

Sweden Innovation Power



Agritechnica 2015

*“Sweden can play a pivotal role
having developed a favourable
innovation climate for decades.”*



Why innovation is necessary

Developments in agriculture since the 1950s are impressive. Satellite technology and aviation, for example, have become natural elements. At the same time the industry is facing increasing global challenges; challenges which cannot be met by improvements alone. The key is innovation.

Technical progress and productivity growth in agriculture since the 1950s is impressive. It should, however, be viewed in relation to rising global challenges. Production in the green sector has to increase even more to meet future demand for food, fibres and energy. At the same time, demands are being set for more sustainable agriculture. The individual farmer is looking for ways to increase profitability in a pressurised industry influenced by tough opinion, new customer behaviours, changed policies and more intensive international competition.

There are several paths to take to meet the challenges. Improvements, harder work and a greater distribution of effective solutions (imitation) are some examples, but they are not enough. The best future strategy is innovation. This is where Sweden can play a pivotal role because it has been developing a favourable climate for innovation for decades.



Sweden is teeming with innovation power. Väderstad is one of the best-known innovation companies in agriculture.

The Swedish ecosystem

The secret behind Sweden's innovation successes is collaboration between companies, institutes, advisory bodies and universities. Platforms for new contacts, dialogue and co-production of innovative processes play an important role as well. Some researchers talk about the green sector's ecosystem for innovation.

More and more innovative companies are participating in dynamic ecosystems for innovation in the green sector. Institutes play an important role in these ecosystems. One example is JTI – the Swedish Institute of Agricultural and Environmental

Engineering. This institute works broadly on issues relating to agriculture and agricultural engineering with a clear environmental and energy profile. Similarly, several of Sweden's academic institutions play an

important role in the systems, including the Swedish University of Agricultural Sciences and Linköping University.

The Rural economy and agricultural societies also play a major role in Sweden, as do independent advisory bodies such as Växa Sverige and Lovangruppen. Non-profit organisations are also crucial as catalysts.

Meeting-places and networks are central components. 'Green clusters' such as Vreta Kluster outside Linköping or Green Tech Park in Skara provide platforms for meetings and co-production. Elmia, one of the largest fair organisers in the Nordic region, helps to unite people and business concepts, and stimulates innovative development through its awards to innovative companies.



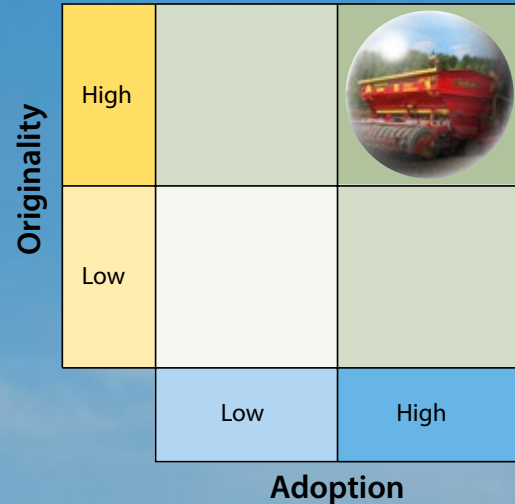
◀ Meetings have always been important for innovative processes. One historical milestone was the National Agricultural Meeting in 1959, which became the forerunner of Elmia Agriculture.

What does innovation mean?

The term innovation is related to revolution, but what does it actually mean? Many define it as the creation of new products (cf. Agritechnica's innovation awards). While it is correct that innovation requires new creation, that creation does not necessarily include physical products alone.

Moreover, innovation is about more than creating something new – although that is of course a great accomplishment. In reality the new creation must first gain ground, either through implementation or on the market. The latter means that promotion and customer demand are central aspects of innovation. Information channels and linking mechanisms such as the press, networks and meeting-places therefore play a crucial role.

In very simple terms, there are two dimensions to innovation: degree of originality, and degree of entry level, i.e. adoption/reception. ▶



“ The secret behind Sweden’s innovation successes is collaboration between companies and organisations.”

Swedish innovations are a driving force for future agriculture

A host of new machines, methods, concepts and services are on the verge of revolutionising agriculture – and Sweden is at the forefront in several areas. Companies like Väderstad, Ålö, Överum, Metsjö and Trelleborg are well known, but there are also other interesting Swedish examples.

