

## **SBRI: First of a Kind (FOAK) 2022 competition winners**

### **FOAK 2022 Rail freight**

**10039629**

**Lead organisation: Project grant:**

**Project title:**

Decarbonising Auxiliary Load in Freight Today

G-VOLUTION LTD

£378,514

**Public description:**

Freight locomotives have auxiliary electric power requirements which account for up to 10-15% of the total power demand, covering engine and traction motor cooling, safety and signalling systems and locomotive control systems.

These loads are currently serviced by an alternator on ubiquitous diesel ICE powertrains. This demand is persistent, requiring the diesel ICEs to remain powered up/idling during the significant periods of dwell time faced by freight services. Up to 20% of freight locomotive fuel consumption and emissions, from CO<sub>2</sub> and particulates, therefore arise from non-traction aspects.

Whilst extreme traction requirements for freight operations restricts adoption of full decarbonised powertrains - unless compromises for traction power or range are made - no existing rail technology targets the significant auxiliary power requirements.

In response, G-volution have engaged a team cutting across the full UK supply chain to realise and integrate a first-of-a-kind system for on-board auxiliary power on freight locomotives, based on high energy-density fuel cells and a carbon neutral bio-LPG fuel system.

Whilst initially representing the lowest cost/technical barrier route to catalyse significant CO<sub>2</sub>, exhaust emission and diesel fuel savings in freight, this approach has potential to also substitute traction power in the long term, and supports the transition to green hydrogen as a rail transport fuel.

Through a live demonstration with a UK freight operator, the project will therefore prove that high-efficiency fuel cells, which are able to use a range of cleaner, greener, cheaper zero net carbon renewable fuels, can work in the rail environment and also stimulate significant commercial benefits for all operators, via reduced fuel costs and future environmental levies.

**10037240**

**Project title:**

Levelling up Freight

**Public description:**

**Lead organisation:**

3SQUARED LTD.

**Project grant:**

£393,271

**Background**

Rail freight is vital to Britain. It contributes almost £2.5bn to the economy and plays a big part in reducing congestion and emissions. Rail is more environmentally friendly than road, with every tonne of freight transported by rail producing 76% less emissions compared to road (RDG "Levelling Up Britain" 2021). The green benefits of rail freight are being driven heavily by the DfT with incentive schemes such as Modal Shift Revenue Support (MSRS) -- a £20m grant, which freight carriers can bid for a share of to support modal shift to rail. Despite widescale use of MSRS, finding new freight routes for additional trains is challenging because:

- Road haulage is seen as easier and more accessible than rail freight, especially at short notice, for short journeys and for single containers.
- Highways are less regulated with no significant barriers to commercial participation, and therefore are free to use the latest technologies to develop and evolve solutions at a faster pace.
- Railway planning systems and processes limit the availability and visibility of freight paths (slots in the timetable which can accept a freight train) resulting in under-utilisation of network capacity.

Our innovative freight planning solution (PathPlanner) will make the use of rail for freight as accessible and easy to use as the road network. PathPlanner is specifically designed to overcome the current operational challenges and blockers that make moving to rail prohibitive.

**Proof-of-Concept Demonstration**

In 2021, NR completed a £17m upgrade around Southampton to enable longer trains in/out of the docks. Completing April 2023, Solent Stevedores is investing c.£3m to strengthen their capability to receive and dispatch longer and more trains -- from 9 to 16 per day.

However, NR's business case did not include any understanding of capacity in/out of the port, so Solent Stevedores is currently unsighted as to how, or if, they can find the additional paths.

There are significant gains to be made if they can; 7 extra trains equate to:

- £12.6m additional revenue p.a.
- a reduction of 55,000 HGVs, and
- a reduction of carbon by 1,165 tonnes.

Our project will demonstrate a Proof-of-Concept solution at Southampton Docks that will facilitate Solent Stevedores, and Eddie Stobart Logistics (ESL) - 2 of our project partners - to find additional freight paths and transfer containers from HGVs to trains.

**10038447**

**Project title:**

Transforming high-speed rail logistics

**Public description:**

Our project is to transform high-speed rail logistics combining a repurposed all electric passenger unit and bespoke consignment device technology to support the conveyance of parcels. This technology, offered alongside 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.

The project meets the competitions challenge and scope through: Development and application of new technologies and approaches to rail, innovative reuse of existing rail assets (such as passenger rolling stock converted for light freight), repurposing of space at station hubs (which has been released due to changing passenger demand) and engagement with new to rail logistics operators to develop and grow new high-speed rail freight services.

