INFRA SWEDEN 2030

Roadmap to a resource-efficient and sustainable transport infrastructure

December 2018

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Introduction

This document describes the roadmap for the work of the strategic innovation programme InfraSweden2030. The time perspective is from the programme's inception in 2015 to 2030 when the programme's long-term effect targets shall have been achieved.

InfraSweden2030 is divided into several focus areas, which means that this document presents a roadmap for each focus area.

The roadmaps have been developed successively and compiled together in 2018 within the framework of the programme's strategic planning work. The document as a whole should be seen as living, i.e. that the content will be revised as InfraSweden2030 develops in its journey towards a resource-efficient and sustainable transport infrastructure.

Stockholm, 28 November 2018

Innovation
Transport infrastructure

The continued development and prosperity of modern society depends heavily on efficient transport, which requires a reliable, safe and sustainable transport infrastructure. Research is ongoing worldwide to develop the existing infrastructure and find tomorrow's transport solutions.

The need to maintain existing transport infrastructures and build new ones in a commercially, socially and environmentally sustainable way makes it necessary to develop new mechanisms to increase the degree of innovation in the sector. There are many driving forces for a higher rate of development and innovation in transport infrastructure and these offer a number of important challenges and opportunities, such as the need for smart, sustainable transport infrastructure, an increased focus on environmental and climate issues, the life cycle perspective and industrial thinking in the construction process, procurement forms and business models, increased international competition and the industry's attractiveness, as well as generational change and the provision of expertise. There is also a need to increase the attractiveness of the industry, to link it with other industries and to cope with future generational change and the provision of expertise.

The rapid development of technology, not least in ICT and materials, creates the conditions for more efficient production and with a reduced environmental impact, reduced maintenance requirements, increased production speed and productivity and an improved working environment.

The boundaries between the physical and the digital world are becoming increasingly fluid. Network connections create opportunities to utilise the power of the data created by a new generation of computers that can communicate both with each other and with users. The integration of cloud computing solutions, so-called "Big Data", and computers in transport and infrastructure creates huge opportunities for increased productivity gains through increased availability and higher efficiency. Building Information Models (BIMs) and Virtual Reality (VR) have had a revolutionary effect in the construction industry.

INFRA SWEDEN 2030

Vision

In 2030, Sweden has a competitive transport infrastructure sector for climate-neutral transport that addresses society's economic and social challenges

The strategic innovation programme InfraSweden2030 was authorised 2015 as a joint initiative from Vinnova, the Swedish Energy Agency and Formas. The overall ambition of InfraSweden2030 is to contribute to the sustainable and competitive development of future transport infrastructure.

Many key players from the infrastructure industry, problem owners, institutes and universities in Sweden are participating in InfraSweden2030, making it a unique and strong industry-wide venture. The programme can last up to 12 years depending on its development and results that are evaluated every three years.

The purpose of InfraSweden2030 is to strengthen Sweden's competitiveness and further the development of sustainability in the Swedish transport infrastructure sector.

This is to be achieved by bringing together different stakeholders in a multidisciplinary and open innovation framework that promotes improvements in transport infrastructure and leads to commercial and applicable innovations.

Objective

To achieve this vision, the programme has three objectives:

Develop innovation for transport infrastructure	The programme shall promote research and development of competitive products and services that shall be in demand nationally and internationally.
Create an open, dynamic and attractive environment	The programme shall promote a creative and interdisciplinary system mindset. The transport infrastructure sector shall be a dynamic industry with good profitability that develops a positive innovation climate.
Reduce impacts on the environment and climate	The programme shall, through innovative thinking, contribute to reducing climate and environmental impact from construction, operation and maintenance.

Focus areas

InfraSweden2030's main activity consists of open calls, targeted projects (individual projects) and activities such as workshops and seminars. These are performed within six identified focus areas, whose orientation and long-term effect targets are described below.

Climate-neutral transport infrastructure

Actions and activities within the focus area aim to reduce the climate impact of the entire life cycle of transport infrastructure by promoting the development and demonstration of innovative methods, working methods, products and tools.