Aerial vehicles in agriculture is an area that is gaining ground. Swedish fighter aircraft have the technology to x-ray land with interesting potential in agriculture. The Swedish company SmartPlanes manufactures unmanned aerial vehicles which have been successful in the USA, among other places. Thanks to IR cameras, for example, a system has been developed to analyse large geographical areas.

Another Swedish profile area is large-scale organic farming. Thanks to proactive farmers and advisors, Gothia Redskap's multi-machine System Cameleon has gained more and more ground. The machine's features include inter-row cultivation with extreme precision thanks to the camera control and stable carriers.

High strength steel is on the verge of casting aside old truths. SSAB has created constructions not previously thought possible in dialogue with machine manufacturers. For example, two Italian companies were able to develop

“ Several Swedish concepts are of interest to other countries in the fight to reduce consumption of energy from fossil fuels.

a new spray boom where the weight was halved, stability increased and production cost decreased by 25%.

Several Swedish concepts are of interest to other countries in the fight to reduce consumption of energy from fossil fuels. ED Biogas has created a compact, highly efficient new biogas reactor which enables farms to produce



Scania has a global reputation when it comes to energy-efficient engines that meet new environmental requirements. Metalfor from Argentina uses a Scania engine.



Energifabriken created a business model for fossil-free agriculture and has begun offering food from fossil-free production to the market.

fossil-free energy locally for their own use or for sale on the market. New business models for fossil-free agriculture are being developed and fossil-free food is being introduced on the market. A concept for running tractors on solar cells has been developed by inventor Kurt Hansson. Energy-efficient engines that are ready for a society non-dependent on oil are already being produced.

Some of the proactive Swedish companies and organisations that are helping to drive future agriculture are joining forces under the banner of Sweden Innovation Power. They will be attending the global Agritechnica exhibition in Hanover on 8-14 November 2015 in the Sweden Innovation Power pavilion (stand H03E18).

9 examples of Swedish innovation power

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1



System Cameleon – the solution for reducing chemicals in agriculture

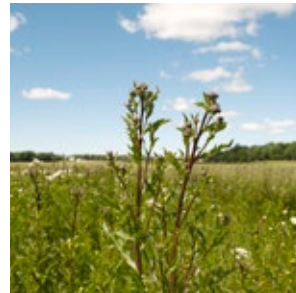
Controlling weeds and applying fertiliser is a major challenge

More and more consumers want to buy organic, which creates business potential for large-scale organic farming. At the same time, there are increasing demands on using fewer chemicals in conventional farming. The challenge for the farmer is to control weeds without chemicals, and optimise the effect of fertiliser which, particularly in organic farming, requires effective mineralisation.

A system to replace several machines and provide higher precision

System Cameleon is a sowing machine, but it is also much more. It is built in modules according to the customer's needs; for instance, it can be mounted at the front or towed behind a tractor. The modules include units for sowing-seed and fertiliser. Different types of cutters for hoeing combined with a system for following the rows creates flexibility and precision. The modules enable more field work to be carried out using the same machine. Since the system replaces several types of machines, farmers enjoy a higher – often double – work span compared to investing the same sum in a conventional machine fleet.

Powerful, precise cultivation is required to have an effect on root-weed. System Cameleon's seed coulters and hoeing cutters are therefore controlled using parallel arms and



1) Thistles and other weeds are the scourge of organic farmers. **2)** New modules are continuously being created for System Cameleon. The latest addition is rear-wheel control which makes hoeing easier on bends and sideways inclines.

wheels in a carrier. Thanks to the special carriers, the cutters run parallel to the ground surface and efficiently cut the roots. The carrier does not yield sideways, thereby allowing high lateral precision. This is the key to cultivating close to the crop row.

About Gothia Redskap

Gothia Redskap is a company that has turned conventional concepts on their head. It creates new opportunities, primarily to reduce the use of chemicals in agriculture. The company develops, produces and sells high-quality, user-friendly products to agriculturalists based on their needs.

