



Future of Mobility: Vision for 2040

 ADVANCED
PROPULSION
CENTRE UK

ZENZIC⁴



Contents

Executive Summary	4
Strategic Pillars	5
Industry Opportunities	6
Key Enablers	6
Impact	6
Foreword	7
Introduction	8
From Vision to Reality	8
The Seamless Ecosystem	9
Exploring the Seamless Ecosystem	10
Orchestrated Intelligence	11
Regenerative Mobility	16
Living Infrastructure	21
Inclusive and Resilient Mobility	26
Key Takeaways	31
Glossary	33
Authors	34

All views and recommendations in this report are independent and do not necessarily reflect government policy



Executive Summary

The Future of Mobility: Vision 2040 outlines a UK-centric strategy to transform road-based transport into a seamless, integrated ecosystem that is safe, efficient, sustainable, and inclusive. This vision addresses the convergence of transport, energy, and digital systems, aiming to deliver economic growth, environmental regeneration, and universal access.



From Vision to Reality

By 2040, mobility will no longer operate in silos. Instead, it will function as a unified, orchestrated system where journeys are predictable, affordable, and accessible. Achieving this requires three foundational shifts:

- **Interoperability and Open Standards:** Common frameworks for data, safety, and accessibility
- **Integrated Energy and Transport Systems:** Bi-directional charging, depot energy management, and renewable-powered corridors
- **User-Centric Design:** Seamless planning and payment through single platforms, proactive disruption management, and inclusive access

Strategic Pillars

These shifts are enabled by four interconnected pillars that define the future ecosystem:

Pillar	Orchestrated Intelligence	Regenerative Mobility	Living Infrastructure	Inclusive and Resilient Mobility
Core Focus	System-wide data integration and AI-driven optimisation	Environmental restoration through transport	Smart, adaptive, self-maintaining infrastructure	Equity and accessibility for all users
Primary Themes	AI, real-time data sharing, connected infrastructure	Circular economy, nature-based solutions, renewable energy	Smart materials, embedded sensors, robotics	Universal design, community-led services, redundancy systems
Outcomes	Efficiency, safety, reduced integration costs	Net-positive impact on climate, biodiversity, and health	Resilience, energy generation, minimal manual intervention	Social inclusion, affordability, robustness to disruption

Impact

The UK's transport system will evolve from a vehicle-centric model to a systemic, adaptive network, delivering economic, social, and environmental value. This transformation positions mobility as a catalyst for sustainable growth and global competitiveness.

Industry Opportunities

Delivering Vision 2040 demands collaboration across sectors:

- **Automotive & OEMs:** Shift to software-defined vehicles and connected ecosystems.
- **Energy & Utilities:** Integration of renewable generation and smart charging.
- **Digital & Telecoms:** Deployment of edge computing, AI orchestration, and digital twins.
- **Infrastructure & Construction:** Modular, adaptive designs and sensor-enabled assets.

Key Enablers

To unlock this transformation, the UK must prioritise:

- AI assurance and certification frameworks
- Outcome-based funding and service models
- Circular economy principles embedded in design and operations
- Policy alignment to manage short-term energy demands and enable innovation

Foreword

The transformation of UK mobility is accelerating at an unprecedented pace, propelled by the strategic convergence of transport, energy, and digital infrastructure. This report, *Future of Mobility: Vision for 2040*, articulates a shared ambition to engineer a seamless, zero-emission, and intelligently connected transport ecosystem, designed to deliver profound benefits for the economy, society, and the environment.

Across the United Kingdom, advancements in computing and autonomy, software-defined vehicles, digital twins, and advanced propulsion systems are fundamentally redefining mobility. These innovations underpin a future where journeys are inherently predictable, infrastructure is dynamically adaptive, and data flows with integrity across diverse regions and modes. This evolution represents more than a technological milestone; it is a systemic shift that necessitates robust new standards, pioneering business models, and deep-rooted cross-sector synergy.

Realising this vision requires a highly coordinated effort across industry, government, and the wider

innovation landscape to navigate complexities such as interoperability, AI assurance, energy integration, and circularity. By harmonising policy, investment, and innovation, the UK is positioned to spearhead the development of mobility systems that are not only resilient and accessible but regenerative by design.

