enable zero emissions in stations**

Lead organisation: Wabtec UK Ltd

Project grant: £59,451

Working with the University of Nottingham, Atkins SNC Lavalin and Angel Trains, the team will provide a solution to substantially reduce emissions when diesel passenger trains are idling by developing and integrating a small, low mass, yet high peak torque and peak power, axle mounted motor, for retrofit and upgrade for passenger vehicle applications. This motor will enable kinetic energy recovery during braking and also provide power to the wheels whilst accelerating, reducing the emissions generated.

## **Zero Emission Powering of Auxiliary Loads in Stations**

Lead organisation: Wabtec UK Ltd

Project grant: £59,921

Supported by Angel Trains, the team will provide a solution to substantially reduce emissions when diesel passenger trains are idling by externally powering ancillary loads, such as heating, ventilation and air conditioning, door control and lighting with a low-cost, automated energy supply connected to the third rail.

## **ERiCS – Emissions Reductions in Closed Stations**

Lead organisation: Porterbrook Leasing Company Ltd

Project grant: £59,549

Working with Pendyne, Eminox and East Midland Railway, the team will develop a new exhaust gas heating solution with the capability to dramatically improve the effectiveness of the exhaust after-treatment system in covered stations. The technology is a development of an electrically heated catalyst

which has been used in road applications but is entirely new to rail and could unlock the in-station benefits of after-treatment systems on diesel trains.

## **25kV Battery Train Charging Station Demonstration**

Lead organisation: Siemens Mobility Ltd

Project grant: £59,910

Working with the University of York, Network Rail, West Coast Mainline operators and Angel Trains, the team will install a novel charging solution enabling charging fed from existing standard local power supply cables. Compatible with all overhead line equipment (OLE)-powered trains, the small, low-cost design enables the removal of diesel passenger train operation on routes without continuous electrification.

## **Cost efficiency and performance priorities for a reliable railway winners**

### **EventGo – Intelligent Rail Service Demand Forecasting for Event-based Travel**

Lead organisation: You. Smart. Thing. Ltd

Project grant: £249,946

Working with Northern Trains, Leeds Rhinos Rugby League Club, West Yorkshire Combined Authority, Leeds City Council, In The Round and Avanti West Coast, the team will demonstrate a solution for accurately predicting rail demand for a series of large visitor events, generating advance insight on rail capacity, and enhancing the ability of train operating companies to optimally plan and deliver timetables and services.

### **NextGen Data-Driven Timetable Performance Optimisation Tool**

Lead organisation: Artonezero Ltd

Project grant: £157,826

Working with Network Rail, Transport for Wales and LNER, the team will develop a timetable analysis system that will aggregate observed train movements against a line or route and compare them to typical planned timings. It will use this to calculate an “achievability score”, which will indicate what proportion of trains could be expected to run on time to that timetable and calculate the minimum headway between consecutive services such that the following service does not have to slow down.

### **Protection and Resilience for OLE using Computer Vision**

## **Techniques (PROLECT)**

Lead organisation: One Big Circle Ltd

Project grant: £247,115

Supported by Angel Trains and Network Rail, this project will apply novel and innovative computer vision techniques to existing video footage to identify where extreme heat has affected the tension of overhead lines; and also install an ultraviolet camera to detect corona discharge as an early warning of potential electrical equipment failure caused by weather conditions. Both can then enable action to prevent assets failing and impacts on service, safety and customer experience.

## **FEIDS – FOAS Enabled Intruder Detection System**

Lead organisation: Thales Ground Transportation Systems Ltd

Project grant: £223,659

Working with GTS, Focus Sensors and Network Rail, the team will demonstrate technology capable of delivering a persistent perimeter detection system that can detect persons approaching a site before they reach the perimeter boundary and alert railway staff to their precise location. This will support railway staff to respond effectively and reduce delay minutes, ensuring efficiency and cost benefits.

## **Rail Flood Defender**

Lead organisation: University of Sheffield

Project grant: £249,771

Supported by Network Rail, the team will explore the use of artificial intelligence and fuzzy logic powered real-time flow control to reduce flooding and associated damage. The Rail Flood Defender system uses low-cost sensors and valves to monitor and control the flow of water inside rail drainage systems. This will provide real-time data to Network Rail, enable the storage volume in upstream pipes to be utilised to reduce downstream flood risk/volume, and enable the periodic flushing of drainage systems to remove blockages.

## **Optimal Prediction of Sand for Adhesion**

Lead organisation: Govia Thameslink Railway Ltd

Project grant: £153,228

Working with Cranfield University and Network Rail, the team will develop an innovative algorithm to plan the route allocation of trains and schedule their maintenance, integrating a tool that can predict sand refilling (needed to aid adhesion to the track). This algorithm will be integrated into the scheduling software to plan train maintenance according to the need for

replenishing sand.

## **Unauthorised Cable Removal and Fault Triage (CRAFT)**

Lead organisation: Focus Sensors Ltd

Project grant: £215,309

Working with Thales and Network Rail, the team will develop a technology solution, using existing trackside optical fibre cables, which can be used to locate cable thefts instantly to within a metre. After a theft is reported or detected by other systems, automatic analysis will pinpoint the location of the acoustic signatures of the theft activity. The location of the theft will be instantly displayed, enabling police and security to be deployed sooner and more accurately.

## **Trains with Brains(R)**

Lead organisation: JR Dynamics Ltd

Project grant: £248,047

Working with Transmission Dynamics Poland and supported by Angel Trains, Network Rail and West Midlands Trains, the team aims to integrate data from a range of Transmission Dynamics' existing remote condition monitoring sensor solutions into Network Rail's monitoring and planning systems/processes, to enable more informed planning of infrastructure maintenance during possessions.

## **SBRI – FOAK 2022 Optimising Railway Possessions**

Lead organisation: Frazer-Nash Consultancy Ltd

Project grant: £232,226

Working with eviFile and Network Rail, the team will develop a product that will use optimisation and machine learning algorithms to identify potential optimal plans for possessions. Using wide-ranging railway possessions data, the team will research and adapt algorithms that will consider (for example) multiple scenarios, locations and types of work, and optimise and efficiently manage resources to ensure minimal impact to infrastructure traffic and capacity.

## **Portable Track Geometry Measurement System**

Lead organisation: Monirail Ltd

Project grant: £249,261

Working with the University of Birmingham, Eurostar, Network Rail (NRHS) and Analog Devices, the team aims to overcome delays to line reopening or removal of speed restrictions by providing track engineers with the first ever portable dynamic track geometry measurement system. They will modify a



permanent solution into a portable one that can be temporarily fixed to vehicles along with a lineside sensor array that can provide additional safety critical track information to the engineer. This solution will provide immediate track information to support informed decisions about the safety of the track and to what extent speed restrictions can be lifted or lines re-opened.

**State of the Railway Compiler Data Solution (SORC-lite): open access real-time signalling data.**

Lead organisation: Park Signalling Ltd

Project grant: £217,128

Working with Instrumental, Network Rail and Northern Trains, the team will provide standardised signalling asset sensor data to Network Rail in near real-time within an open commercial model, so that Network Rail will have ownership of the data, enabling them to implement new measures, identify bottlenecks within the network and target unexplained delay minutes in a way not currently possible. Data will also be available for use by train operators and the wider data analytics supply chain, removing some of the systemic blockers around access to data.