

# Introduction

Strategic Vehicle Research and Innovation (FFI) is a public-private partnership between the government agencies Vinnova, the Swedish Transport Administration and the Swedish Energy Agency, vehicle manufacturers Scania CV AB, AB Volvo, and Volvo Car Group, and FKG, the industry organisation for Scandinavian suppliers to the automotive industry. FFI has been funding road traffic research and innovation for a sustainable society since 2009. Through FFI, knowledge has been built up in industry, higher education institutions and research institutes. Solutions developed within the collaboration have been implemented and welcomed by both users and society.

A global transition to sustainable road transport is crucial to ensure sustainable living conditions for future generations. In 2023, six of the nine planetary boundaries were transgressed<sup>1</sup>, underlining the acute need for transition, not the least in areas such as energy and transport systems.

Road transport accounts for approximately one third of Sweden's carbon emissions, largely due to fossil fuels. At the same time, the transport of people and goods is a necessary condition for growth and welfare. FFI is a long-term collaboration program intended to accelerate the transition to a sustainable road transport system.

The automotive industry and its ecosystem are vital to export revenue and investment, as well as to research and development. We have a significant common responsibility to accelerate this work and to find and contribute to increased competence, novel solutions and collaboration.

The FFI Roadmap sets out a strategic direction for the programme as a whole, as well as for its various sub-programmes. It is a policy instrument and a support for following up and evaluating the programme. The roadmap is regularly revised to reflect current societal challenges, and to ensure that FFI can accelerate the transition to sustainable road transport and contribute to Swedish competitiveness in the best way possible.

## Our direction

### **Vision**

Sweden leads the global transition to sustainable road transport

### **Mission**

FFI empowers road transport research and innovation for a sustainable society

### **FFI objectives**

The FFI programme has three strategic objectives:

1. FFI demonstrates solutions that make society's road transport fossil-free, safe, equal and efficient.
2. FFI develops sustainable solutions that are implemented and accepted by users and society.

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<sup>1</sup> [Planetary boundaries – Stockholm Resilience Centre](#)

3. Through innovation, partnership and collaboration, FFI contributes to the development of skills, infrastructure, new technologies, regulations and business models for the road transport system.

FFI intends to strengthen the competitiveness of Swedish industry and develop transport solutions for a global market. The programme stands for risk mitigation for brave development steps at a time of rapid change.

To successfully meet new and more complex societal challenges, the transport and automotive stakeholders must collaborate, build partnerships with adjacent sectors and adopt a systems perspective to a greater degree. In addition to new technologies, we also need to change our regulations, infrastructure, business models and behaviour.

The work of achieving our vision, mission and strategic objectives is based on our four thematic sub-programmes, plus a fifth sub-programme focused on large-scale, real-world system demonstrations.

These are our sub-programmes:

1. **FFI Circularity** with the focus on minimising the climate and environmental impact of manufacturing, service and decommissioning vehicles.
2. **FFI Zero Emissions** with the focus on reducing the negative climate and environmental impact of vehicles in the use phase, in combination with user behaviour and charging and refuelling infrastructure.
3. **FFI Safe Automated Driving** with the focus on increasing road safety and making transportation more sustainable through safe, connected, automated vehicles prepared for next-generation transport systems.
4. **FFI Transport and Mobility Services** with the focus on efficient transport and mobility solutions that meet society's sustainability, accessibility and resilience challenges.
5. **FFI Accelerate** with the focus on accelerating transition through systems demonstrations, upscaling and demand-driven projects in which all dimensions of systems are addressed: new technology, regulations, infrastructure<sup>2</sup>, business models and behaviour.

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<sup>2</sup> This refers to digital and physical infrastructure (but not to road infrastructure, road surfacing, bridges, etc.).

# FFI Circularity

*The sub-programme FFI Circularity is intended to minimise the climate and environmental impact of manufacturing, service and decommissioning vehicles. This can be achieved through initiatives that encompass the entire lifecycle of the vehicle, from concept, through design to production, service, reuse and eventual decommissioning, including components.*

## Challenges

Challenges that the Circularity sub-programme needs to address have been identified in three areas:

### **Climate and energy**

Reducing greenhouse gas emissions and a more efficient usage of energy and other resources is a challenge. Phasing out hazardous substances associated with the production and decommissioning of vehicles is also important.