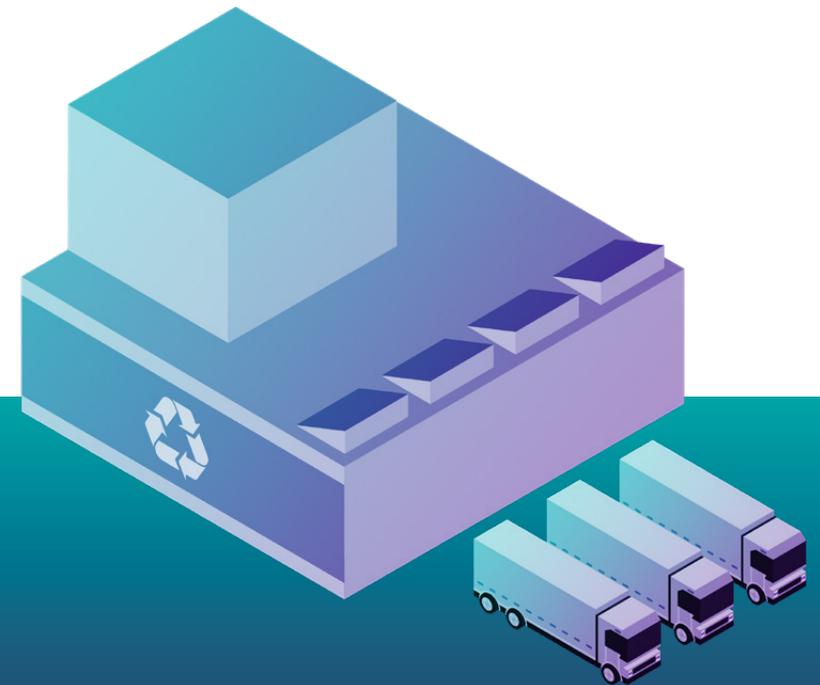
As organisations dedicated to architecting the UK's mobility future, the APC and Zenzic employ a dual-mission approach to accelerate the research, deployment, and scaling of the technologies defining this new era. We trust this report provides the clarity and strategic direction necessary to ensure the UK captures the full economic and social dividends of this historic transformation.

Dr Hadi Moztarzadeh,
Head of Technology Trends,
Advanced Propulsion Centre UK

Francis McKinney,
Head of Technology and Insights,
Zenzic

Introduction

The purpose of this report is to illustrate a vision for road-based mobility by 2040, including micromobility, by identifying potential development pathways and investment opportunities for both established industries and emerging start-ups. It also explores opportunities and business models where existing industries and new start-ups could invest resources and capital. This vision is informed by stakeholder engagement and desk-based research, aiming to outline a future transport system in the UK that is safer, more reliable, efficient and seamlessly integrated with other infrastructure systems. In this report, 'AI' refers primarily to advanced large language models and data-driven optimisation systems capable of analysing real-time information and supporting decision-making across the mobility ecosystem.



From Vision to Reality

Vision 2040 represents a strategic transformation of the transport sector into a seamless, integrated ecosystem. This future mobility framework aligns with global trends of system convergence, where transport is no longer viewed in isolation but as part of a broader network of interconnected services. The vision for such an integration can be viewed as a seamless ecosystem.

This vision brings together the current and upcoming sectors within the transport sector, like connected and automated mobility, zero-emission transport, energy integration and digital operations all into one coherent system.

The seamless ecosystem

2035 – 2040

Public authorities, operators, OEMs and energy actors run mobility as a joined-up service. Journeys are easy to plan and pay for in one place; the network adapts in real time; vehicles, signals and depots and hubs work to common standards; and the energy system and transport system reinforce each other rather than clash. Underpinning this are trends already signposted in UK roadmaps: large-scale use of digital twins and connected corridors, mainstream bi-directional charging and depot energy management, and staged deployment of automated services with whole-life assurance.

2040 and beyond

Travel becomes seamless and predictable. A single account works nationwide with clear pricing and automatic concessions. When a bus lane is blocked, the city's digital twin detects it, retimes signals, opens an AV-only lane for shared services, and your app suggests the best alternative before delays hit. At the network edge, kerbside sensors track occupancy and safety risks; on freight corridors, megawatt charging is booked and settled enroute, so HGVs keep moving while depots earn flexibility revenue through V2G and virtual power plants. Automation runs where proven and supervised, with software updates extending fleet life. Private car ownership shifts toward subscription and shared access, reducing idle assets and freeing urban space for people, not parking. Everything operates as one governed system with shared standards for data, safety, privacy, and accessibility.

Features of the seamless ecosystem

- **Integration & Interoperability:** Open standards, audit trails, and conformance testing ensure seamless operation across platforms and services.
- **Governance & Coordination:** Cities define outcomes; operators deliver; regulators assure safety, privacy, and accessibility.
- **Accessible-by-Default UX:** Entitlement engines, real-time cost/emissions data, and proactive disruption management.
- **Outcome-Based Market Models:** Contracts tied to reliability, safety, charger uptime, and emissions performance, with monetisation of software-defined vehicles (SDV), over-the-air updates (OTA) and energy participation.

Exploring the Seamless Ecosystem

The Vision for 2040 builds on themes consistently highlighted in the Automotive Council Roadmaps and the UK CAM Roadmap to 2035: interoperability, standardisation, collaboration, AI integration, software-defined vehicle architectures, and digitalisation. These principles underpin a future where mobility operates as a connected, intelligent system.