Furthermore, the project is in support of permanent modal shift from road to rail, delivering rail freight growth, meeting future customer needs, and realising significant emissions reductions which supports the UK's low emissions target of a 68% reduction by 2030, compared to 1990 levels through modal diversion from road.

**Lead organisation: Project grant:**

VARAMIS LTD

£396,467

**10039135**

**Project title:**

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

**Public description:**

Automating today's manual processes associated with access right management and spot bidding and wrapping these digital processes in an intuitive, integrated, modern, bespoke and scalable user system. The benefits of this innovation are not only cost efficiency but also enabling a much better experience to freight customers to drive modal shift.

**Lead organisation: Project grant:**

HACK PARTNERS  
LIMITED

£322,420

**10039606**

**Project title:**

"Freight Skate" a self-powered freight bogie and platform

**Public description:**

Governments have recognised that the continued dependence on the motor/freight vehicles is unsustainable and that modal shift to low and zero-carbon public transport solutions, both for passengers and freight, is essential if legislative commitments to Net Zero are to be met.

The Freight Skate provides a sustainable, low cost, reliable and high-quality rail freight experience which will drive down emissions and increase profits to freight companies and assist in bringing about the much-needed modal shift from road to train. To achieve this objective, it required us to use different ways of thinking across every aspect of the programme - design, supply, build and system implementation. This approach has yielded the desired results.

The skate chassis was originally designed with steering axles for passenger trains. It is a unique and tested design which we believe lends itself to operating as an independent 4-wheel unit that can be virtually coupled to form a platform for 10', 20', 30' or 40' containers. The study would also allow us to optimise loading for 9'6" HC units; Three units could also be used to carry 2 x 40' containers. An individual unit would carry a 10' container.

TDI plans to commercialise the Freight Skate vehicle over the next 3 years, with the product entering freight terminal service in 2025.

**Lead organisation: Project grant:**

TDI (EUROPE)  
LIMITED

£400,000

**10039559**

**Project title:**

A rapidly deployable rail stress sensor for next generation freight monitoring

**Public description:**

As UK rail freight growth increases, a detailed live understanding of the network condition is essential and is driving the need for industry digitalisation in the form of real-time and in-situ condition monitoring. This is also a key enabler of automated networks and the adoption of autonomous vehicles.

In the UK many of the existing wayside rail measurement technologies (e.g. Weigh-in-Motion[WiM] and Wheel Impact Load Detector [WILD]) are expensive, time consuming to install, and permanent. Thus, the adoption of measurement technologies for improving service offerings is becoming increasingly important. Some proposed data streams are unmeasurable using commercially available technologies; other smaller rail sensors on the market only offer very basic measurements (such as vibration and temperature). Some can be achieved through strain gauging, weighbridges or manual inspection. However, Peak to Peak Measurement Solutions (PktoPk)'s solution is more robust, has longer term stability, is rapidly deployable, offers higher measurement frequency and is significantly cheaper/faster to deploy than any of the competing technologies. It builds on similar systems PktoPk have deployed to non-competing industries such as automotive, large marine diesel, and injection moulding.

PktoPk proposes a novel technology to take key measurements using an ultrasonic array transducer mounted in a robust clamp that can be rapidly fixed under a rail of any gauge. Measurements will be taken in real-time and uploaded to a cloud platform. This solution is fast, portable and excellent value for money whilst providing tangible, reliable and cost-saving data.

**Lead organisation: Project grant:**

PEAK TO PEAK  
MEASUREMENT  
SOLUTIONS LTD.

£263,725

The system benefits to asset owners include; reducing possession duration, reducing inspection/maintenance downtime and providing rail operators with easy access to all the data streams listed below.

- Dynamic lateral and vertical force (L/V)
- Wheel-rail contact position and shape
- Wheel-rail interfacial stiffness
- Axle load/weight (ALM)
- Additional 'standard' measurements (temperature/noise/vibration)

The project will utilise PktoPk's close relationship with University of Sheffield, where the IP and right to operate is also shared, and will work with other local partners to create a demonstration of their novel technology to key rail stakeholders in a live rail environment. This event will also be broadcast with some international stakeholders who have already expressed their excitement about the demonstration.

## FOAK 2022 Cost efficiency and performance priorities for a reliable railway

**10037294**

**Lead organisation: Project grant:**

**Project title:**

EventGo - Intelligent Rail Service Demand  
Forecasting for Event-based Travel

YOU. SMART.  
THING. LIMITED

£249,946

**Public description:**

**Aim:** EventGo will demonstrate a first-of-a-kind solution for accurately predicting how large visitor events impact demand for specific railway services, generating advance insight on rail capacity, and enhancing the ability of TOC planning teams to optimally plan and deliver railway timetables and services. Data-enabled decision-making is expected to improve overall TOC operational performance, as demand is more precisely matched with supply in order to realise new cost efficiencies, improve yield, and deliver enhanced customer experiences. The project outcomes address the competition's plan resilience and recoverability theme.