Effect target 2030
InfraSweden2030 has clearly contributed to halving the climate impact of transport infrastructure throughout its life cycle as well as creating good conditions for climate-neutral transport in Sweden. Swedish stakeholders in transport infrastructure are exporting climate-smart solutions to a global market in significant quantity.

Interlinked transport infrastructure

The area focuses on new value-creating processes, solutions and services that are made possible by the infrastructure being connected to other parts of the transport system. Examples are services for more efficient operation and maintenance of infrastructure and services for efficient utilisation of transport infrastructure. The aim is to increase the precision of all measures through efficient use of information and new technology.

Effect target 2030
InfraSweden2030 has contributed to a significantly increased value of existing transport infrastructure through deeper integration between the various stakeholders in the transport system. Citizens and businesses in Sweden have a more efficient transport system and a more predictable level of service. Swedish companies are successful suppliers of commercialised new solutions in the growing international services market.

Construction solutions and methods

This area covers everything from developing innovative and functional materials to construction and building methods for designing smart and green transport infrastructure.

Effect target 2030
InfraSweden2030 has clearly contributed to the development of new materials, methods and processes for smart and green transport infrastructure.

Focus areas

Increased productivity

In this area, the focus is on the prerequisites for managing and allocating resources to areas where they provide the greatest societal benefit and increased focus on sustainable and smart solutions. InfraSweden2030 shall promote the choice of solutions (product, process and tools) that are most effective and sustainable from a societal perspective and give the supplier market the right commercial conditions.

Effect target 2030
InfraSweden2030 has clearly contributed to increasing the productivity and competitiveness of Swedish transport infrastructure and creating a culture of learning organisations where follow-up is natural.

Condition assessment, operating and maintenance methods

In this area, the focus is on developing new, objective methods for measuring and analysing installation conditions and new, innovative solutions for more sustainable maintenance of transport infrastructure now and in the future.

Effect target 2030
InfraSweden2030 has clearly contributed to innovative technological solutions and efficient planning and follow-up tools based on modern digitalisation technologies such as Big Data, IoT and AI having contributed to proactive, sustainable and productive maintenance. With many new specialist companies in the field of condition assessment, operation and maintenance, a more dynamic market has been created.

Increased competence and attractiveness

InfraSweden2030 's vision is dependent on the infrastructure sector being able to attract and develop skilled employees. Through this focus area, InfraSweden2030 wishes to support innovation projects that have a stated purpose of increasing competence and attractiveness.

Effect target 2030
InfraSweden2030 has clearly contributed to the transport infrastructure sector being regarded as open, dynamic and attractive, known for interesting and stimulating work.

Roadmap for the focus areas

The roadmap for InfraSweden2030 has been developed on the basis of the following definition:

A roadmap links what we have knowledge or experience of today with what we can imagine about the future. A roadmap shall support the planning that is done in other contexts.

It is not, therefore, a plan that can be directly translated into a business plan. The roadmap is a plan with objectives and milestones to navigate on the basis of an organisation's further work.

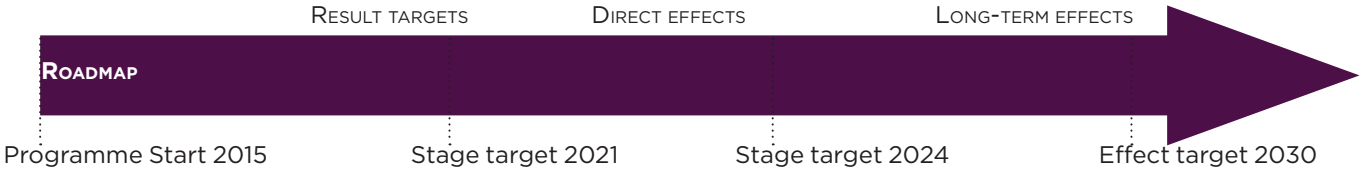
InfraSweden2030's roadmap extends from the programme's inception in 2015 to 2030, by which time InfraSweden2030's long-term effect targets are to have been achieved. This 15-year time horizon is divided into three periods: 2015 to 2021 (short term), until 2024 (medium term) and until 2030 (long term).