The transport sector is broadly divided into two key applications:

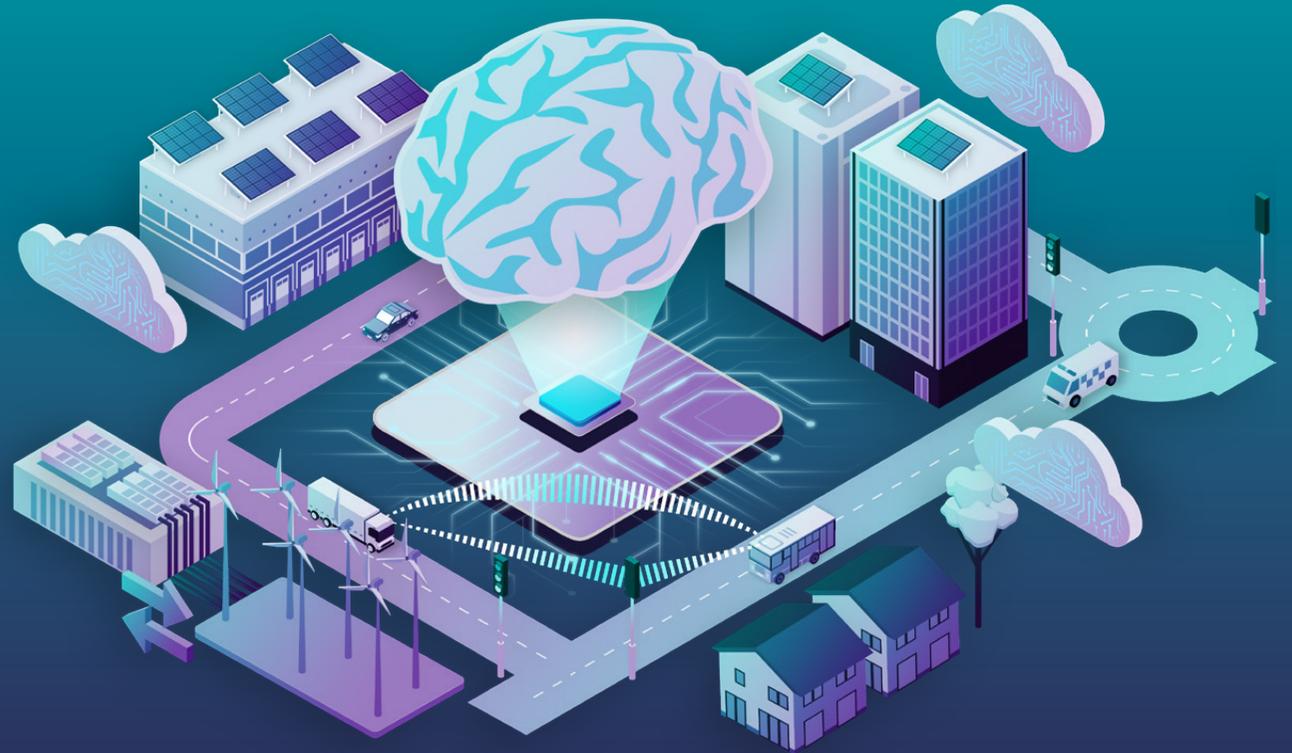
- **Mobility of People:** Encompassing on- and off-highway applications, personal mobility, and shared mobility.
- **Mobility of Goods:** Covering freight, logistics, and non-road mobile machinery across on- and off-highway environments.

Within Mobility of People, private vehicles will integrate seamlessly into the wider ecosystem, interacting intelligently with other road users and infrastructure. For Mobility of Goods, the transformation will centre on depots, hubs, factories, seaports, airports, and the energy grid—creating a synchronised flow of goods powered by real-time data and smart infrastructure.

At the heart of this ecosystem are key enablers: a safe, reliable, and efficient transport interface that drives productivity and economic growth. This vision demands smart vehicle architectures, regulated and consistent infrastructure, and control centres capable of sharing real-time data to optimise movement across networks.

To deliver this transformation, four strategic pillars define the Vision for 2040:

- **Orchestrated Intelligence**
- **Regenerated Mobility**
- **Living Infrastructure**
- **Inclusive and Resilient Mobility**



Orchestrated Intelligence

Orchestrated Intelligence

VISION	PURPOSE	BENEFIT
To create a fully connected, intelligent UK transport ecosystem where advanced computing and AI act as the network's nervous system. Every element i.e. vehicles, infrastructure, and control centres will share real-time data to orchestrate the safe, efficient, and sustainable movement of people and goods.	Integrate transport modes into a seamless, data-driven system.	Safety: Predictive analytics and real-time monitoring reduce accidents and congestion.
	Leverage AI and automation not just for self-driving vehicles but for holistic network optimisation.	Efficiency: Dynamic routing and load balancing optimise flows of passengers and freight.
	Reduce complexity and cost of integration across transport networks.	Sustainability: Lower emissions through optimised journeys and electrification.
	Accelerate deployment of smart infrastructure and services to meet future mobility needs.	Economic Growth: Supports innovation clusters, creates high-value jobs, and strengthens supply chains. Resilience: Enhances adaptability to disruptions and geopolitical or climate-related shocks.