### **Changes to product and system requirements**

Tomorrow's mobility and circular systems put demands on the working life, traceability and adaptability of products. New products such as batteries and fuel cells create new production, maintenance and recycling challenges. They also place new demands on the production system and operating and maintenance organisations. For example, dealing with software and data in production and supply chains. These demands also affect the role of people in the system.

### **Regulations and standards**

New regulations and standards must be developed in order to create circular systems for the production and maintenance of vehicles. Common and transparent principles are also needed for calculating emissions from the production and decommissioning of vehicles and their components.

## Focus areas

FFI Circularity intends to help solve these challenges by focusing on the following three enabling areas:

### **The product:** Design for circularity and reduced environmental impact

Future product development must enable circular flows in order to achieve maximum use of resources along the entire value chain. Among other things, this can be achieved with the help of new methods and processes for modularisation, traceability, remanufacturing and upgrading.

### **The human:** Skills, cognitive and physical support, the work environment as well as health and safety

The human role needs to be enhanced by focusing on skills, cognitive and physical support, the work environment in line with health and safety. These tools are vital to achieve

resource-efficient, circular products, processes and business models. Jobs along the entire value chain must be attractive and sustainable.

**The production system:** Climate-neutral production, service and decommissioning  
The production system needs to be made more circular through, for example, smart service and maintenance, as well as production and logistics systems that promote circularity. A circular automotive industry demands development towards robust, sustainable value chains and ecosystems.

## FFI Zero Emissions

*FFI Zero Emissions contributes to achieving FFI's objectives by working towards achieving net zero emissions and by making the use phase of zero-emission vehicles more sustainable. This includes both road vehicles as well as plant and industrial utility vehicles.*

### Challenges

Challenges that have been identified within the Zero Emissions sub-programme:

#### **A holistic perspective**

Accelerating the transition to zero-emission vehicles demands a holistic approach to the vehicle and its societal role. It also requires a socioeconomically effective supply of transport for communities and businesses nationwide that is sustainable in the long term, including vehicles adapted to user behaviour and type of use. Furthermore, these aspects include the consideration of climate and environment, health, social sustainability, energy and competitiveness. Another important area for development is digital solutions that create an integrated system of vehicle, charging and refuelling infrastructure and user.

#### **Energy efficiency, resource efficiency and cost-effectiveness**

A user-centred perspective is vital to achieving resource- and energy-efficient solutions for zero-emission vehicles. This includes digital solutions, choice of vehicles and how they are used. The value chain and its constituents must be efficient and sustainable in terms of the climate, environment, human health and cost. A broader view of the types of emissions associated with the vehicles is also required. Cost-effectiveness must be balanced with climate benefits along the entire value chain, for vehicles, infrastructure and society.

#### **Energy supply**

Zero-emission vehicles and associated infrastructure present challenges in terms of their operation, energy supply and energy security. The sub-programme also intends to foster understanding of the need for risk management from a societal perspective, and to promote the co-development of regulations, standards and technologies.

### Focus areas

FFI Zero Emissions intends to help solve these challenges by focusing on following areas:

- Policy development that keeps pace with technological and societal developments, thus enabling the more rapid implementation of necessary measures/technologies.
- Hardware and software optimisation, for example new hardware and electrical/electronic architecture, in vehicles as well as charging and refuelling infrastructure.
- New, relatively unexplored technologies, for example, using vehicles for energy storage or as flexible resources, or other areas with significant potential for achieving FFI's impact goals.
- Optimised energy efficiency in vehicles in the use phase.
- Power electronics in vehicles and infrastructure.

## FFI Safe Automated Driving

*The mission of this sub-programme is to increase road safety and to make road transport more sustainable. We do so through investments in safe, connected, automated<sup>3</sup> vehicles prepared for next-generation transport systems.*

*The aim of the FFI Safe Automated Driving sub-programme is to identify innovative solutions that make road safety a driving force for automation. By supporting the development of knowledge and technology, FFI also seeks to create the conditions for Swedish industry and academia to become more competitive.*

### Challenges

FFI's ambition is that Sweden will be a leader in the safe automated transport of people and goods. FFI Safe Automated Driving addresses the following challenges:

- **Vision Zero**
- **Equal transport** – increased safety for more types of road users irrespective of biomechanical or cognitive variations, as well as greater accessibility in both urban and rural areas.
- **Sustainability** – promoting efficient use through automation.
- **Productivity** – greater automation enables increased levels of vehicle utilisation, as well as allowing drivers to use journey time for other activities.

