FFI Fordonsstrategisk Forskning och Innovation

Preface

FFI, *Fordonsstrategisk forskning och innovation*, is a collaboration between the Swedish state (Vinnova, Swedish Traffic Administration and Swedish Energy Agency) and the automotive industry (Scania CV AB, AB Volvo, Volvo Car Group and FKG - *Fordonskomponentgruppen*). Through FFI, knowledge has been built up among industry, universities, colleges and research institutes, and solutions developed within the collaboration have been implemented and accepted by both users and society.

The aim of this roadmap is to set the direction for the different programmes and to provide an important instrument for steering, monitoring and evaluation. The roadmap includes all FFI programmes, and its priorities will be evaluated and updated on a regular basis in order to dynamically reflect current societal challenges and enable an accelerated transformation of the transport sector.

Roadmap FFI

The transport system is facing the biggest transformation of our time and the window of opportunity to meet the global sustainability goals is closing rapidly. The transport system is a vital part of the functioning of society, and the movement of goods and people, and is a prerequisite for a welfare society. At the same time, today's transport system poses several challenges such as emissions, congestion, health impacts and, not least, inefficiency. To make an impact, we need to act now.

The FFI has a major responsibility to accelerate this work and contribute to new solutions. To succeed, we need to transform the system jointly. In addition to new technologies, we need changes in regulations, infrastructure, business models and behaviour. To achieve this in time, we need to be flexible so that we continuously learn, adjust and review our priorities.

Vision: Sweden leads the global transition to sustainable road transport
Mission: FFI empower innovation for road transport aiming for a sustainable society

In order to achieve the mission FFI adopted in 2021, new impact goals were set to steer the development towards 2030. These are:

1. FFI has demonstrated solutions that make society's road transport fossil-free, safe, equality and efficient.
2. FFI has developed sustainable solutions that have been implemented and accepted by users and society.
3. FFI has contributed, through innovation, partnership and collaboration, to the development of skills, infrastructure, policy, regulatory frameworks and business models in the road transport system.

To achieve the impact goals, FFI has formulated four thematic programmes. In order to operate and finance large complex projects involving many partners and crossing several thematic areas, a fifth programme, FFI Accelerate, is also in place. The programmes are:

1. **FFI Circularity,** focusing on climate and environmental impacts from a life-cycle perspective and strengthening sustainability throughout the value chain linked to the development, production and decommissioning of vehicles.
2. **FFI Zero Emissions**, focusing on the climate and environmental impact of the automotive sector by developing and integrating fossil-free and electrified vehicles with their infrastructure and users.
3. **FFI Safe Automated Driving**, focusing on improving road safety and making transport more sustainable through safe connected automated vehicles prepared for shared use.
4. **FFI Transport and Mobility Services**, focusing on developing services, transport solutions and systems integration to enable a more resource-efficient and sustainable transport system. This includes technology development, business models, infrastructure, policy and behaviour.
5. **FFI Accelerate**, focusing on accelerated transformation through system demonstration, scale-up and demand-driven projects addressing all system dimensions.

Key aspects for all FFI programmes

Several aspects are important for all FFI programmes and for ensuring the achievement of the overall impact goals.

- **Internationalisation**. An international approach is needed across the project portfolio to create synergies and develop internationally connected research and innovation environments.
- **Competitiveness**. The programme will contribute to strengthening industrial competitiveness and developing competitive transport solutions for a global market.
- **Digitalisation**. Digitalisation is a key enabler for the realisation of the overall impact objectives and permeates all FFI programmes.
- **Equality and gender equality.** Successful innovation requires initiatives that challenge norms and contribute to increased gender equality and equal opportunity. The programme wants to actively contribute to the

promotion of gender equality perspectives both in project group compositions and in research questions.

- **Coordinate policy, regulation and technology**. In order to facilitate the development and implementation of technologies, the development of policies and regulations needs to be developed simultaneously.
- **Risk mitigation.** The programme provides risk mitigation for brave developments in times of rapid change. Incremental improvement in mature areas is given less focus.

FFI Circularity

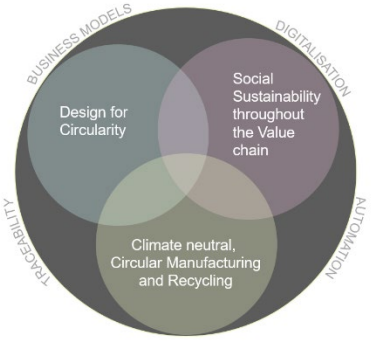
The mission of the programme is to minimise climate and environmental impacts from a life-cycle perspective and to strengthen sustainability throughout the value chain linked to the development, production and decommissioning of vehicles, including their components. This will develop and improve opportunities for future production in Sweden.