Innovations to enable the Vision for 2040

INNOVATIONS	DESCRIPTION	STRATEGIC VALUE
Adaptive Traffic Optimisation (Quantum & Climate Aware)	Combine quantum algorithms and climate-adaptive controls to optimise traffic flow dynamically, considering congestion, weather, and emissions.	Delivers ultra-efficient routing while supporting net-zero and climate-responsive infrastructure.
AI-Driven Multimodal & Regional Interoperability	Use predictive AI to coordinate buses, trains, shuttles, micro-mobility, and standardise adaptive systems across regions for seamless travel.	Improves reliability, reduces wait times, and boosts trade, tourism and regional coordination.
Smart Infrastructure and Digital Twin Planning	Integrate traffic systems with city-wide digital twins and automate designated corridors using Level 4/5 vehicles and smart infrastructure.	Enhances long-term planning, resilience, and maximises throughput through automation.
Resilience and Safety Systems	Deploy AI-driven emergency routing protocols for real-time traffic reconfiguration during disasters or critical incidents.	Strengthens public safety and resilience analytics for emergency response.
Mobility-Energy Synchronisation	Align traffic flow with energy grid demands, including EV charging load balancing and transport-energy integration.	Reinforces grid stability and supports sustainable energy-transport ecosystems.

Enabling the Vision for 2040: Industry's next steps

SECTOR

<p>Automotive and OEMs</p>	<p>Automakers are shifting to software-defined vehicles with integrated V2X modules, enabling real-time connectivity and orchestration. New entrants can add value by integrating adaptive traffic APIs, licensing routing algorithms, and partnering on connected fleet optimisation.</p>	<p><i>Example: Tesla's over-the-air updates and Mercedes-Benz Drive Pilot illustrate how OEMs embed automation and connectivity into their platforms. An example in the UK, Angoka, funded by APC's TDAP focuses on securing V2X communications for connected and autonomous vehicles.</i></p>
<p>Energy and Utilities</p>	<p>Energy providers are coordinating depot charging, bi-directional flows, and hydrogen refuelling to support electrified fleets and grid resilience. Companies can contribute by embedding EV charging orchestration into SaaS platforms and offering flexibility services.</p>	<p><i>Example: BP Pulse and Shell Recharge are integrating smart charging and V2G solutions for commercial fleets, and APC's Project ARCHER delivers high-power hydrogen fuel cell systems for heavy-duty vehicles, complemented by Project ICEBreaker's digital twin validation for hydrogen HGV architectures.</i></p>
<p>Telecom and Cloud Providers</p>	<p>Telecom and cloud firms enable orchestration engines and edge-cloud platforms for low-latency mobility services. Opportunities include delivering high-bandwidth V2X connectivity and algorithm-as-a-service for transport operators.</p>	<p><i>Example: Vodafone's 5G Mobility Lab and AWS IoT FleetWise demonstrate how connectivity and cloud infrastructure underpin real-time orchestration.</i></p>
<p>Infrastructure & Construction</p>	<p>Infrastructure players are retrofitting smart corridors and deploying digital twin overlays to create adaptive urban transport systems. Companies can supply IoT sensors for traffic control and develop middleware to integrate legacy systems with modern platforms.</p>	<p><i>Example: Siemens Mobility's adaptive traffic signals and Sidewalk Labs' digital twin projects show physical and digital convergence.</i></p>
<p>Consultancies and Certifiers</p>	<p>Consultancies and certifiers provide AI assurance, integration support, and compliance frameworks for complex transport ecosystems. Specialists can build regulatory modules and conduct cybersecurity audits for V2X networks.</p>	<p><i>Example: Deloitte and TÜV SÜD are shaping AI assurance frameworks for autonomous vehicle deployments.</i></p>

Enabling the Vision for 2040: Industry's next steps

FOCUS AREA

AI and Edge Computing

AI and edge computing power orchestration platforms, predictive analytics, and real-time routing. Data analytics firms can build dashboards, while integrators connect legacy systems to advanced platforms.

Example: NVIDIA DRIVE uses edge AI for real-time traffic optimization.

Quantum Mobility

Quantum algorithms promise breakthroughs in traffic and logistics optimization. Universities and startups can license multi-agent reinforcement learning models for commercialization.

Example: Volkswagen's pilot with D-Wave applies quantum computing to urban traffic flow.

Digital Twin Platforms

Digital twins simulate urban systems for planning and resilience. Partners can link these platforms with adaptive traffic systems for city-scale orchestration.

Example: Bentley Systems and Dassault Systèmes lead in creating transport-focused digital twins.

Cybersecurity & V2X

Securing V2X communications and transport data is critical for trust and resilience. Vendors can develop intrusion detection systems, while blockchain firms enable secure identity exchange.

Example: GuardKnox and BlackBerry QNX deliver hardened cybersecurity for connected vehicles.

Inclusive Mobility

Inclusive mobility platforms address underserved communities and multimodal coordination. SaaS developers can embed accessibility features and partner with local authorities.