The level of automation is expected to increase for a long time to come. This opens up new opportunities in vehicle design, transport solutions and utilisation; at the same time, it raises new safety issues that need to be addressed. The implementation of automation and the development of transport solutions must not only be as safe as the transport solutions today but will also play a significant role in improving road safety in the long term. This development will involve a mix of manual vehicles and vehicles with various levels of automation sharing the roads for many years to come. To achieve Vision Zero, security solutions must be developed for this mix of vehicles.

Priority is given to projects involving broad collaboration between industry, academia and the public sector, such as local and regional authorities. In this sub-programme, FFI is especially keen for the users of project results to participate in projects.

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<sup>3</sup> The term *automated* refers to the entire field, from advanced driver-assistance systems to fully automated systems, as described in the [SAE J3016 "Levels of Driving Automation" standard](#).

## Focus areas

FFI Safe Automated Driving has five focus areas related to the above challenges. Contributions within the sub-programme must address one or more of these focus areas. Below are some examples of what the focus areas cover.

### **Safe automated vehicles**

- The automated vehicle's perception, situational awareness, planning, rules and associated driving decisions in varying traffic environments and weathers.
- Verification and development technologies for the effective development and deployment of automated functionality.
- The role of remote support (supervision, assistance, steering) and safety drivers in safe automation.
- Securing vehicle systems against external threats such as cyberattacks, including secure, upgradable software.

### **The safety of road users in and outside the vehicle**

- Safety and security aspects of shared vehicles.
- Interaction between the vehicle and other nearby road users.
- New-user aspects, such as seat position and activities.
- Robust safety systems for biomechanical variations.
- Understanding driver behaviour, the driver's availability, attention and expectations of the automated vehicle.
- Human-system interaction and interaction design.
- Methods and tools for human representation, both physical and behavioural.
- Collision compatibility between vehicles.

### **Integration of the vehicle with the transport system**

- Rapid, reliable and accessible high-capacity communication between vehicles and infrastructure, road users and transport systems.
- Robust vehicle localisation system.
- Interaction between vehicles, transport systems and physical and digital infrastructure.

### **Enabling methods and technologies with obvious applications for the development and deployment of safe automation**

- Methods and technologies such as artificial intelligence, digital connectivity, cloud solutions, data collection and analysis, and electronic and software systems with high computational capacity for safe automated driving.
- Contributing to policy and regulatory development.

### **Demonstrations, pilot projects and field tests**

- Testing and validating safe automated vehicles in real and simulated traffic environments in restricted and public areas depending on the use case.
- Cooperation with users and public authorities (for example, permits and regulations) for testing, developing and validating benefits.

## FFI Transport and Mobility Services

*The mission of this sub-programme is to contribute to more efficient transport and mobility solutions to tackle societal challenges in relation efficiency, accessibility and resilience.*

*We fund research, development and testing of new, innovative solutions that include a systems perspective<sup>4</sup> to challenges in the transport system. This relates to vehicles, technologies, services, business models, processes/tools, regulatory frameworks and behaviour. We consider it beneficial if the project considers system effects at a societal level.*

## Challenges

Challenges that have been identified within the sub-programme Transport and Mobility Services

### **Efficiency**

To meet the challenges posed by climate change, society needs to transition to fossil-free, resource-efficient transport for personal mobility, freight, housebuilding and other societal services. In addition to transitioning to fossil-free energy, we also need to use existing infrastructure more effectively, something that demands greater efficiency in the system. To do so, we must understand how the system functions as a whole, be able to identify suboptimization, and design the system so that its component parts contribute to an optimal holistic solution. The results of a more efficient system include lower costs, increased competitiveness and reduced consumption of energy and materials.

Digitalisation plays a key role here, including improving integration and cooperation between vehicles, modes of transport, infrastructure and business ecosystems, and between commercial stakeholders, people and society. The servicification and division of resources is another important contributing factor to increased efficiency.

### **Equality and accessibility**

Equal accessibility means equal access to work, housing, societal services, leisure activities and deliveries. In striving for a socially sustainable transport system, it is therefore important to consider the needs and conditions of various user groups to a greater extent, as well as the transport needs of businesses.