**Challenge:** Large visitor events create extreme demand peaks within the railway network. Though such events are often scheduled months in advance, accurately predicting how this demand is likely to impact a specific scheduled railway service is notoriously complex due to the lack of advance data about visitors' travel plans. In leu, TOCs often rely on best guess estimations. As recent UEFA Champions League finals in Pairs demonstrated, underestimating visitor travel can have severe consequences for an organisation's reputation, and visitor safety.

**Project:** A mature EventGo prototype solution will be deployed by UK TOC planning team to predict how a series of sporting fixtures between January and March 2023 in the Yorkshire region are likely to impact time-tabled railway services. During this period, partners will investigate how advanced insight generated by EventGo can be exploited by planners to make intelligent adjustments to scheduled services, e.g., adding capacity to specific services to match high demand, to ensure optimal asset utilisation and deliver the highest level of customer experience.

**Value:** Demonstration in a live railway environment allows partners to both verify the accuracy of the model's rail travel demand prediction, and to evidence the business value such intelligence can have on TOC operations. In addition, accrued results will facilitate product approval procedures and raise the visibility of the novel solution in the target market.

**Consortium:** The project is led by You. Smart. Thing. ("YST"), a specialist in intelligent mobility solutions, and supported by two UK TOCs, a top-tier sporting institution and stadium management company, and regional government partners. Professional project management is provided by In The Round ("ITR"), a UK-based consultancy specialising large visitor events travel management.

**10037862**

**Lead organisation: Project grant:**

**Project title:**

NextGen Data-Driven Timetable Performance  
Optimisation Tool

ARTONEZERO  
LIMITED

£157,826

**Public description:**

During the pandemic, the on-time reliability of services significantly increased due to the reduction in the number of services and passengers.

However, as passengers have returned to the railway performance has once again deteriorated. This has an even greater impact on the industry post-pandemic as passengers' expectations for services that are reliable and run on-time is even higher. Increased delays and passenger dissatisfaction therefore leads to an even greater decreased revenue from ticket sales.

Poor performance is in large part due to a poorly planned timetable that is often operationally unachievable or cannot handle minor perturbations. This is due to the timetable usually being

planned with simulations and the method does not in how trains performing in reality at junction or stations.

Through years of working closely with performance, planning and operational teams, we've identified that by using granular train movement data and machine learning techniques, the actual performance of the existing timetable could be accurately calculated. This would enable planners with accurate information to make faster and better planning decisions that are based on real-world evidence.

Our Timetable Analysis tool will deliver automatically updated insights and recommendations to planners that is highly aligned to the planning process. Utilising both on-track (track circuit) and on-fleet (GPS and OTMR) data, the tool will provide an integrated view to both Network Rail and TOC teams.

Fundamentally this tool will result in a step change in the speed and quality of timetable planning, moving away from the use of limited simulations and anecdotal experience to a fully evidenced-based approach.

**10039201**

**Project title:**

Protection and Resilience for OLE using Computer Vision Techniques (PROLECT)

**Public description:**

**Lead organisation:**

ONE BIG CIRCLE LTD

**Project grant:**

£247,115

This project will utilise Computer Vision techniques applied to existing video footage and capturing a new type of video sensor to address two main challenges which are exacerbated by weather events and can result in the railway being closed. Providing means in which these type of challenge can be predicted and prevented will help provide the railway to become more resilient to weather events and season agnostic.

The following two areas will be addressed:

- Extreme hot weather causes OLE wires to extend and cause the tensioners to come into contact with the ground which can reduce tension and cause damage or event de-wirement. Utilising existing video footage this project will automatically identify OLE tensioners, position and measure them and generate an live asset map with current status level. This can be utilised as part of a digital twin model and fed into systems which are able to alert maintainers to the issue so they are able to take preventative action.
- Hot, cold and humid weather can also have an impact causing Corona discharge from electrical assets such as insulators. The Corona discharge is an early warning sign of potential damage and failure of the equipment and can be measured as part of a predictive maintenance regime to prioritise preventative maintenance activities. This project will install a UV Corona camera onto a measurement fleet or in-service train and enable automated data capture with real-time data transmission and processing. The results will be evaluated by experienced working groups to tune and amend the level of Corona events to ensure an optimum level of precision and recall ensuring an operationally useful tool.