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SmartPlanes' drones monitor crops

The challenge of gaining overview of large areas

Cost-effectively monitoring crops using unmanned aerial vehicles can have major advantages in terms of time management, information processing, and, above all, harvest outcomes. This is true of both grain and energy crops. The problem is that many of today's solutions are difficult to manage, unreliable and hard to use over large areas.

Aerial monitoring systems give a faster crop analysis

SmartPlanes' drones can cover large areas efficiently. They are an excellent tool for quickly gaining an overview of crops and for generating terrain development plans. The specialised cameras enable the user to carry out high-precision analysis of crops and detect mould and pests, for example. If the drone lands where it is hard to find, such as in a maize field, the special tracker system will directly guide the user to the exact location.

The human eye can only perceive certain wavelengths. A camera, however, is able to see far more. For example, near infrared (IR) cameras can be used to survey the quantity of chlorophyll in crops and other plants. A healthy plant reflects more chlorophyll than an unhealthy plant. The camera can also detect signs of stress, ripeness and overall development of the crop. In short: the analysis



1) Each part of a field has a unique nutrient and water profile but often there is no analysis available. **2)** SmartPlanes offers a system for monitoring large areas in the form of a turnkey solution. A complete package with adapted hardware and software for suppliers of field data and for end users in the green sector.

enables the user to target their efforts with high precision, which saves costs and results in bigger and better harvests.

About SmartPlanes

SmartPlanes offers high-quality unmanned aerial systems, UAS, for surveying areas, remote analysis and monitoring. These types of systems are also called Remotely Piloted Air Systems, RPAS. SmartPlanes' high-resolution cameras and sensors are easy to use and effective for aerial monitoring.

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The MR biogas reactor enables small-scale energy production

Energy supply challenges

Energy is a pivotal issue in agriculture. Farms need energy for vehicles, heating and electricity. Energy is expensive, not always eco-friendly and sometimes linked to political interests. Many dream of being able to produce their own energy. Biogas is an interesting solution, particularly for farms with large quantities of manure. Farmers who are interested in biogas, however, are often told that the gas has to be produced in large facilities at a long distance, which means expensive transportation and that the energy still has to be bought from others.

Small-scale, highly efficient energy production on the farm

The MR biogas reactor (methane reactor) overcomes several of these problems. Firstly, it is compact and ideal for small-scale energy production, which eliminates the need for distant, expensive transportation to and from central biogas facilities. Secondly, it is highly efficient – it combusts the substrate in half the time of conventional biogas facilities. Thirdly, the farmer gains a residual product in the form of a more stable fertiliser which is more readily absorbed by plants in the soil. All in all, MR is a profitable system solution. Installation is simple, operating costs are low and it can be controlled remotely.



1) Energy is a key factor for agriculture. Many want to reduce both costs and environmental impact. **2)** The new MR biogas reactor is an energy solution for farmers wanting to produce their own energy in an eco-friendly way. The picture shows installation using a crane.

About ED Biogas

ED Biogas comprises a number of companies with specialist knowledge of smart energy solutions. By bringing together advanced expertise in technical design, manufacturing, project management and construction, ED Biogas can deliver energy solutions adapted to customer conditions.

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4

SSAB

Strenx and Hardox – lighter agricultural constructions



1) Soil compacting can be a major problem for farmers. Many would like to see lighter machinery and equipment. **2)** High strength steel means new types of construction that are both stronger and lighter.

Heavy constructions – a challenge in agriculture

The use of steel in agricultural machinery has remained unchanged for several years, but there is a real need for lighter agricultural machines that are more fuel-efficient, robust and reliable. To solve the problem of heavy or weak constructions and increase safety, new steel grades and new construction ideas are urgently required.

High strength construction steel offers many benefits

SSAB's high strength construction steels Strenx and Hardox are two steel solutions that take a new approach

to construction. Extra high strength steel (EHSS) can be used to manufacture machines that are considerably lighter, stronger and safer than previous constructions.

Light steel constructions are an important factor in developing agricultural machines with low soil compaction. They also help reduce fuel consumption.

Many years' experience and knowledge from other industrial segments, such as the automotive industry, have helped make optimal use of EHSS. For instance, welding is avoided. Instead the constructions are bent, moulded and bolted or riveted together. This eliminates problems with fatigue, reduces the thickness of the material and increases strength. The technique helps reduce the weight of the end product while increasing the construction's strength and life span.