### **Resilience**

A functioning transport system for people and freight is a cornerstone of society, and it must continue to function under changing circumstances and during crises and disruptions. A resilient and reliable transport system must also be able to recover quickly after disruptions. In this area – with the aid of data analysis, digital twins, AI and other innovative digital technology – there is significant potential to develop new functionality to ensure a secure and resilient system in preparation for tomorrow's resource-efficient transport system. This includes cybersecurity, which is one vital aspect to consider when designing digital infrastructure.

## Focus areas

This programme has defined a number of focus areas in relation to the challenges mentioned above, but applicants may also suggest other relevant areas

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<sup>4</sup> See page 9, sub-programme FFI Accelerate, for a description of the system perspective.

It is also important to integrate different aspects of system innovation, and projects should therefore include two or more system perspectives<sup>5</sup> that, aside from technology, involve new forms of collaboration, business innovation, behavioural change or policy testing:

- **Vehicle technology and infrastructure.** The development of new vehicle concepts and technologies. The development of new digital technologies related to vehicle use and infrastructure, as well as transport and mobility systems.
- **Efficient transport solutions for freight and mobility.** The development of digital technologies that contribute to seamless logistics flows and personal mobility. Improved transport efficiency and optimised cooperation between vehicles and/or infrastructure and transport systems.
- **User-centred development.** Technology, services and system solutions that consider human factors and social conditions in the transport system. One important point of departure for the developed services and solutions is that they include aspects related to user needs, objectives and experiences, as well as being functional, accessible and user-friendly.
- **Methods and tools.** Innovative development methods and tools for assessing and optimising system effects at system-of-systems and societal level.
- **Services and business models.** New and improved business models and transport and mobility services that clearly describe customer value, how this value is created, and how revenue is split between the involved parties.
- **Policy and regulation.** Processes, policy instruments and rules used to govern and guide transport and mobility systems in the right direction. This includes legislation, policies and guidelines defining the responsibilities, rights and obligations of all involved.



*The mission of FFI Accelerate is to accelerate the pace of the transition to sustainable road transport through broad collaboration and major system demonstrations. Projects in the sub-programme must demonstrate innovative system solutions on a large scale.*

The transport system is facing significant societal challenges in the green transition. This is at the same time as rapid technological advances on various levels. To successfully transition to fossil-free, secure, equal and efficient road transport, stakeholders must work together to identify at an early stage any issues that may otherwise impede the rapid and broad implementation of new solutions. FFI Accelerate is intended to both combine project results from the other sub-programmes and to identify relevant solutions and stakeholders that can contribute to achieving FFI's overall vision.

**Accelerate projects are characterised by:**

- being challenge-driven and being crucial to accelerating the pace of the transition to sustainable road transport
- large-scale, real-world demonstrations
- being intended to verify system effects
- establishing a strong and broad collaboration along the entire value chain in which all stakeholders, including the problem owner, participate actively
- a high level of technical maturity and the potential to be implemented within a few years. An emphasis on societal benefits and feasibility
- scalability in a national and international context
- a clear system perspective that addresses all of the following

**Behaviour, culture and values**

To some extent, new solutions involve a new or different role for people in relation to technology and its utilisation. When developing new solutions, it is important to study and understand the human role from both a user and system perspective in order to gain acceptance and trust.

**Business models, procurement and collaboration**

It is vital to examine the business model in parallel with developing the technology. There must be willingness to pay among potential customers, and the solution must be able to stand on its own two feet. New business models and collaborative constellations may be needed to create a sustainable business system and new financing models.

**Policy, standardisation and regulation**

Regulations are basically agreements on how and in what forms the transport system, and its resources, are to be used. The regulations must be adapted as technology and services develop and conditions change, something that requires dialogue and cooperation with stakeholders. Standards may need to be developed for new solutions.

**Infrastructure**

Refers to both physical and digital infrastructure. Physical infrastructure may need to be adapted to ensure effective interaction with new vehicle concepts and mobility solutions. Digital infrastructure is a prerequisite for a seamless data flow in the transition to new mobility solutions, and in this regard it is increasingly important to consider security aspects. Digital infrastructure is a prerequisite for traceability, which is a prerequisite for the transition to a circular business system.

**Technology, products, services and processes**

For example, through a higher degree of vehicle utilisation and more efficient logistics, artificial intelligence and other advanced digitalisation, collaborative and shared services, electrification or automation.

FFI Accelerate intends to combine project results from the other sub-programmes as well as identify relevant solutions and stakeholders that can contribute to achieving FFI's overall vision.