Both of these events can have very impacts on the railway in terms of delay, safety and customer experience. By providing tools which have the capability of preventing these from occurring the railway will have an increased resilience to the weather conditions.

**10038989**

**Project title:**

FEIDS - FOAS Enabled Intruder Detection System

**Lead organisation:**

THALES GROUND  
TRANSPORTATION  
SYSTEMS LIMITED

**Project grant:**

£223,660

**Public description:**

Intruders in a railway environment and critical sites are a major problem for the rail industry, and one that can cause severe delays if not prevented. Conventional monitoring technology is low range, impractical and has a high deployment and operational cost. Instead, a system that can monitor the perimeter of a large area with minimal human supervision and can be used to direct rail staff to the correct location is required to introduce work efficiencies.

Thales' subcontractor Focus Sensors have developed the technologies 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, insuring efficiency and cost benefits.

We propose to showcase a first-of-a-kind application of Focus Sensors' next-generation Fibre Optic Acoustic Sensing (FOAS) technology to deliver accurate and real-time information and alerts on intruders or potential intruders in a rail environment using our lateral-positioning technology developed for detection trains. This capability will enable security staff to rapidly respond to incidents and ensure intruders can be dealt with quickly and efficiently.

The FOAS-Enabled Intrusion Detection System (FEIDS) will use FOAS to detect objects moving near the fibre/perimeter, identify them and determine the distance from a boundary. This monitoring is both real-time and persistent, enabling alerts to be sent when a person or vehicle gets too close to or crosses a boundary. The high fidelity of the system means that an intruder's location can be determined to an accuracy of +/- 50cm, and this information is crucial to ensuring that on-site security teams are able to quickly and efficiently deal with the intruder.

This technology can be utilised both along sections of the railway and at specific, sensitive sites. Due to the long range and autonomous nature of the system, it drastically reduces the workload of railway staff. Staff will be provided with an automatic alert that will provide them with information on the nature of the intruder(s) and the exact location. This reduces the time for intervention, enabling trains slowed due to the risk to resume at normal speed quicker, lowering the impact of trespass. It also increases the likelihood of trespassers being stopped committing vandalism, which can disrupt operations, and reduces the likelihood of reoffending.



**10038342**

**Project title:**

Rail Flood Defender

**Lead organisation: Project grant:**

University of  
Sheffield

£249,770

**Public description:**

Rail Flood Defender will deliver a more reliable railway network that is safer for all stakeholders, and empower Network Rail (NR) and the UK to become global leaders in intelligent holistic rail drainage management. It will future-proof rail transport against the effects of climate change where more intense and regular rainstorm events are expected.

The project will explore principles of autonomous active flow control to reduce manual operations associated with protecting rail infrastructure from the effects of flooding. It achieves this by taking the latest advances in edge computing and applying it to real-time automation of mechanical and electrical equipment to control the flows in rail drainage systems, thus protecting the track drainage from being overloaded and flooded during rainstorm events.

The importance of managing rail drainage infrastructure cannot be overstated. It is designed to carry stormwater safely away from the track via a system of pipes and channels. When drainage infrastructure is compromised or inadequate, flooding can occur. Flooding causes delays to passengers and costs to asset owners, but crucially can also affect other assets such as structures and signalling, which endangers human life (e.g. Watford Tunnel Derailment <https://www.gov.uk/raib-reports/derailment-and-subsequent-collision-at-watford>). This project aims to collaboratively investigate the application of AI-powered automated real-time control (RTC) for protecting the railway system and mitigating any impact on adjacent land.

The feasibility project will identify how the following benefits and sustainability opportunities can be delivered:

- Reduce risk of rail services being disrupted during rainstorm events
- Make the drainage design process more efficient
- Avoid capially and spatially expensive flood solutions (e.g. stormwater retention tanks)
- Provide a means for automated flushing to clear blockages (reduce manual intervention)
- Reduce surcharging on adjacent rural or urban areas
- Explore additional opportunities such as rainwater harvesting for agriculture

**10039258**

**Project title:**

Optimal Prediction of Sand for Adhesion

**Lead organisation: Project grant:**

GOVIA  
THAMESLINK  
RAILWAY LIMITED

£153,228

**Public description:**

Train services are affected by seasonal variables particularly leaf fall between September and December. They can also be compromised by wet weather, icy and snowy conditions at a regional or very localised level on a particular route. Maintaining wheel-rail contact to ensure adequate and safe braking requires the use of sand in low adhesion conditions. Sand is dispensed to trains in response to a combination of train service plans and of weather forecast. However, not all trains are currently able to be replenished during overnight stabling and servicing with attendant risks of delays and damage to trains and infrastructure. Also, there is a high level of safety risk when sand replenishment on trains is carried out on a third-rail yard.