Example: Moovit and Via provide inclusive, multimodal transport solutions, while Zenzic project partners Moonbility enable real-time wheelchair bay availability on buses, and Blueskeye AI improve safety through driver fatigue detection.

Regenerative Mobility

VISION	PURPOSE	BENEFIT
To create a UK transport system that goes beyond zero emissions to actively restore nature. Every journey improves air, water, and biodiversity, powered by circularly design, renewable energy, and modular infrastructure. Making mobility a driver of environmental recovery and net-positive outcomes.	Embed circular economy principles into vehicles, batteries and infrastructure for reuse and recycling.	Sustainability: Net-positive impact on climate, ecosystems, and public health.
	Integrate nature-based solutions such as green corridors and permeable surfaces into transport planning.	Resilience: Infrastructure designed to adapt to environmental stresses and resource constraints.
	Accelerate deployment of renewable-powered mobility and modular infrastructure to minimise waste.	Economic growth: Stimulates green innovation, creates jobs in circular systems and renewable energy. Social value: Enhances liveability and equity through cleaner air, greener spaces, and inclusive design.

Innovations to enable the Vision for 2040

INNOVATIONS	DESCRIPTION	STRATEGIC VALUE
Circular Mobility-as-a-Service (MaaS)	Embed reuse and repair into shared mobility platforms, from bikes to EVs	Reduces waste, extends asset life, and supports local repair economies
Regenerative Logistics Hubs	Co-locate depots with green infrastructure, energy storage, and water treatment	Supports clean freight, local resilience, and circular supply chains
Eco-Routing Algorithms	AI tools that prioritise routes with lower environmental impact and higher ecological benefit	Encourages behaviour change and supports nature-positive travel
Living Transport Corridors	Integrate green roofs, bioswales, and wildlife crossings into roads, rail, and cycleways	Enhances biodiversity, reduces urban heat, and improves flood resilience

Enabling the Vision for 2040: Industry's next steps

SECTOR

Automotive and OEMs

Automakers are designing vehicles for disassembly, reuse, and material recovery, enabling circular systems for EVs and batteries. Opportunities exist for OEMs and suppliers to pilot closed-loop battery programs and integrate second-life applications.

Example: Nissan and BMW are trialling circular battery systems, and APC's Project RECOVAS is building a UK-wide circular supply chain for EV batteries, including collection and recycling infrastructure. Brill Power and About:Energy are also advancing second-life battery applications through APC's TDAP.

Energy and Utilities

Energy providers are integrating transport with local renewable generation and storage to decarbonize fleets. Companies can contribute by enabling renewable-powered EV charging and supporting community energy hubs.

Example: Octopus Energy and ZapMap are driving renewable EV charging, while local authorities install solar canopies for fleet depots.

Construction and Infrastructure

Infrastructure firms are building with nature-positive materials and modular, low-impact designs to reduce embodied carbon. Opportunities include prefabricated stations, demountable EV charging hubs, and recyclable components.

Example: Arup and Mott MacDonald are designing modular depots, while HS2 uses low-carbon concrete and recycled aggregates in major projects.

Digital and AI Firms

Digital players are developing eco-routing, emissions tracking, and biodiversity analytics tools to support sustainable mobility. New entrants can create platforms that reward regenerative travel choices and integrate nature-based data into routing algorithms.

Example: AI-driven eco-routing tools from firms like Google Maps and emerging startups are helping reduce emissions and optimize green corridors. Zencic project partners Eloy and Gaist add UK capability by providing multi-vehicle coordination software and highways data for eco-routing and green corridor planning.

Local Authorities and Planners

Local authorities are embedding regeneration into transport planning, procurement, and maintenance. Opportunities include implementing green corridors, permeable surfaces, and biodiversity-friendly infrastructure.

Example: National Highways is trialling green bridges and pollinator corridors, while councils deploy tree-lined cycleways and green bus shelters with support from NGOs like Sustrans.

Enabling the Vision for 2040: Industry's next steps

FOCUS AREA

Circular Design

Vehicles, batteries, and infrastructure are being built for longevity and reuse. Innovators can develop second-life battery applications and material recovery systems.

Example: APC-funded projects and OEM pilots are advancing circular battery ecosystems, including RECOVAS for battery recycling and Brill Power for second-life battery intelligence.

Nature-Based Solutions

Green infrastructure restores ecosystems and manages water while enhancing transport corridors. Companies can supply permeable materials and biodiversity-friendly designs.

Example: Wildlife Trusts and local councils collaborate on green bus shelters and pollinator routes.

Local Energy Integration

Community-owned renewables are powering transport systems, reducing reliance on centralized grids. Opportunities include solar canopies, biogas hubs, and smart charging integration.

Example: Energy Systems Catapult supports local energy integration for EV fleets.

Eco-Mobility Platforms

Apps and services incentivise regenerative travel choices through rewards and emissions tracking. Startups can build platforms that integrate eco-routing and carbon credits.

Example: Mobility apps like Moovit and emerging green-routing tools are shaping user behaviour toward sustainability.

