

Lightweight solutions strengthen Swedish competitiveness and growth

– for a more sustainable world 🌍

LIGHTer

A national cross-industry lightweight arena

LIGHTer creates an effective structure for the development of technologies, test environments and individuals. We are an arena for collaboration between companies, research institutes, academia, trade associations, municipalities, regions and authorities. Our aim is to effectively create competitiveness for Swedish industry – while contributing to a more sustainable world. LIGHTer consists of two main parts: The Strategic Innovation Programme (SIP) Lightweight and the LIGHTer Membership Programme.

SIP Lightweight

Strategic Innovation Programme (SIP) Lightweight

LIGHTer has been entrusted with leading and developing the Strategic Innovation Programme Lightweight. In spring 2013 Vinnova, the Swedish Energy Agency and the Swedish Research Council (Formas) established the first five strategic innovation programmes, of which Lightweight was one. 17 programmes have been set up in total. The motive behind our programme is to make lightweight technology one of Sweden's industrial areas of strength.

The Strategic Innovation Programme Lightweight is a long-term investment that builds upon the Lightweight Strategic Research and Innovation Agenda. Stage 3 runs from 2020 to 2022.

A unique and cross-industry meeting place

The greatest challenge is still to go from innovation as a thought, to research where we can test the concept, then on to industrial development and finally industry-relevant application development. Therefore, LIGHTer is needed.

KAJ FREDIN

Volvo Car Group
Chair of LIGHTer 2019

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Third Agenda: Lightweight is more important than ever

In producing this third Lightweight Agenda, LIGHTer has the benefit of six years of experience in the role as the hub for Sweden's development in the lightweight field. The unanimous view of the board of LIGHTer, the agenda's working group and the management team is that we are constantly discovering new evidence of the significance of national coordination and how our unique cross-industry initiative leads to new insights and constructive collaborations. This is also acknowledged on an international level.

It is particularly pleasing when a small company with the help of LIGHTer manages to find the path to expansion and volume production. Besides, when this occurs in cooperation with one of Sweden's global manufacturing companies, it is the ultimate proof that the combined efforts of everyone to create new collaborations, collaborative structures and meeting places work.

When we critically evaluate the role of LIGHTer in the perspective of today's mega trends, we ask ourselves whether lightweight

still has an equally important role in strengthening the competitiveness of Swedish industry on a global market. Is it simply the case that electrification, artificial intelligence technology and the growing awareness of sustainability and the development of multifunctional materials per se can create answers to the question of how we mitigate the climate threat? Is the lightweight perspective actually marginalised in terms of reducing carbon emissions?

No matter how we twist and turn the question, the answer is: lightweight is more important than ever! All the possibilities of the mega trends, together with increased demands, really only mean that the exchange of a structured and coordinated lightweight development has even greater sustainability effects. As a nation, we have every opportunity to take a leading role in that work. In several areas we now see core competencies emerge thanks to the deeper collaboration between companies, research institutes and academia on several levels. At the same time, we see the inclusion of more industries.

Read about how selected mega trends impact on lightweight development

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The life-cycle perspective has become a prerequisite

Sweden is a small country and we see major initiatives being announced outside the country's borders. As a result we need to use all our funds very efficiently. LIGHTer is a way to do this.



MALIN ÅKERMO
LIGHTer Academy
Professor at KTH Royal Institute of Technology



Volvo Trucks' combined development of lighter truck components and larger cargo spaces have resulted in reduced carbon dioxide emissions and lower fuel costs. This increases competitiveness.

Image: Volvo Trucks

LIGHTWEIGHT SOLUTIONS in a life cycle perspective

Our national lightweight agenda is structured around the need for Swedish industries to develop lighter products. And the need only gets bigger.