As the use phase of the vehicle becomes increasingly fossil-free, it is in the production and decommissioning phase of the vehicle that there is the greatest potential to reduce a vehicle's overall environmental and climate impact.

With the FFI Circularity programme, FFI wants to contribute to increasing competence in, and finding concrete solutions for, challenges related to circularity. The programme will, among other things, contribute to reduced climate emissions and energy use, more efficient use of resources and the phasing out of hazardous substances linked to the manufacture and decommissioning of vehicles. There is a need to increase competences in the field of circularity, where new business models and approaches will be needed to enable a shift towards a circular system. In addition, there are challenges related to regulations and standards. The programme will contribute to ensuring that automotive companies have common principles for calculating emissions related to vehicle production/scrapping within a few years and can report this transparently.

Changing customer demands and behaviours linked to mobility, place new demands on products, such as increased durability, traceability and flexibility. New products, such as battery and fuel cell vehicles, create new challenges in production. Other demands are put on the production system, such as the management of software and data for products in production systems and supply chains, changing manufacturing systems and new actors. A robust and competitive production chain locally and globally needs to be ensured. It is also important to be able to offer sustainable and attractive work throughout the value chain, in order to retain workers and attract new skilled people.

The FFI Circularity programme focuses on funding projects in the following areas:



1) Design for circularity, e.g.
    a) Taking responsibility for the whole value chain, including through circular business models. A competence shift is needed throughout the chain; development, manufacturing and recycling and reuse.
    b) Optimising the lifetime of products, materials and components
    c) Development of methods, tools and standards
    d) Circular material flows
    e) New production processes that enable reuse and recycling
    f) Modularisation for increased lifetime, interchangeability and flexibility

2) Social sustainability throughout the value chain, e.g.
    a) ethical and social aspects of sustainability
    b) Retaining employees and attracting new skills through cognitive and physical support technologies and solutions
    c) Clean and sustainable processes

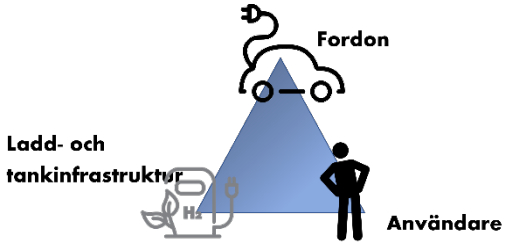
3) Climate neutral, circular manufacturing and recycling, e.g.
    a) Reuse (including that of equipment)
    b) Sustainable, resource-efficient and circular production systems
    c) New technologies, including to adapt to electrification and reduce current environmental footprint
    d) Creating the conditions for robust production chains
    e) Increasing the use of secondary materials

4) Other areas contributing to the mission of the programme, such as
    a) new materials, technologies or methods that radically minimise the environmental impact of vehicle development, production and decommissioning

The programme will not finance pure cost savings, efficiency improvements or rationalisations not linked to circularity. The projects approved must have a clear description of how the project contributes to a possible improvement from a life-cycle perspective.

FFI Zero Emissions

The mission of the programme is to reduce the negative impact of the automotive sector on climate and the environment by developing and integrating zero emission vehicles with their charging and refuelling infrastructure and with its users.



FFI Zero Emissions contributes to the FFI's impact goals by working towards achieving zero emissions and making the use phase more sustainable.

FFI aims to cultivate new solutions for zero emissions through research, development and innovation on vehicles, their associated charging and refuelling infrastructure and their use. This includes a holistic approach to the vehicle, addressing climate, environment, health, energy and cost reduction, which will help to accelerate the transition to a fossil-free economy. It also includes the development of digital solutions to create an integrated system including the vehicle, the charging and refuelling infrastructure and the user.

The programme will increase the resource and energy efficiency of vehicles from a user perspective, as a step towards achieving efficient zero emission solutions. This includes design, digital solutions, optimised lifetime and sustainable choices of vehicles and their use, but also their role in the future transport system, including charging and refuelling infrastructure.

The programme will work towards operational, supply and energy security for vehicles and their associated infrastructure. In addition, the programme will promote the understanding of risk management from a societal perspective and the co-development of policies, regulations and technologies in the relevant fields.

Therefore, the programme Zero Emissions focuses on areas that aim in different ways to weave together the zero emission vehicle, the infrastructure and the users:

1. efficiency across the value chain from a sustainability perspective, e.g. for components and systems, where sustainability refers to climate, environment, health and cost, and has a broader perspective on emissions.
2. cost reduction balanced with climate benefits enabling implementation.