Inclusive Regeneration

Ensuring benefits reach underserved communities is central to equitable mobility. Firms can design inclusive planning frameworks and digital tools for community engagement.

Example: Local councils and NGOs embed regeneration principles into transport projects to deliver social and environmental value.



Living Infrastructure

Living Infrastructure

VISION	PURPOSE	BENEFIT
To transform UK transport infrastructure into adaptive, resilient, and energy-positive systems. Roads, stations, and hubs evolve into intelligent assets that self-monitor, self-repair, and generate clean energy, creating a responsive network with minimal manual intervention.	Embed smart materials, sensors, and robotics for predictive maintenance and autonomous repair.	Sustainability: Energy-positive assets reduce emissions and reliance on centralised grids.
	Integrate solar, kinetic, and battery systems into infrastructure for local energy generation.	Resilience: Infrastructure withstands climate shocks and adapts dynamically to disruptions.
	Deploy modular, reconfigurable layouts to adapt to demand and environmental stresses. Self-monitoring roads can proactively manage maintenance.	Economic growth: Drives innovation in smart materials, robotics and clean energy sectors.
		Efficiency: Predictive maintenance lowers lifecycle cost and minimises downtime.

Innovations to enable the Vision for 2040

INNOVATIONS	DESCRIPTION	STRATEGIC VALUE
Self-healing adaptive infrastructure	Deploy smart materials and embedded sensors to enable autonomous repair and predictive maintenance.	Reduces lifecycle costs, improves safety, and extends asset life.
Energy-positive corridors	Integrate solar, kinetic, and hydrogen systems into roads and stations to generate clean energy.	Supports Net Zero, reduces grid strain, and creates local energy resilience
Digital twin-enabled asset management	Use virtual models to simulate infrastructure performance and guide upgrades.	Enhances planning, reduces downtime, and improves investment targeting.
Modular mobility hubs	Build reconfigurable hubs that adapt to passenger and freight demand.	Increases flexibility, supports multimodal integration, and reduces capital costs.
Smart road reconfiguration	Enable dynamic lane allocation and routing based on real-time conditions.	Improves throughput, reduces congestion, and enhances emergency response.

Enabling the Vision for 2040: Industry's next steps

SECTOR	Construction & Infrastructure	Infrastructure is shifting from static builds to adaptive, sensor-integrated assets, creating demand for smart materials and robotics. Companies can innovate with self-healing surfaces, embedded sensors, and modular designs for roads and bridges.	<i>Example: National Highways is piloting smart road materials, while the University of Cambridge researches self-healing concrete and firms like Costain and Skanska trial smart infrastructure in live environments.</i>
	Energy & Utilities	Energy providers are exploring corridor-based generation, storage, and grid integration to power transport systems. Opportunities include solar-integrated corridors, modular energy hubs, and partnerships for nuclear micro-reactors.	<i>Example: Great British Energy is investing in solar-enabled transport corridors, while Rolls-Royce SMR collaborates on modular nuclear hubs for transport-linked zones.</i>
	Digital & Telecoms	Digital firms are expanding edge computing, IoT networks, and digital twin platforms for infrastructure management. New entrants can deliver real-time simulation tools and predictive analytics for asset performance.	<i>Example: Siemens Mobility deploys corridor-level digital twins, and Connected Places Catapult leads urban transport twin pilots for planning and emergency response. Zencic project partners Arcadis and Reed Mobility strengthen this by developing interoperable CAM simulation strategies for UK testbeds.</i>
	Mobility & Transport Operators	Operators are adopting predictive maintenance, dynamic routing, and modular service hubs to improve resilience and efficiency. Opportunities include integrating AI-driven asset monitoring and modular depot designs.	<i>Example: TfL and Transport Scotland are piloting modular hubs supported by Innovate UK funding and Zencic's standards for adaptive infrastructure. APC project partner Monolith AI adds predictive modelling for battery systems, reducing testing cycles and improving resilience.</i>
	Software & AI Firms	AI firms are developing orchestration platforms, asset analytics, and infrastructure control systems to optimize performance. Companies can create predictive maintenance algorithms and resilience planning tools.	<i>Example: Emerging AI platforms are enabling real-time infrastructure monitoring and automated maintenance scheduling.</i>
	Local Authorities & Planners	Authorities are investing in digital twins, resilience planning, and inclusive infrastructure upgrades. Opportunities include embedding climate adaptation into procurement and leveraging simulation for emergency response.	<i>Example: Local councils are using digital twins to guide investment decisions and improve disaster preparedness.</i>

Enabling the Vision for 2040: Industry's next steps

FOCUS AREA

Smart Materials & Robotics

Self-repairing surfaces and autonomous maintenance systems reduce lifecycle costs and improve safety. Innovators can develop sensor-embedded materials and robotic inspection tools.

Example: University of Cambridge's research into self-healing concrete and National Highways' smart surface trials highlight this trend.