*"Optimal Prediction of Sand for Adhesion" (OPSA)* lead by Govia Thameslink Railway, the major Train Operating Company on third rail in the UK, will deliver a more efficient and cost-effective

means of predicting the dispensing of sand to trains to ensure services are not compromised by adhesion losses and train sets are not required to be removed from planned operating diagrams because of inadequate on board sand supplies. The algorithm developed as a results of this project will base the estimates on an integrated framework that includes the forecast adhesion, track maintenance and the expected speed profile in order to capture the change in weather and the seasonal factors.

The algorithm developed represents a cost effective solution to predict the use of sand and schedule the maintenance of trains enhancing in turn safety and reducing the impact of delays on the timetable. The algorithm will be developed including direct measure of sand dispersion, braking, wheel slip and line speed diagram also accounting for human behaviour effects such as driving style.

Govia Thameslink Railway has engaged with Cranfield University to deliver the disruptive innovation proposed in this project. The algorithm will enable a more efficient train scheduling improving public performance measure (PPM) addressing train delay targeting in particular the 25% of delay up to 15 minutes cause by several concurrent issues including train rescheduling and the National Rail Passenger Survey satisfaction.

**10038790**

**Project title:**

Unauthorised Cable Removal and Fault Triage (CRAFT)

**Public description:**

**Lead organisation:**

FOCUS SENSORS LIMITED

**Project grant:**

£215,310

When cable thefts occur the operation of the railway, often in nationally critical locations, can be brought to a standstill with significant impact on passengers and freight supply-chains. Under extreme industry and public pressure, Network Rail must delay scheduled activities and scramble teams to effect repairs and get critical railway operational systems working again. Current technology may not be able to locate the break to better than a few km accuracy, meaning long periods of manual inspection are required to locate the exact position of the theft before the repair can be started. This wastes valuable time, increasing the effect of the theft on the efficiency of the network and creating cost for operators and delays for customers.

This proposal is for a technology solution, using existing trackside optical fibre cables, which can be used to locate cable thefts instantly to within +/- 1m. After a theft is reported or detected by other system, automatic analysis will pinpoint the location of the acoustic signatures of the theft activity. The location of the theft will be instantly displayed, both on a map overlay with geographical coordinates, and as a linear ELR, miles and yards track location. This will enable first-responder policing and security to be deployed sooner and more accurately. Secondly, with an accurately timed and positioned event signature, there is an opportunity for other parties with evidence collecting abilities (e.g. Forward Facing CCTV on trains) to more proactively, and possibly automatically, to retain evidence which may support prosecution. Thirdly the Network Rail engineering team will be given advanced information to allow them to attend the site with the right materials and resource to affect an earlier resolution.

As secondary activity we will enable location of optical cable by creating a companion georeferencing co-reference for the trackside fibre cable, so that faults and fibre issues can be located instantly to a more precise physical location. This provides a valuable tool for Network Rail's engineering teams, to reduce time for maintenance and fault finding.

**10036632**

**Project title:**

Trains with Brains(R)

**Lead organisation:**

JR DYNAMICS  
LIMITED

**Project grant:**

£248,046

**Public description:**

Trains with Brains(r) aims to integrate data from a range of remote condition monitoring sensors into Network Rail's monitoring and planning systems/processes, to enable operations and maintenance teams to address key cost efficiency and performance priorities via more informed possession planning.

This will be delivered via a head to toe monitoring solution, enabled via bi-directional integration between Transmission Dynamics and Network Rail.

**10038228**

**Project title:**

SBRI: FOAK 2022 Optimising Railway Possessions

**Lead organisation:**

FRAZER-NASH  
CONSULTANCY  
LIMITED

**Project grant:**

£232,226

**Public description:**

One of the biggest challenges facing the railway industry is the complex process of planning and possession management. The logistics of diverting, blocking, or closing sections of track can have implications across the network. As the rail timetable becomes more congested, with increased services, there is more potential for disruption and less obvious times for possession. Delays on main-lines could result in huge fines, consequently delivering works and handing back possession on-time is vital.

In 2020/21, NR spent £1.6bn on enhancements, £1.9bn on maintenance, and £3.2bn on renewals (Office of Rail and Road, 2021). This translates into thousands of engineering works, most of these require possessions to allow safe, traffic-free worksites for maintenance activities (e.g. remedial works, inspections, maintenance and planned renewals).

Possessions result in both planned and unplanned disruption. Unplanned disruption can occur for many reasons; machine faults, access issues, staff planning, or wrong engineering train arrangement - all demonstrating the complexity of planning possessions.