The roadmaps for each focus area are explained below by setting the most important stage targets for how the programme's stated targets in the short-term and anticipated effects in the medium and long term can be achieved.

In order to fulfil its function, the roadmap shall be clear and possible to follow up. The specified stage targets and final target shall be tracked and preferably also measured and compared with base year conditions.

The roadmaps described need to be concretised to a certain extent, partly to improve clarity in the programme work and partly to facilitate measurement and follow-up. As a specific activity, it is planned to perform zero measurements from the base year 2015 in 2019 and at the same time establish methods and processes for target follow-up.

The results of this planned activity will be the basis for updating the current document.



Climate-neutral transport infrastructure

Actions and activities within the focus area aim to reduce the climate impact of the entire life cycle of transport infrastructure by promoting the development and demonstration of innovative methods, working methods, products and tools.

RESULT TARGETS 2018-2021	MEASURABLE STAGE TARGETS 2021	DIRECT EFFECTS 2021-2024	MEASURABLE STAGE TARGETS 2024	EFFECT TARGETS AND MEASURABLE TARGETS 2030
New and further developed methods, materials and processes that reduce climate impact and significantly improve resource efficiency in the production, operation and maintenance of transport infrastructure have been developed and demonstrated. New and further developed methods to consider and reduce climate impact in a lifecycle perspective in the planning of new and rebuilding of existing transport infrastructure have been used and evaluated. Innovations that increase the proportion of recycled parts and materials in the transport infrastructure have been initiated. Innovations for electrification of the transport infrastructure have been initiated. Innovations for energy recovery from the transport infrastructure have been initiated. Stakeholders in the focus area participate in EU projects on innovations for climate-neutral transport infrastructure.	One or more new materials with lower climate impact under development in Sweden. New solutions for electrification of and energy recovery from the transport infrastructure are under development in Sweden. Balanced participation in the focus area from both large and small companies along the entire value chain (measured number of companies of different size by NACE code). Increased knowledge among the focus area's participating stakeholders about how the climate impact of transport infrastructure is calculated and reduced. 5 ongoing industrial PhD projects in the field.	Increased knowledge among stakeholders in the sector about how the climate impact of the transport infrastructure can actually be reduced. Methods for considering the climate impact in a lifecycle perspective are used in the planning of new transport infrastructure. Methods to improve the resource efficiency of transport infrastructure are in use by stakeholders in the sector. LCA methodology for calculating climate impact is applied by all purchasers who participated in projects in the programme. Suppliers offer transport infrastructure solutions that have a significantly lower climate impact in a lifecycle perspective. Increased demand from purchasers, in Sweden and abroad, for Swedish innovations for reducing climate impact from the transport infrastructure. Swedish stakeholders participate in international or EU collaboration on innovations for climate-neutral transport infrastructure. Increased awareness in society of the climate work of the infrastructure industry. Knowledge from the programme is used in relevant education and training.	The climate impact of infrastructure construction in Sweden has stopped increasing. One or more new materials with lower climate impact is/are demonstrated in infrastructure projects. Project results are used by purchasers (local authorities or the Swedish Transport Administration). Balanced participation in the focus area from both large and small companies along the entire value chain (measured number of companies of different size by NACE code). 5 ongoing industrial PhD projects in the field.	*InfraSweden2030 has clearly contributed to halving the climate impact of transport infrastructure throughout its life cycle as well as creating good conditions for climate-neutral transport in Sweden. Swedish stakeholders in transport infrastructure are exporting climate-smart solutions to a global market in significant quantity.* ▪ 50% reduction in annual climate impact resulting from the production, operation, maintenance and rebuilding of transport infrastructure. (Base year: 2015) ▪ 100% increase in the proportion of recycled materials in infrastructure projects in Sweden. (Base year: 2015) ▪ 500% increase in the export value of Swedish expertise in climate-smart transport infrastructure. (Base year: 2015) ▪ At least two new technologies for energy recovery from transport infrastructure have been demonstrated in Sweden. ▪ At least two new technologies for electrification of transport infrastructure have been demonstrated in Sweden. ▪ 10 industrial PhD students in the field have achieved a doctorate with support from the programme.