3. Optimised societal benefits by focusing on societal needs, such as adapting vehicles to behaviour and type of use (rural, urban, shared mobility etc).
4. Hardware and software optimisation and electrical architecture in vehicles and charging and refuelling infrastructure, and the impact thereof.
5. Safety, both in terms of in-vehicle technology solutions and charging and refuelling infrastructure.
6. New, relatively unexplored areas, where vehicles are used, for example, for energy storage/flexibility resource.
7. power electronics and optimised energy efficiency of the vehicle in the user phase

The main focus is on electrification (including fuel cells). Also other powertrain options for zero-emission vehicles are included, provided that life-cycle, resource and long-term perspectives are taken into account. Incremental improvements in mature areas will not be funded.

FFI Safe Automated Driving

The mission of the programme is to improve road safety and make transport more sustainable through safe connected automated vehicles prepared for shared mobility. "Automation" refers to the field spanning from assisting systems to fully automated systems as described in *SAE J3016*:

• Level 1: Driver Assistance
• Level 2: Partial Driving Automation
• Level 3: Conditional Driving Automation
• Level 4: High Driving Automation
• Level 5: Full Driving Automation

With the Safe Automated Driving programme, FFI aims to find concrete innovative solutions that make road safety a driving force for automation. By supporting this technology and knowledge development, FFI also wants to create the conditions for Swedish industry and academia to achieve world-class performance in the field.

FFI's ambition is to make Sweden a leader in safe automated transport of people and goods.

The degree of automation will increase in the long term, opening up new possibilities for vehicle design, transport solutions and use, while at the same time new safety aspects must be addressed. The implementation of automation and the development of transport solutions should not only be safe but also play a role in achieving long-term improvements in road safety.

The new forms of usage and traffic situations that automated transport solutions open up are also expected to improve safety in terms of equality, including multiple road user types and variations in biomechanical and cognitive conditions, important in a future automated environment.

The following focus areas provide an overview of the areas where the Safe Automated Driving programme will fund projects. The programme welcomes projects that also include demonstration activities.

Safe automated vehicles

- Vehicle perception, situational awareness, planning, control and associated driving decisions in varying traffic environments and weather conditions.
- Verification and development techniques for efficient development and deployment of automated functionality.
- Remote control drivers and safety drivers related to safe automation.
- Vehicle systems secure against external attacks including secure software upgradeability.

Safety for road users inside and outside the vehicle

- Safety- and security aspects regarding shared mobility.
- New user aspects such as seating positions.
- Understanding of driver behaviour including driver availability, attention and vehicle expectations and its safety system.
- Human-system interaction and interaction design.
- Methods and tools for human representation and driver behaviour.

Integration of vehicles and infrastructure for safe transport solutions

- Fast, reliable and accessible high-capacity communication between vehicles and with infrastructure, road users and transport systems.
- Vehicle location systems.

Enabling methods and technologies with clear application for the development and deployment of safe automation

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

FFI Transport and Mobility Services

The mission of the programme is to develop and test new innovative services and transport solutions that contribute to more efficient use of vehicles and transport systems.

Innovative services and business models are examples of identified critical areas that can accelerate the transition to a more sustainable transport system for goods and people. Other key areas that need to be addressed are adaptive regulatory frameworks to and new technologies. Furthermore, it is also important that initiatives within the programme are developed from a user perspective respecting mobility needs of all groups in society.

The programme aims to contribute to test solutions optimizing the transport system and to tackle following challenges:

- Equal accessibility to the transport system
- Efficient use of resources in the transport system, including logistics
- Efficient collaboration with societal actors and within R&D projects

Based on these challenges, the programme aims to support projects and applied research focusing on transport services and solutions that demonstrate benefits of a resource-efficient transport system. The programme focuses on integrating different aspects of system innovation and the projects that include two or more of the focus areas described below will be prioritised.
We challenge projects to include a system perspective, for example regarding objectives, methodology, implementation and evaluation.

Following focus areas has been defined within the programme:

1. **Technologies, services and processes** to make better use of resources and to develop services, including enabling technologies. This could for example be higher vehicle utilisation and more efficient logistics flows, as well as collaborative and shared services for personal mobility and interoperability between e.g. vehicles and infrastructure.
2. **Business models and collaboration.** Business innovation is a key element to exploit the potential of transport and mobility services and to ensure a wider adoption of new services. New collaborative partnerships are needed between business and societal actors to create new financing models.
3. **Robust and safe infrastructure** needs to be future-proof and designed in line with the demands of future mobility solutions. The physical infrastructure needs to be adapted to ensure effective interaction with new vehicle concepts and forms of mobility solutions. Digital

infrastructure is a prerequisite for seamless data flow and an enabler for digital communication, data collection and data exchange for current and future mobility solutions. The development and implementation of new solutions should take into account the need to invest in robust and secure digital infrastructure. Digitalisation also opens up new possibilities for smarter use of existing road infrastructure and road equipment, but also planning for resource- and transport-efficient societies.