Getting staff and equipment to worksites on time and minimising travelling distances are critical efficiency requirements. The barriers to this are mutual road and rail points, staff numbers and equipment types. Furthermore, engineering trains typically start in sidings which may be in remote locations due to available sidings being occupied during large possession works. Consequently, this cause issues in both timetabling and plans that ensure that engineering trains reach worksites at the correct time and in the correct formation.

With increasing traffic and reducing availability of possessions this problem is likely to be further exacerbated. Network Rail have identified a requirement to develop solutions for planning procedures such that possession efficiency is increased, resulting in the delivery of infrastructure maintenance work with minimal disruption and cost.

Combining Frazer-Nash's deep experience in optimisation of railway challenges and eviFile's possession management solution, we will innovate to develop a product that will support rapid planning and replanning of possessions through the application of optimisation and ML algorithms to identify potential optimal plans. Using wide-ranging railway possessions data we 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.

This will deliver possessions more efficiently, help plan work-activities during possessions more precisely, manage infrastructure access more efficiently, allow tasks to be planned more efficiently, and predict the impact of possessions on overall network performance more accurately.

**10037542**

**Lead organisation:**

**Project grant:**

**Project title:**

Portable Track Geometry Measurement System

MONIRAIL LTD

£249,148

**Public description:**

Rail incidents can take many forms and can result in many different types of intervention from temporary speed restrictions to full track closures. Many incidents either result from or cause track damage and in order to remove any speed restrictions or track closures engineers need to be confident that the track is in a safe condition. It is therefore common practice after many incidents where track damage is suspected or track repairs have been undertaken for Track Recording Vehicles (TRVs) to be required to run the track before passenger or freight vehicles are allowed to run the line again. However, the availability of these vehicles can cause significant delays to line reopening or removal of speed restrictions.

MoniRail has developed an in-service track monitoring system that can be permanently fitted to passenger vehicles and is currently on trial with Network Rail (NR) in Scotland and also fitted to 2 Eurostar vehicles on HS1. One potential use-case for the permanent system is for speedier removal of speed restrictions. However, even with the fixed solution delays are likely as track monitoring systems are only likely to be fitted to 1/3 to 1/2 of all vehicles, approx 1500 of 5100 vehicles.

This project aims to overcome these delays by providing track engineers with the first ever portable dynamic track geometry measurement system by modifying the 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 therefore provide immediate track information to track engineers such that can make informed decisions about the safety of the track and to what extent speed restrictions can be lifted or line re-opened.

**10038973**

**Lead organisation:**

**Project grant:**

**Project title:**

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

PARK SIGNALLING LIMITED

£217,128

**Public description:**

Our project seeks to support Network Rail in regaining understanding and ownership of key signalling asset information so that this data can be used to adopt new performance measures, identify bottlenecks within the rail network and target the 800,000 unexplained delay minutes that occur annually. The project combines a number of existing technologies to deliver the hardware, pipeline, analytics, and visualisation as a working demonstration. The data stores 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.

## FOAK 2022 Low emissions and a greener railway

**10036245**

**Project title:**

ECML Net Zero Traction Decarbonisation Demonstration

**Public description:**

**Lead organisation: Project grant:**

SIEMENS MOBILITY LIMITED £59,983

Electrification is the foundation of all modern railways and fundamental to decarbonisation. Through delivering faster, smoother, quieter and more reliable train services, rail electrification reduces industry fuel cost by 45%, rolling-stock costs by 33%, and track maintenance costs by 10-20% (compared to diesel operation). Electric railways are the most efficient, lowest carbon form of transportation in the UK.

Network Rail operates the largest power distribution network in the UK, and is the largest consumer of electricity in the UK, consuming 4TWh electricity per year. Power is provided from the electricity supply industry, a mix of gas, nuclear, coal and renewables, emitting approximately 944,000 tonnes of carbon dioxide annually. Connecting new renewable generation directly to the railway reinforces the railway power supply, while reducing coal and gas use in the UK and is a longstanding Network Rail industry challenge statement. To date, engineering incompatibilities between renewable, electricity supply systems and the railway single-phase electrical and other railway systems have prevented local renewable connection in rail.

In a world first, Siemens Mobility, working with British Solar Renewables, DB Cargo UK, Network Rail, ECML operators, and the University of York, will directly connect large-scale renewable generation to the East Coast Mainline. The demonstrator phase will deliver up to 1GWh green electricity direct to trains each year, reducing UK gas imports by 151,000 cubic metres and carbon emissions by 236 tonnes annually. It will gather vital data creating a new green industry, creating a precedent and setting standards to enable larger scale roll-out across the UK.