Interlinked transport infrastructure

The area focuses on new value-creating processes, solutions and services that are made possible by the infrastructure being connected to other parts of the transport system. The aim is to increase the precision of all measures through efficient use of information and new technology.

RESULT TARGETS 2018-2021	MEASURABLE STAGE TARGETS 2021	DIRECT EFFECTS 2021-2024	MEASURABLE STAGE TARGETS 2024	EFFECT TARGETS AND MEASURABLE TARGETS 2030
Identify and motivate innovation and commercialisation of solutions and services for more efficient planning and management of the operation and maintenance of the Swedish transport infrastructure through the reuse of data in an interlinked infrastructure. Identify and motivate innovation and commercialisation of solutions and services for efficient management of transport systems in an integrated and interlinked transport infrastructure. Initiate targeted calls for projects in Interlinked Transport Infrastructure in 2019. Coordinate Swedish industry networks and initiatives for a mustering of strength in applications based on integrated data provision, IoT and AI and greater international exchange of knowledge.	The proportion of projects in the area of Interlinked Transport Infrastructure amounts to around 20% of the total programme volume. At least two pilot projects with commercially promising solutions are under way in more efficient operation and maintenance and in management of transport systems. Increased industry collaboration in coordinated data supply and application of IoT and AI. An application for the establishment of an Interlinked Transport Infrastructure centre in Sweden is under consideration by an international financier.	Increased access to persons with analytical skills for IoT and AI applications in transport infrastructure. Significant increase in data collection and number of sensors in the Swedish transport infrastructure and the quantity of data shared between different stakeholders. Significant value for integrated transport infrastructure in work on relevant societal challenges such as more efficient operation and maintenance of transport systems for a circular economy. Greater awareness of Swedish service innovation through increased international exchange of knowledge.	Train delays have fallen by 15 per cent. Export value has increased by 200 per cent. Mobility services per capita have increased by 75 per cent. Workforce IoT/AI in the industry. Increased data collection and use of data. Increased awareness of Swedish service exports.	*InfraSweden2030 has clearly contributed to an increased value of existing transport infrastructure through deeper integration between the various stakeholders in the transport system. Citizens and businesses in Sweden have a more efficient transport system and a more predictable level of service. Swedish companies are successful suppliers of commercialised new solutions in the growing international services market.* ▪ Train delays have fallen by 50 per cent ▪ Export value has increased by 500 per cent ▪ Mobility services per capita have increased by 200 per cent

Construction solutions and methods

This area covers everything from developing innovative and functional materials to construction and building methods for designing smart and green transport infrastructure.

RESULT TARGETS 2018-2021	MEASURABLE STAGE TARGETS 2021	DIRECT EFFECTS 2021-2024	MEASURABLE STAGE TARGETS 2024	EFFECT TARGETS AND MEASURABLE TARGETS 2030
New innovative construction solutions and methods that are safe, efficient and sustainable. Modified building processes with working methods and materials that reduce climate and environmental impact. More resource-effective and robust technologies, processes and applications with the aid of digitalisation, robotics and automation. New, innovative solutions for more efficient logistics in the construction process. Innovative infrastructure solutions with a particular focus on social sustainability and equality in the transport system. New materials with better or adapted properties.	There should be a plan for delivery with business concept and dissemination of results in 100% of projects. We have started projects in all the addressed areas with a clear increase in the Technology Readiness Level (TRL) A call for proposals performed with a clear focus on digitalisation. 5% increase in application demand compared with base year.	New and innovative construction solutions and methods have been developed and tested for more efficient, safe and sustainable transport infrastructure. Digitalisation and robotisation are used more systematically and more widely throughout the transport infrastructure construction process. New materials with optimised properties have been developed and demonstrated in projects. Increased research and innovation investments in companies in the transport infrastructure sector. Increased product quality/sustainability related to execution process and new building materials.	> 25% of completed projects in the implementation phase/test bed. > 5 projects with a focus on digitalisation. 10% increase in application demand compared with base year.	*InfraSweden2030 has clearly contributed to the development of new materials, methods and processes for smart and green transport infrastructure.* ▪ Sweden shall be regarded as one of the best in the use of digital aids in the construction process. ▪ Clear annual growth trend for the number of applied innovations in the infrastructure sector originating from InfraSweden2030. ▪ Increase in application demand of 20% for research and innovation projects within InfraSweden2030. (Base year 2016)