About SSAB

SSAB is a highly specialised global steel company. It is a market leader in advanced high strength steels (AHSS), quenched and tempered steels (Q&T), strip, plate and tubular products, as well as construction solutions.

SSAB's production units in Sweden, Finland and the USA have an annual steel production capacity of 8.8 million tonnes.

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JTI – Swedish Institute of Agricultural and Environmental Engineering

JTI drives future agricultural and environmental engineering

High demands on future agrarian production methods

In the future agriculture needs to produce milk, meat and grains in a competitive way, and the competitive pressure is increasing. At the same time production must use methods that are economical with energy and natural resources. Furthermore, it must focus on a good working environment and animal health. Future agriculture must also adapt to anticipated climate changes.

Technological development and smart methods

JTI – Swedish Institute of Agricultural and Environmental Engineering, works with the demands and challenges faced by agriculture. It focuses on technical development and method development in the fields of agriculture, energy and the environment. For example, in one successful project the institute successfully applied the Lean industrial method to dairy, grain and pig farms to increase time efficiency. RFID technology is being developed to increase the traceability of agricultural products.

When it comes to farming, JTI has developed technology for combined chemical and mechanical plant protection, and has designed the CombCut* weed cutter in partnership with a farmer. Intensive work is under way to help increase the production of domestic sources of protein (soya, field beans). Storage

* In collaboration with Jonas Carlsson, a Swedish organic farmer.



- 1) JTI's innovations respond to needs and challenges in agriculture.
- 2) CombCut was voted Sweden's Rural Innovation 2012.

methods are being developed for grains to cope with warmer, damper climates. Electric tractors and electric hybrid vehicles are being evaluated ahead of a changeover to fossil-free agriculture.

About JTI

JTI – Swedish Institute of Agricultural and Environmental Engineering, is an industrial research institute with a focus on agriculture, the environment and energy. It is part of the SP Group, Sweden's largest and broadest technical research group. By applying research and innovation work in close collaboration with companies, organisations and authorities, JTI helps to improve industry's competitiveness.

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Vreta Kluster – a green workshop for growth

Tough challenges in the raw materials segment

Companies in the raw materials segment of the agricultural value chain often struggle with several challenges. Low margins are one such challenge. These companies may be very small and have little time for development work.

Efficiency and streamlining are needed to increase profitability. Alternatively, revenue can be increased through a raised refinement value, new business models or new areas of production. Perceptions and attraction need to be improved by an updated image in the social debate of the reality facing green companies.

Development arena and catalyst for business leaders

Vreta Kluster offers a creative development arena for innovation systems in green industries. An innovation leader co-ordinates support for applied technical progress and business development. Vreta Kluster is a catalyst that drives networks and organises meeting-places and events. Business leaders can meet to discuss common tricky problems. A platform is offered for contacts with research and other industries. Workshops generate ideas into development projects based on concrete needs. The ideas are carefully followed up and the process is supported all the way until the idea is realised, including ways of funding.

About Vreta Kluster

Vreta Kluster is a regional development arena with an international perspective that focuses on technical progress and business development in the green sector. Since it began in 2011, approximately 30 companies have moved into the business park and 20,000 people have participated in meetings which, in several cases, have created great value, for example by generating new projects.



1) There are many promising small companies in the green sector, such as VicVision. This and other smart companies realise that they are not strong enough on their own. **2)** Vreta Kluster offers an arena where companies interested in technical progress and business development can gain valuable capacity reinforcement.

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Elmia –where people and ideas meet

The importance of face-to-face meetings

Business is very much about trust, and trust is something that is built in meetings between individuals. Technological progress and the emergence of more digital solutions make face-to-face meetings more essential than ever. Globalisation and tougher competition are additional factors that increase the importance of the personal meeting place.

Companies need to create confidence-inspiring business, build networks and create new opportunities. There are an increasing number of sources for innovation, development and trends. There is also an increasing need to gain a quick overview of developments and what is being offered in the industry.

A proactive, knowledgeable meeting-place

As a fair organiser, Elmia is in a proactive position – among people and companies that either have or are looking for new ideas, products or services within agriculture. The fair is an arena for contacts, creating ideas and acquiring new knowledge. A generator that inspires, stimulates and drives development and innovative power in the green sector.