**10039100**

**Project title:**

UBER - Ultra-high power Battery for low Emission Rail

**Public description:**

**Lead organisation: Project grant:**

ECHION TECHNOLOGIES LTD £59,917

Project UBER (Ultra-high power Battery for low Emission Rail), aims to demonstrate for the first time, Echion's XNO(tm) battery chemistry as the preferred battery technology for certain classes of battery electric trains. It targets Theme 1 of this competition.

Specifically, UBER aims to demonstrate the suitability of XNO(tm) 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 -- e.g. 3rd rail), to then run in battery-only mode on unelectrified section of a route. An example of such a train is the Revolution Very Light Rail (Revolution VLR) developed by Transport Design International (TDI), who is a partner in UBER.

**10037562**

**Lead organisation: Project grant:**

**Project title:**

ZERRCI – Zero Emissions Repowering of Railway  
Construction Infrastructure

EMINOX LIMITED

£59,852

**Public description:**

**ZERRCI -- Zero Emissions Repowering of Railway Construction Infrastructure**

Eminox, HS2 and SCS Railways propose a solution for the delivery of a low emissions, greener railway. Our solution covers the development of an electric motor and battery system, which can be retrofitted into existing construction equipment, 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 constructing and maintaining railway infrastructure.

Eminox is leading this project with its experience in providing cost effective retrofit emissions solutions and together with HS2 and SCS JV will be involved in demonstrating the first repowered construction equipment in a real-world rail infrastructure environment.

This proposed venture has been instigated by HS2 in line with their ambition as set out in their Net Zero Carbon plan for diesel free construction sites by 2029. As the solution will extend the life expectancy of the machine, it will contribute to HS2's vision of net-zero by 2035.

This solution will offer a more cost-effective route to zero emissions construction compared to purchasing similar new electric powered equipment by extending the life expectancy of existing plant and machinery. With a target of 50% the price of purchasing new excavators it is expected to incentivise the broader uptake of demand in electric plant and equipment at scale across the industry supply chain

Phase 1 of this project aims to deliver a proposal for a prototype zero-emissions excavator. By performing a feasibility study on the conversion principals, we intend to extract a broad understanding of the challenges associated with integration and develop an optimised battery and motor system specification.

Phase 2 will involve the conversion, commissioning and delivery of a repowered excavator, and subsequent in-service validation. By using this converted machine to conduct initial trials, it will be proven that no machine functionality or safety features have been compromised during conversion, and we will establish power storage requirements to provide adequate duty cycle performance. This will result in a fully proven demonstrator with real-world validation enabling further development of optimised battery solutions.

**10038683**

**Lead organisation: Project grant:**

**Project title:**

Axle mounted motor for retrofit to DMU's to enable zero emissions in stations

WABTEC UK LIMITED £59,450

**Public description:**

This project provides a solution to substantially reduce emissions including NOx and PM when diesel passenger trains are idling.

There are over 3,500 passenger rail vehicles in the UK currently fitted with a diesel engine, the large majority of these would significantly benefit from emissions reduction, especially in and around stations, where diesel engines currently continue to idle, or elevated idle whilst stationary, sometimes for up to 30 minutes at a terminal station. This is a significant contributor to local air quality issues from NOx, PM emissions etc.

Furthermore, rail vehicles require large amounts of energy and power to accelerate (and therefore contributing more emissions), and yet, on the approach to stations significant amounts of energy are "lost" through "braking".

This project will address both issues by recovering the braking energy during deceleration and re-using it for auxiliary loads in station and traction to accelerate out of station, this will enable diesel engines to be isolated in and around stations, whilst also reducing the average emissions such as PM and NOx over a complete drive cycle by up to **35%** and operational costs by up to **30%**.

Our objective is to develop and integrate a small, low mass, yet high peak torque and peak power, axle mounted motor, for retrofit and upgrade for DMU/DEMU passenger vehicle applications. This motor shall enable kinetic energy recovery during the braking application and also provide power to the trailer bogie wheels whilst accelerating.

This project will enable several key cost and decarbonisation benefits to the railway.