Increased productivity

In this area, the focus is on the prerequisites for managing and allocating resources to areas where they provide the greatest societal benefit and increased focus on sustainable and smart solutions. InfraSweden2030 shall promote the choice of solutions (product, process and tools) that are most effective and sustainable from a societal perspective and give the supplier market the right commercial conditions.

RESULT TARGETS 2018-2021	MEASURABLE STAGE TARGETS 2021	DIRECT EFFECTS 2021-2024	MEASURABLE STAGE TARGETS 2024	EFFECT TARGETS AND MEASURABLE TARGETS 2030
New or further development of products (technical solutions), processes and tools as well as sustainable production methods that provide increased productivity. Demonstration of innovative products, processes and tools for efficient planning and implementation. Cost-effective transport infrastructure solutions based on life cycle costs (LCC). New forms of contract that stimulate innovation and thus the construction industry's interest in R & D. More acceptance of alternative tenders through the development of functional requirement specifications in contracts. New innovations developed by SME companies. Increased use of digital tools in the construction sector, such as BIM. More solutions that can be classified as alternative tenders in construction contracts. More follow-up and analysis of projects to make the most of experiences and improve before future projects.	Evaluate the impact of completed TEM/ECI type contracts to develop the contract form. Get 3 pilots started with the Swedish Transport Administration or local authorities to test 3 new contract types that enable productivity-enhancing elements such as automation and LCC etc. Start work on an industry-wide institution for functional requirement specification and to approve "equivalent function" in new technical solutions. Well worked out examples (corresponding to high TRL level) of procurement models for project design and construction contracts not only based on "lowest price". Follow-up and backing of the Construction Forum's recommendations for further development. Follow-up and backing of the Swedish Transport Administration's work on simplifying regulations to stimulate competition.	Implementation of cost-effective and sustainable innovation in transport infrastructure. Better interaction between purchaser and supplier. New or improved marketable, innovative niche products and services. Better climate to work out and adopt alternative tenders. More flexible contract forms that allow for innovation.	Finalise an industry-wide institution for approving "equivalent function" in new technical solutions. Increased competition with more tenders and less concentration. A greater share of existing technology (meaning 2018 technology such as BIM and GPS control etc.) implemented in everyday activities. A broader palette of innovation-promoting forms of contract for the purchasing local authorities and the Swedish Transport Administration.	*InfraSweden2030 has clearly contributed to increasing the productivity and competitiveness of Swedish transport infrastructure and creating a culture of learning organisations where follow-up is natural.* ▪ Positive development of the construction sector's productivity in national accounts and the Swedish Transport Administration's data on costs. ▪ The overall market share of the four largest stakeholders shall be below 50% in the construction sector.

Condition assessment, operating and maintenance methods

In this area, the focus is on developing new, objective methods for measuring and analysing installation conditions and new, innovative solutions for more sustainable maintenance of transport infrastructure now and in the future.