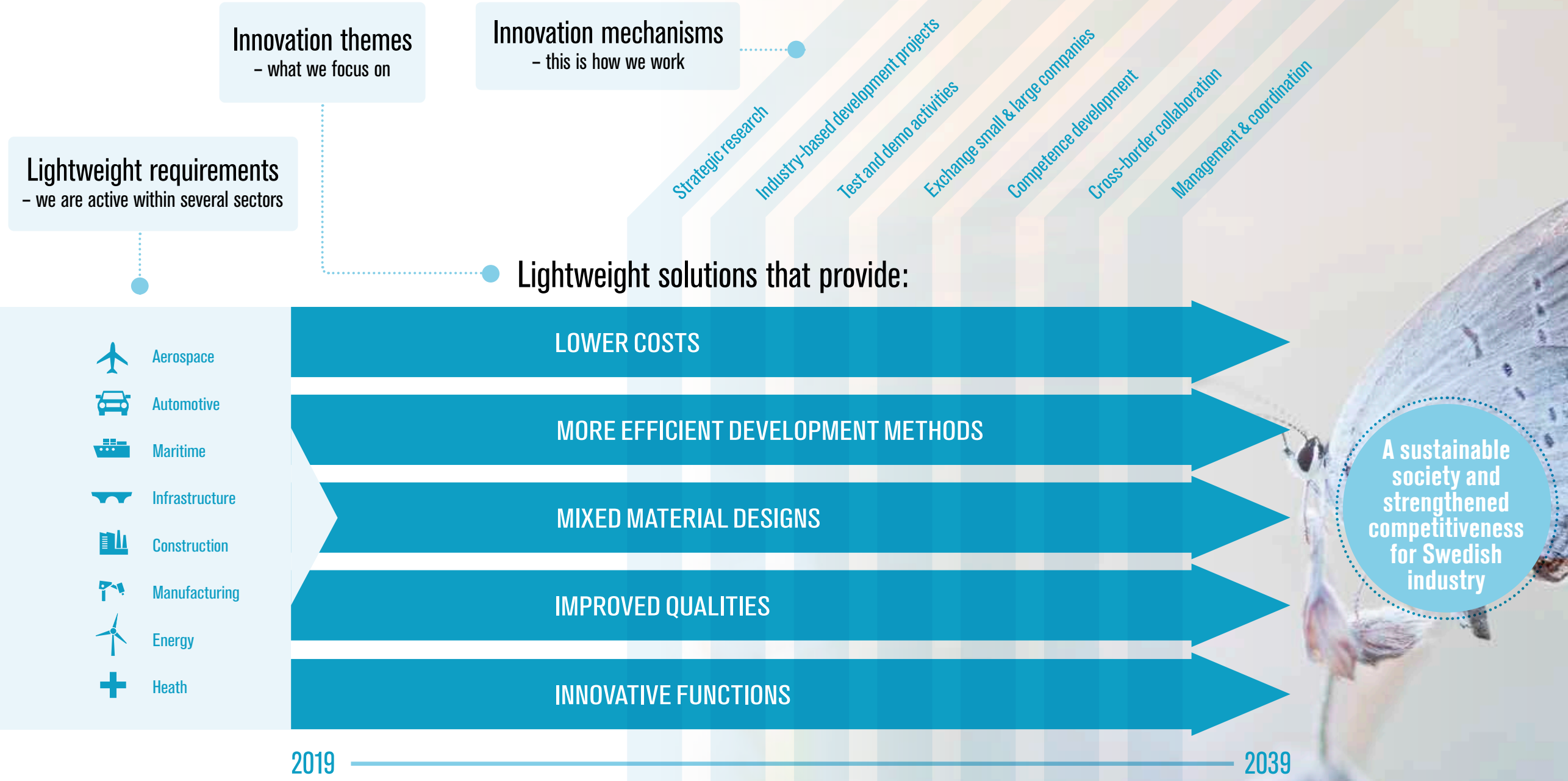
The four mega trends electromobility, multifunctionality, artificial intelligence and sustainability contribute with additional perspectives in this third version of the agenda. Overall strategy from a lifecycle perspective is increasingly central to the development of new solutions, to create a more sustainable society and to strengthen the competitiveness of Swedish industry on a global market.

After our analyses we have chosen to clarify and supplement our previous four innovation themes with a fifth: Lightweight solutions through innovative functions. The aim is to give further prominence to the need to create pre-requisites for lightweight projects with high potential that can really result in radically lighter solutions.

Through our five innovation themes we describe what needs to be done and how we continue to link together, but also demarcate projects and research areas, so that we work diligently towards our goals. As might be expected, a single project can contribute towards development within several themes.

Our seven innovation mechanisms determine how we work to achieve success. The mechanisms are trimmed and developed continuously, as we acquire a growing understanding of working with lightweight issues. Together, these innovation mechanisms boost Lightweight Sweden and create better sustainability, competitiveness and growth.