- It shall enable zero emissions, including NOx and PM, in and around the station, by enabling a DMU to approach, dwell and depart from a station with the engine switched off
- It shall enable a proportional average reduction in all emissions, through reduced fuel consumption resulting from the electrical energy recovery from regenerative braking and re-deployment through auxiliary and traction use
- It shall enable less brake wear thus reducing particulate emissions from brake pads especially around stations
- It shall enable reduced operating costs for the train operator through fuel saving, engine/transmission maintenance savings and brake pad saving
- It will not require any modification to the existing diesel engines or drivetrain and will compliment any other decarbonisation initiatives.
- It shall provide a substantially lower cost and risk solution when compared to any other previous or current hybrid solutions



**10038972**

**Lead organisation: Project grant:**

**Project title:**

Zero Emission Powering of Auxiliary Loads in Stations

WABTEC UK LIMITED £59,921

**Public description:**

This project provides a solution to substantially reduce emissions including NOx and PM when diesel passenger trains are idling.

There are over 3,500 passenger rail vehicles in the UK currently fitted with a diesel engine, the large majority of these would significantly benefit from emissions reduction, especially in and around stations, where diesel engines currently continue to idle, or elevated idle whilst stationary, sometimes for up to 30 minutes at a terminal station. This is a significant contributor to local air quality issues from NOx, PM emissions etc.

Brecknell Willis aim to further develop their existing current collection product portfolio by producing a low-cost, automated shore supply for powering the auxiliary loads of each vehicle and enabling the diesel engines to be disabled while stationary.

This project will enable several key cost and decarbonisation benefits to the railway.

- It shall enable zero emissions, including NOx and PM, in and around the station, by enabling a DMU to dwell at any enabled station or depot with the engine switched off through an automated shore supply.
- It shall enable a proportional average reduction in all emissions, through reduced fuel consumption due to not using the diesel engine whilst the vehicle is stationary
- It shall enable reduced operating costs for the train operator through fuel saving
- It will not require any modification to the existing diesel engines or drivetrain and will compliment any other decarbonisation initiatives.
- It shall provide a substantially lower cost and risk solution when compared to any other previous or current hybrid solutions

**10038627**

**Lead organisation: Project grant:**

**Project title:**

ERiCS - Emissions Reductions in Closed Stations

PORTERBROOK LEASING COMPANY LIMITED £59,549

**Public description:**

We have previously developed an exhaust aftertreatment system to install on Porterbrook's Class 170 and Class 158/9 vehicles. This technology successfully showed we could significantly reduce the emissions from mid-life diesel trains. All aftertreatment systems, including those fitted to new diesel engines, work effectively at higher exhaust temperatures but when the train is idling in a station, the aftertreatment is much less effective. This innovation is to develop a new exhaust gas heating solution with geo-fencing capability to dramatically improve the effectiveness of the exhaust aftertreatment system in covered stations.

The innovation 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 aftertreatment systems on diesel trains. This will specifically target NOx and complement PM reduction in stations caused by trains idling and provide a viable retrofit option until full electrification is available.

The innovation will be led by rolling stock asset owner Porterbrook with their partner Eminox who has supplied rail exhaust solutions to diesel engines for several decades. In Phase 1, the project will carry out work to prove the technology on a bench test at Eminox's test facility. Later in Phase 2, if we are successful, working with our operating partner East Midlands Railway, we propose to

demonstrate the additional benefit in emissions reductions in stations by fitting the equipment onto a suitable DMU, and validating the test results in passenger service. This new innovation enhances the business case for fleet roll out of this technology by offering additional benefits where it matters to passengers, staff and neighbours at railway stations. Both Porterbrook and Eminox are delighted to continue the development of their after-treatment system to specifically target emissions in stations, this will take abatement solutions to the next level and provide greener railways. Neil Bamford, Fleet Director at East Midlands Trains said, "The project aligns well to our sustainability objectives, as it offers the opportunity to provide tangible benefits for emissions reduction in stations. We look forward to working with the consortium"

**10037158**

**Lead organisation: Project grant:**

**Project title:**

25kV Battery Train Charging Station Demonstration

SIEMENS MOBILITY  
LIMITED

£59,910

**Public description:**

The UK rail industry is committed to decarbonisation, including the removal of diesel trains by 2040. Replacing diesel trains with electric, hydrogen or battery bi-mode rolling stock provides faster, smoother and more reliable journeys, as well as eliminating local pollution and greatly reducing carbon dioxide. To enable clean, green electric bi-mode operation without continuous electrification requires enhancement of the power supply to existing electrification and novel charging facilities to support bi-mode trains. No small, low-cost solution is currently available for charging facilities that are compatible with standard UK trains and locally available power supplies and space.

Siemens Mobility, working with ROSCO, TOCs and Network Rail, will deliver a novel AC charging solution enabling simple installation of small, low-cost rapid charging facilities fed from existing standard local power supply cables. Compatible with all OLE-powered trains, the novel design enables the removal of diesel passenger train operation on non-electrified routes across the UK, while minimising land requirements and modifications required to existing station structures.