Elmia is further developing its hosting platform at Elmia Lantbruk on October 19-21, 2016. An arena

will be created where the agriculture of the future is shaped and where politicians, decision-makers and opinion-leaders will be given more space. The meeting place will have a broader dimension.

About Elmia

For over half a century Elmia has, through a progressive approach, been generating the most important meeting places for a host of industries including agriculture, forestry and the subcontractor industry. Major fairs like Elmia Wood and Elmia Subcontractor are arenas where ideas and innovations can be tested and distributed.



1) The individual farmer is often in need of a meeting forum. **2)** Elmia's fairs are a generator that inspires and drives development forward.

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Grönovation – cutting edge innovation research

The new knowledge requirement

The green sectors and their support businesses constantly require new knowledge about areas such as sowing-seeds, cultivation methods, machinery and grain management. That has always been the case. As the green sector's need for more radical renewal increases, so does the need to understand marketing, business development and how innovative processes work and can be stimulated.

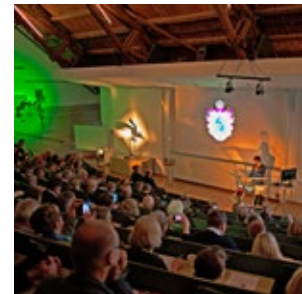
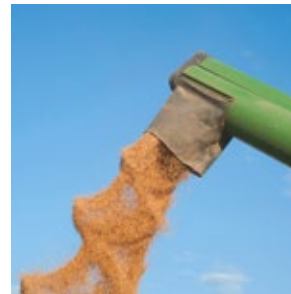
Knowledge of innovative processes

The Grönovation (green innovation) project is a platform for knowledge development and value creation. Here, knowledge about the resistance and barriers met by innovative processes is honed. The primary area of scrutiny is how innovations arise, gain distribution and can be stimulated. The project's sights are set on developing first-class knowledge in terms of business development and innovation within the green sectors. The methods include case studies, surveys and experiments.

One example of the results is a visual descriptive language for depicting innovative processes, also including movies. Another example is the innovation cube, which helps companies and researchers define innovations based on three dimensions. In collaboration with 3M and SMHI, the researchers have also developed a method for collecting views and ideas from potential users on prototypes or newly launched products.

About Grönovation

Grönovation is a research project at Linköping University, supported by Vinnova. Partners include 3M Sweden, Biototal, Cre8it, Elmia, Energy Developer - ED, Hushållningssällskapet – Swedish Rural Economy and Agricultural Societies in Östergötland County, JTI – Swedish Institute of Agricultural and Environmental Engineering, Lantmännen R&D, Lovanggruppen, Region Östergötland, Swedish University of Agricultural Sciences, SLU Holding, SSAB, Svenska Mätanalys, Tolefors Gård, VicVision and Vreta Kluster.



1) How can we produce more and better food in the future without sacrificing the natural environment? 2) A dialogue between the academic and practical world is a hallmark of Grönovation. The photograph shows H.R.H. Prince Carl Philip of Sweden who opened Agriculture Innovation Day 2014 with 200 people from the academic and practical worlds.

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Torpa Gård – bespoke mini fairs

Major need for product demos and testing platforms

Many companies want to demonstrate their products to their customer group. They want to let customers test and touch the company's machines and products, but they have difficulty finding facilities that can fully meet their requirements.

Fair structure with an opportunity to test the products

Torpa Gård Conferences & Events helps companies organise their own fairs, product demonstrations or tests. By organising their own fair, a company can enable its customers to test and examine its products in a personal and undisturbed environment. Torpa Gård tailors events to meet the customers' exact needs, whether they want to display small hand-held devices or large agricultural machines. Accommodation, food and activities can also be arranged depending on the customers' wishes and requirements.


About Torpa Gård Conferences & Events

Torpa Gård is a full-scale conference and event facility with a hotel, restaurant and activity park. The facilities include a 1,500 m² exhibition hall, and an outdoor area comprising 100 hectares of arable land and 60 hectares of forest. Torpa Gård also has its own gravel pit, motor-racing track and all-terrain vehicle track. The company works with a clear environmental profile.