Lightweight requirements are critical in a number of competitive sectors and are simultaneously representative of corresponding needs in a range of other activities.



5 INNOVATION THEMES with focus on our goals



LOWER COSTS

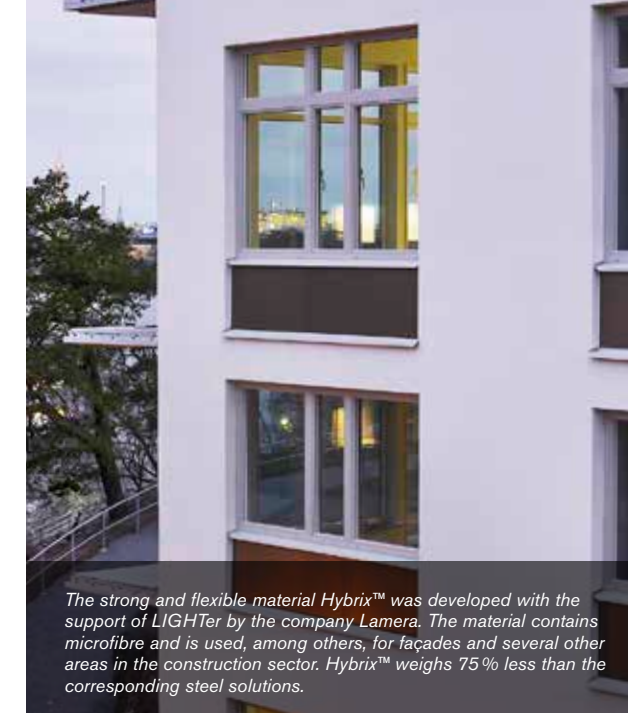
► We have long known that we can develop more sustainable and at the same time lighter components. The challenge is to find the design and production solutions that make every innovation attractive to use even from a cost standpoint. It does not matter whether it concerns photovoltaic solar panels or automotive components, or if the company is called IKEA or Volvo.

► If, for example, cast iron cannot be replaced by a composite in a profitable way, the improvement never reaches the market, no matter how climate smart it is. The general opinion within the aerospace industry is that every kilogram of reduced weight is worth about SEK 10,000 during the lifespan of an aircraft, in the form of, among others, reduced fuel consumption. It is therefore also the level that must be taken into account when it comes to possible increased production costs for lighter solutions.

MORE EFFICIENT DEVELOPMENT METHODS

► The investment in LIGHTer Product Optimisation with the help of virtual solutions has turned out well. The network is an industrial initiative to boost the industry's ability to use optimisation methods early in product development. Optimisation methods are particularly suitable for new technologies, such as additive manufacturing, in industries with high quality requirements and short product development times.

► The demands for even shorter and more predictable time schedules continue to increase on all global markets. Therefore, we need to further develop safer and faster ways to verify new technologies and development methods, prior to introduction into a business project.



The strong and flexible material Hybrix™ was developed with the support of LIGHTer by the company Lamera. The material contains microfibre and is used, among others, for façades and several other areas in the construction sector. Hybrix™ weighs 75% less than the corresponding steel solutions.

MIXED MATERIAL DESIGNS

► We are the world leader within steel, but Sweden must strive for a leading position for the use of mixed materials too, for example, with steel and fibre composite. The durability and functionality of various materials and joints in different climates and temperatures must be ensured, while reducing weight.

► In addition to material knowledge and developed joining methods, it also places increased demands on a broader competence in joint calculations. Today we see successful outcomes with sandwich materials that meet the demands of durability, lighter weight and the possibility of mass production at a reasonable cost. In parallel, effective recycling methods must be developed that make mixed materials fully sustainable.



The Neptuni Bridge in Malmö, built using fibre composite, is Sweden's first self-supporting lightweight bridge. It replaced an old railway bridge and the solution entailed minimal damage to the aquatic environment and existing quayside. Through the LIGHTer project FALCON, the city of Malmö received help from RISE SICOMP and Chalmers with calculations and requirements specifications.

IMPROVED PROPERTIES

► Side by side with the development of multi-functional materials, it is important to continue improving material properties through continuous enhancements.

► The gradual analysis and development of new materials result in components and products becoming stronger, having increased rigidity or lower density, for example. Improved properties not only mean functional advantages, but can also reduce the sustainability impact through lighter shipments and reduced material consumption.