4. **Policy, standardisation and regulatory frameworks** are important aspects that need to be taken into account when introducing and implementing robust and sustainable mobility solutions. In order to develop solutions, they need to be tested in cooperation with authorities responsible for policy development and stakeholders who can influence the design of regulations.
5. **Behaviour, culture and values** form the basis for collaboration between the different actors of the transport system and their needs, both today and for a changing transport system. These needs must be met as far as possible, but also balanced in a sensible way, to ensure that we build a sustainable, equitable and resource-efficient system.

Applying projects should not be restricted to the five focus areas but can be complemented by other aspects if considered important for the implementation of the project.

Examples of initiatives and themes that could be funded in the programme:

- **Testing solutions for resource efficient transport systems**. Testing the technical functionality, user-friendliness and integration of innovative transport services and their impact at the system level.
- **Seamless intermodal transport solutions "door-to-door".** Solutions and services that contribute to more sustainable and equitable accessibility for different user groups by creating more seamless intermodal passenger transport "door-to-door".
- **Seamless freight and goods transport solutions**. Increased efficiency in logistics flows from the first to the last mile through the development of new services and system integrations.
- **New forms of collaboration**. Testing new forms of constellations and partnerships to develop the business innovation capacity of the transport system.
- **Development of digital platforms and enabling technologies from a holistic perspective**. Development of the necessary technologies from a systems perspective needed to build new types of services, business models and digital platforms.

FFI Accelerate

The mission of Accelerate is to contribute to an increasing pace of transition to sustainable road transport through broad cooperation and major system demonstrations. In Accelerate, innovative system solutions with high societal benefits will be demonstrated on a large scale.

The transitioning transport system faces significant societal challenges in the process to achieve the climate goals. In order to succeed in the transition to fossil-free, safe, equal and efficient road transport, it is necessary for the relevant stakeholders to work together to identify aspects at an early stage that could otherwise impede rapid and broad implementation.

Accelerate projects are characterised by the fact that they:

- Are challenge-driven and critical to accelerating the pace of the transition to sustainable road transportation.

- Are large-scale and demonstrated in a real environment to verify the system effects.

- Have established a strong and broad cooperation throughout the value chain where all actors, including problem owners, participate actively.

- Has a high level of technical maturity and has the potential to be implemented within a few years. The focus should be on societal benefit and attainability.

- Are scalable in a national and international context.

- Have a clear system perspective in which all of the following perspectives must be addressed:

- **Behaviour, culture and values.**
  New solutions imply a partially new or changed role for humans in relation to technology and its use. It is important to study and understand the human role from both the user and system perspective when developing new solutions in order to gain acceptance and trust.

- **Business models, procurement and collaboration.**
  It is important to examine the impact on the business model at an early stage in parallel with ongoing technology development. There must be a willingness to pay among potential customers and the solution must be a stand-alone solution. New business models and collaboration constellations may be needed to create circular business systems and new financing models.

- **Policy, standardisation and regulations.**
  Regulations are basically agreements on how, and under what conditions, the transport system and its resources should be used. Regulations need to be adapted as technology and services develop and their conditions

change. This requires both dialogue and cooperation with relevant stakeholders.

- **Infrastructure.**
  Refers to both physical and digital infrastructure. The physical infrastructure may need some adaptation 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 with this, for example, the security aspect is becoming increasingly important. Digital infrastructure is a prerequisite for traceability in the transition to a circular business system.

- **Technology, products, services and processes**.
  This could for example mean a higher degree of vehicle utilisation and more efficient logistics, artificial intelligence, collaborative and shared services, electrification or automation.

The intension of FFI Accelerate is to both combine project results from the other FFI programmes and capture relevant solutions and actors that contribute to the overall vision of FFI.

Limitations and distinctions between programmes

- Projects related to automotive batteries can be applied for under both FFI Zero Emissions and Circularity programmes. However, battery projects submitted to Circularity should primarily aim at minimising its environmental impact, from all aspects.
- For the development of technology solutions, the focus is on the deployment phase in the FFI Zero Emissions.
- In the area of safety, FFI Zero Emissions focuses on technology solutions related to zero-emission vehicles.
- Software and hardware development is included in FFI Zero Emissions in cases where projects are linked to energy efficiency, sustainability perspectives and communication for infrastructure and vehicles.
- Digitalisation, linking users, infrastructure and vehicles, is included in FFI Zero Emissions in cases where projects are focused on zero emission vehicles.
- Implementation and scalability are included in FFI Transport and Mobility Services in cases where the scope of the projects is limited; projects of larger scope should instead be included in FFI Accelerate.