RESULT TARGETS 2018-2021	MEASURABLE STAGE TARGETS 2021	DIRECT EFFECTS 2021-2024	MEASURABLE STAGE TARGETS 2024	EFFECT TARGETS AND MEASURABLE TARGETS 2030
New or further developed tools and calculation models for condition assessment of transport infrastructure Techniques, methods and tools for condition assessment, operation and maintenance of transport infrastructure where digitalisation opportunities (e.g. IoT, AI, VR, self-learning technologies) are utilised Modern IT-based tools for resource- and cost-efficient transport infrastructure operation and maintenance New innovative solutions for more efficient logistics (e.g. mass transport, route planning) in the operation and maintenance of transport infrastructure New or further developed technical solutions, materials or methods for more efficient operation and maintenance measures Data for new standards and regulations that allow for more modern maintenance methods.	At least 3 preliminary studies shall have been carried out on the potential of digitalisation for effective maintenance management (from measurement to execution and follow-up). At least one development project on logistics solutions. At least 2 demo projects on new condition measurement techniques or production methods. At least one project on standards and regulations linked to enabling implementation. This may be on analysing good examples.	New, more efficient methods and techniques for condition assessment are in use. Increased knowledge of an installation's condition and the development of its condition. Better decision support for planning operational and maintenance measures. Increased knowledge about requirements for an installation's operation and maintenance based on expected future changes in the climate or technology. More efficient maintenance planning thanks to developed condition indicators and forecasting and effect models. New, more efficient production methods are available.	New measurements/ indicators and measurement methods for monitoring an installation's condition have been implemented by both buyers and those performing the work. Project results regarding functional requirements are used by purchasers (the Swedish Transport Administration or local authorities). One or more new or further developed production methods based on digitalisation and/or automation have been demonstrated. One or more new or further developed tools for maintenance planning and follow-up have been demonstrated.	*InfraSweden2030 has clearly contributed to innovative technological solutions and efficient planning and follow-up tools based on modern digitalisation technologies such as Big Data, IoT and AI having contributed to proactive, sustainable and productive maintenance. With many new specialist companies in the field of condition assessment, operation and maintenance, a more dynamic market has been created.* ▪ 50% reduction in climate impact from operation and maintenance. ▪ 50% reduction in traffic disruption due to more efficient maintenance methods and fewer acute maintenance measures. ▪ 50% reduction in maintenance debt. ▪ At least 5 new specialist companies linked to the projects carried out in this area.

Increased competence and attractiveness

InfraSweden2030 's vision is dependent on the infrastructure sector being able to attract and develop skilled employees. Through this focus area, InfraSweden2030 wishes to support innovation projects that have a stated purpose of increasing competence and attractiveness.

RESULT TARGETS 2018-2021	MEASURABLE STAGE TARGETS 2021	DIRECT EFFECTS 2021-2024	MEASURABLE STAGE TARGETS 2024	EFFECT TARGETS AND MEASURABLE TARGETS 2030
Modern and innovative technology and tools. Technology and work processes to improve the working environment. Better knowledge and understanding in the transport infrastructure sector of the importance of creativity, innovation and change management. Multidisciplinary networks, meeting places and forms of collaboration. New forms of collaboration between purchaser/authority, contractor and academia. Working methods to promote diversity and equality and to attract young people and women into the transport infrastructure sector.	A number of projects specifically addressing the provision of competence and the attractiveness of the industry. Ongoing projects within InfraSweden2030 contribute to the result targets in this area.	An open and dynamic innovation arena in transport infrastructure. Increased investment in innovation and creative thinking in the transport infrastructure sector. Fun and creative environments that attract a range of competencies. Clean, modern and safe working environment adapted to the needs of individual employees. Stimulating working environment and organisation for effective work. Diversity and creative thinking among the various stakeholders in the sector. Smooth and workable generation changes.	Number of applicants with the right skills for advertised positions in the industry's companies. (Target: Increase of 25% from programme start to 2024). Application demand for social structure education and training. Increase of 30% from programme start to 2024. The number of employees with an M.Sc.in engineering or a research background at industrial companies in the sector (Target: Increase of 25% from programme start to 2024). The proportion of women in the transport infrastructure sector. (Target: Increase of 50% from programme start to 2024).	*InfraSweden2030 has clearly contributed to the transport infrastructure sector being regarded as open, dynamic and attractive, known for interesting and stimulating work.* ▪ Number of applicants with the right skills for advertised positions in the industry's companies. (Target: Increase of 50% from programme start to 2030). ▪ Application demand for social structure education and training. (Target: Increase of 50% from programme start to 2030). ▪ The number of employees with an M.Sc.in engineering or a research background at industrial companies in the sector (Target: Increase of 50% from programme start to 2030). ▪ The proportion of women in the transport infrastructure sector. (Target: Increase of 70% from programme start to 2030).

December 2018

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Med stöd från
VINNOVA Sveriges innovationsmyndighet
Energimyndigheten
FORMAS
Strategiska innovations-program