Energy Integration

Solar, hydrogen, and kinetic energy systems embedded in transport infrastructure enable energy-positive corridors. Opportunities include modular hubs and hybrid generation systems.

Example: Great British Energy and UK ports are deploying solar-integrated assets and exploring hydrogen-powered upgrades.

Digital Twins & Edge AI

Real-time simulation and control of infrastructure assets improve resilience and efficiency. Companies can build platforms for predictive analytics and emergency response.

Example: Siemens Mobility and Connected Places Catapult lead digital twin deployments for transport corridors.

Modular Design

Reconfigurable hubs and stations adapt to changing needs and reduce construction waste. Opportunities include prefabricated depots and scalable EV charging hubs.

Example: TfL and Transport Scotland's modular hub pilots showcase flexible infrastructure solutions.

Resilience & Climate Adaptation

Infrastructure designed to withstand environmental stressors ensures long-term reliability. Firms can integrate climate risk modelling and adaptive materials into projects.

Example: Innovate UK funds resilience-focused infrastructure trials to future-proof transport systems.



Inclusive and Resilient Mobility

Inclusive and Resilient Mobility

VISION	PURPOSE	BENEFIT
To create a UK transport system where mobility is a public right: accessible, affordable, and resilient for all. Inclusive design is embedded from the start, ensuring age, income, ability, or location are never barriers. Services adapt to disruption and integrate digital and non-digital access channels.	Embed universal design standards across vehicles, stations, and digital platforms.	Equity: Guarantees access for underserved communities and vulnerable users.
	Ensure affordability through inclusive fare structures and subsidies for low-income users.	Affordability: Reduces cost barriers through subsidies and flexible pricing.
	Build resilience with redundant energy, communication, and control layers.	Resilience: Maintains service continuity during disruptions and emergencies.
	Support community-led solutions for rural and demand-responsive mobility.	Social cohesion: Strengthens rural connectivity and community participation in mobility planning.

Innovations to enable the Vision for 2040

INNOVATIONS	DESCRIPTION	STRATEGIC VALUE
Redundant Mobility Systems	Deploy microgrids, backup comms, and control layers to ensure continuity during disruption	Enhances resilience and public safety
Universal Mobility Access Platforms	Develop hybrid digital/offline platforms for booking, payment, and journey planning	Ensures equity and inclusion
Community-Integrated Mobility	Scale demand-responsive services and rural shuttles into national networks	Strengthens cohesion and rural access
Inclusive Design Certification	Create standards and assurance frameworks for inclusive infrastructure and vehicles	Builds trust and compliance
Resilience Analytics & Planning	Use digital twins and predictive tools to plan for climate, cyber, and operational shocks	Futureproofs infrastructure and services

Enabling the Vision for 2040: Industry's next steps

SECTOR

Automotive & OEMs

Automakers are designing vehicles with universal access features and modular interiors to meet national accessibility standards. Opportunities include embedding adaptive controls, tactile interfaces, and inclusive cabin layouts.

Example: The Department for Transport and TfL are collaborating with Disability Rights UK and RNIB to shape accessibility frameworks for future vehicles. APC Project M-LightEn supports this by creating ultra-lightweight modular chassis' using recycled materials, meaning more flexibility for accessible design.

Energy & Utilities

Energy providers are deploying microgrids, second-life batteries, and resilient energy systems to support transport continuity. Companies can contribute by integrating storage solutions and renewable generation into rural and urban hubs.

Example: National Grid and Ofgem are partnering with Siemens and Connected Places Catapult to deliver resilient energy infrastructure for mobility corridors.

Telecom & Cloud Providers

Telecom firms are ensuring coverage in rural areas and enabling low-latency, secure data exchange for inclusive mobility platforms. Opportunities include hybrid access solutions and robust connectivity for demand-responsive services.

Example: UrbanThings and Passenger Technology Group are working with local authorities to provide digital and non-digital access channels for rural transport. Zenzic project partner ADASTRA feasibility study pilots self-driving shuttles in rural hubs, addressing connectivity and inclusive transport access.

Infrastructure & Construction

Infrastructure players are building accessible stations, modular hubs, and adaptive corridors to accommodate diverse user needs. Companies can innovate with prefabricated designs and universal wayfinding systems.

Example: TfL and Innovate UK are funding modular station pilots that integrate accessibility features and flexible layouts. Connected Places Catapult's Rural Transport Accelerator delivers modular hub demonstrators, while its Station Innovation Zone tackles wayfinding and interchange pain points.

Consultancies & Certifiers

Consultancies are developing inclusive design standards and resilience assurance frameworks for transport systems. Specialists can support compliance audits and embed accessibility into procurement processes.

Example: Innovate UK-backed projects are leveraging consultancy expertise to validate universal design principles across mobility platforms.

Enabling the Vision for 2040: Industry's next steps

FOCUS AREA

Inclusive Mobility Platforms

Hybrid access combining digital and offline channels ensures equitable participation. Opportunities include smartcards, entitlement engines, and voice-assisted booking tools.