1) Brochures and information in digital channels can provide a lot of information. But many want to try a product in practice. **2)** Torpa Gård offers mini fairs where companies can demonstrate their products in reality.

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A close-up, low-angle shot of a green John Deere tractor in a field of tall, dry grass. The tractor is the central focus, with its headlights and grille clearly visible. The John Deere logo is on the grille. The background is a clear, bright blue sky. The overall scene is bright and sunny.

A tractor of today is not primarily a physical product. It is a service package wrapped in digital technology.

“ The fourth agrarian revolution is characterised by sensor and satellite-based precision, high-tech construction materials and digital technology.

The dawn of the fourth revolution

Agrarian development can be divided into four revolutions. Thanks to the favourable Swedish innovation system, many Swedish companies act as drivers in the ongoing fourth revolution.

The Swedish innovations in the green sector presented here are just a selection, but they give an idea of the change and renewal currently under way in agriculture. They are part of a more general wave of change that can be observed from a historical perspective.

The first agrarian revolution was the transition to the agricultural society 10,000 years ago (6,000 years ago in Northern Europe). The next revolution was the expansion in the 18th century through land reforms, drainage and crop rotation, as well as horse-drawn iron ploughs and sowing machines. The third was the mechanisation in the wake of electricity and the tractor which heralded, among other things, milking machines, combine harvesters and grain elevators – and later on everything from reversible ploughs to the concept of ensilage.

Now the fourth agrarian revolution has begun. It is characterised by sensor and satellite-based precision, high-tech construction materials and digital technology. It is also driven by international hyper-competition. Other hallmarks are servicification, advanced communication, working environment optimisation, niches and new business models.

One sign of that something big is happening is the debate in the USA surrounding John Deere in 2015. The company said that customers who bought a John Deere



The third agrarian revolution laid the foundation for outstanding social development. Illustrated here with Ferguson's tractor with three-link suspension at the Science Museum in London.

were not buying a tractor, but the right and opportunity to use tractor power and its peripheral services for a particular amount of time. Or in the words of Darin Bartholomew (of Global Intellectual Property Services, Deere & Company): the farmer receives “an implied licence for the life of the vehicle to operate the vehicle”. This reflects servicification.

The sustainability perspective in particular is central. From having been viewed as just one industry among many – and an industry on the decline – agriculture has come to be regarded as a central component of the entire social system. One key concept is bioeconomy. It is interesting to note that agriculture, unlike many other industries, can make a net contribution to nature, the environment and climate. But innovation is required to optimise it.

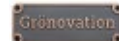
“Sweden is teeming with innovation power.”



SWEDEN
INNOVATION POWER



JTI – Swedish Institute of Agricultural
and Environmental Engineering



Sources: Diagram (page 3): P. Frankelius, Innovationsbegreppet och innovationsindikatorer – En analys med tonvikt på statistikens validitet [The concept of innovation and innovation indicators – An analysis with an emphasis on the validity of statistics] (Linköping: Linköping University, 2015). Quote from John Deere: D. Bartholomew, Long Comment regarding a Proposed Exception under 17 U.S.C. 1201. Open letter dated 12 December 2014 (http://copyright.gov/1201/2015/comments-032715/class%2021/John_Deere_Class21_1201_2014.pdf, downloaded 24 September 2015). **Photo sources:** Front page: cjp, p.2: urbancow, p. 3: Grönovation, p. 5: Large picture and model: Grönovation, p. 7: Left: Scania. Right: Grönovation, p. 8: Elmia AB, p. 9: Left: Grönovation. Right: Gothia Redskap AB, p. 10: Left: Grönovation. Right: SmartPlanes AB, p. 11: Left: Grönovation. Right: ED Biogas AB, p. 12: SSAB, p. 13: JTI, p. 14: Grönovation, p. 15: Elmia AB, p. 16: Grönovation, p. 17: Left: Case IH. Right: Torpa Gård, p. 18: Grönovation, p. 19: Grönovation. **Publishers:** Elmia AB and Grönovation. **Authors:** Elina Lejon and Per Frankelius with the support of the participating companies and organisations. Special thanks to Christer Svensson and Charlotte Norrman, both at Linköping University. © Elmia and Grönovation at Linköping University 2015.

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