Example: UrbanThings and Citymapper are creating platforms that integrate subsidies and multimodal access for underserved users.

Resilient Infrastructure

Redundant systems, predictive maintenance, and adaptive routing strengthen transport resilience. Innovators can develop microgrid-enabled hubs and battery storage solutions.

Example: Siemens and Connected Places Catapult are piloting resilience-focused infrastructure for critical corridors. APC Project ARTICO introduced automated mobile robots for logistics hubs, improving operational continuity and resilience.

Community-Led Innovation

Local shuttles, volunteer transport, and integrated booking systems expand rural mobility. Companies can co-create demand-responsive services with councils and NGOs.

Example: Mobility Innovation Labs and Zenzic are supporting rural pilots that combine community transport with digital orchestration, including CAM Pathfinder Pilots such as ADASTRA for autonomous rural shuttles.

Equity & Affordability

Fare subsidies and outcome-based funding models ensure affordability for all users. Opportunities include dynamic pricing engines and rural service guarantees.

Example: DfT and local councils are trialling inclusive fare structures with digital and non-digital payment options.

Environmental Resilience

Nature-based design and flood-adaptive assets reduce climate risk while integrating clean energy. Companies can supply permeable materials and renewable-powered infrastructure.

Example: Local authorities are embedding environmental resilience into transport corridors through green infrastructure and energy integration.

Key Takeaways

Blurring Boundaries Across Sectors

We are on the edge of a technology-enabled watershed, driven by the growth of AI and the future promises of quantum computing both critical to solving complex societal challenges, including transport. At its core, transport is a multi-layered optimization problem, spanning macro and micro levels. The convergence of transport with sectors like energy is accelerating, creating an interconnected ecosystem where what happens on the road directly influences energy systems, and vice versa.

This growing exchange of data across sectors enables seamless integration, aligning requirements and dependencies for coherent operation. However, this integration introduces an energy paradox; while long-term solutions aim to reduce energy consumption, the short-term innovation journey powered by AI and automation may demand greater energy use. This paradox underscores the need for policy alignment and revision, ensuring innovation is not hampered by fragmented regulations.

Future Directions

- **Open Standards & Interoperability:** Ensuring systems can communicate and integrate effortlessly.
- **AI Assurance & Certification:** Building trust in intelligent systems through rigorous validation.
- **Optimised Mobility Systems:** Leveraging data and automation for efficiency and resilience.
- **Emphasis on reuse and second-life applications, reducing waste and maximizing resource value.**

Key Takeaways

Beyond Vehicles: A Systemic Approach

Transport is no longer limited to vehicles, it is evolving into a complex, adaptive system. This represents a paradigm shift in how we design, operate, and experience mobility.

Industries are moving toward service-based models, with consultancies and platform-driven offerings becoming dominant. This shift reflects a systemic approach where transport is no longer about vehicles alone—it is evolving into a complex, adaptive system that integrates multiple modes of mobility, accelerated by technologies like AI.

Supply Chain & Export

To strengthen the UK's position in global trade, government and industry collaboration is essential for improving supply chains and boosting exports.

The bottom line, transport is becoming deeply integrated with other aspects of life, optimized through technology and systemic thinking. If this trajectory holds, policies must evolve in harmony with these changes. If not, we risk constraining opportunities for innovation. The challenge and opportunity lie in resolving the energy paradox through strategic alignment, enabling a future where mobility is sustainable, adaptive, and user centric.

Core Principles Driving the Shift

- **Sustainability:** From emissions reduction to ecological restoration.
- **Technology-Driven:** AI, smart materials, sensors, and renewable energy at the core.
- **System-Level Thinking:** Viewing transport as an integrated ecosystem.
- **Resilience & Adaptability:** Infrastructure and services that respond dynamically to change.
- **User-Centric Design:** Accessibility, safety, and improved quality of life for all.

Glossary

AI	Artificial intelligence
API	Application Programming Interface
AV	Autonomous Vehicle
CAM	Connected and Automated Mobility
EV	Electric Vehicle
HGV	Heavy goods vehicle
IoT	Internet of Things
MaaS	Mobility-as-a-service
NGO	Non-governmental organisation
OEM	Original Equipment Manufacturer
OTA	Over-the-air
SDV	Software-defined vehicle
UX	User experience
V2G	Vehicle-to-grid
V2X	Vehicle-to-everything

Authors

Authors

Angad Jessel

Automotive Trends Analyst,
Advanced Propulsion Centre UK

Mili Naik

Technical Delivery Lead, Zenzic

Dr Hadi Moztarzadeh

Head of Technology Trends,
Advanced Propulsion Centre UK

Francis McKinney

Head of Technology and
Insights, Zenzic

Further Information

If you have any questions, email info@apcuk.co.uk

Sharing this document

This report is produced by APC UK and Zenzic, when sharing the contents of this document, please reference APC to help others connect with our research and support.

Acknowledgements

The APC and Zenzic would like to thank key stakeholders who took part in shaping the contents of this report.



ZENZIC²