Juteborg AB has with LIGHTer's help developed the mini car JuteBee, which has a body built of jute fibre. By intertwining the textile and automotive industries in new consortiums, the initiators meet the demand for more sustainable materials.

INNOVATIVE FUNCTIONS

► The innovation theme, Innovative functions, has been added to this third Lightweight Agenda with the ambition to clearly stimulate completely new approaches and dare to test ideas that are judged to be a high risk. Within LIGHTer we prefer the concept high potential and by developing more funding models that provide long-term conditions to think in new ways and try radical ideas, we also hope to establish more projects in the category.

► Multifunctionality is when two or more functions are integrated in a component or material and is one way of achieving innovative functions. One example is the area of structural batteries where LIGHTer Academy is a partner.

7 INNOVATION MECHANISMS for national success



INDUSTRY-BASED DEVELOPMENT PROJECTS

- ▶ LIGHTer's ambition is to strengthen several industries and supplier levels at the same time. Thus we have an annual call for innovation projects with two specialisations. We work both in projects whose results can be implemented within five years from completion of the project, as well as in more visionary projects at lower technology maturity levels.
- ▶ It's always the industrial needs that drive our projects forward. Through stimulating and finding the keys for this type of collaboration, we know from experience that we attain positive results.



STRATEGIC RESEARCH

- ▶ LIGHTer has created, and intends to continue to create, new structures for strategic Swedish research. LIGHTer Academy and LIGHTer PhD Network are good examples of initiatives that contribute to industry, university and interdisciplinary collaborative research.
- ▶ From working in parallel and competing for resources, we now see how KTH and Chalmers¹⁾ collaborate and, among others, have taken major steps in the research into carbon fibre that can store energy. This has been made possible by the LIGHTer Academy and was judged by Physics World to be one of the ten most significant scientific contributions in 2018.

1) KTH Royal Institute of Technology and Chalmers University of Technology

COMPETENCE DEVELOPMENT

- ▶ Through continuing to develop a forum for skills exchange and education, we see how the awareness of the role of lightweight in competitiveness is steadily increasing. LIGHTer reaches a broad target group through a combination of our web-based courses, seminars and workshops as well as our growing doctoral network PhD network.
- ▶ With a multidisciplinary approach, we complement the industry's own training and also strengthen awareness of the need to collaborate. Here, of course, our regional nodes also play an important role in creating new skills development structures.

TEST AND DEMO ACTIVITIES

- ▶ One focus area in the years to come is to work to create more test and demo activities for small businesses. We must continue to increase availability, minimise risks to the business and to create synergy across the entire value chain and between various industries.
- ▶ One path to a stronger test and demo infrastructure with more facilities can be an increased interplay between several Strategic Innovation programmes, but it is only part of a possible solution. Here we need to create stronger national coordination to literally create more space for Swedish lightweight development. LIGHTer has conducted several pilot projects with good results.

CROSS-BORDER COLLABORATION

- ▶ The interplay between regional, national and global levels is one of LIGHTer's many success factors. Today, we can point to several concrete examples where new research collaborations have culminated in new insights, radical research results and advanced excellence.
- ▶ We constantly strive for solid collaboration with public financiers, industry-specific organisations and other strategic innovation programmes to create even more resources for lightweight projects. The great interest in our international lightweight conference shows that LIGHTer has established itself as a major player in Europe.

EXCHANGE SMALL & LARGE COMPANIES

- ▶ How would the optimum meeting place be structured to find the interplay between small technology oriented companies and Sweden's major global manufacturing industries? This is definitely a key issue that as a nation we need to find a variety of good answers to.
- ▶ Involving suppliers in ongoing development projects with concrete assignments at an early stage, mitigates the step to a volume order and the ability to invest time and resources increases for more small and medium sized companies. This is an important parameter for success. LIGHTer's regional nodes are a way to create more meeting places and this kind of development work will continue.

MANAGEMENT & COORDINATION

- ▶ The ability to coordinate financial resources and the roles of cross-industry parties is an important prerequisite for creating steadfastness and a clear direction in research and development projects.
- ▶ We have built up a great trust in our role as a hub over the years. Our main driving force is that Sweden and each individual organisation should get the most out of the available resources. Our overall management function, combined with individual project managers within industry, academia or institutes, allows us to create opportunities together.

LIGHTWEIGHT INNOVATION from idea to industrialisation

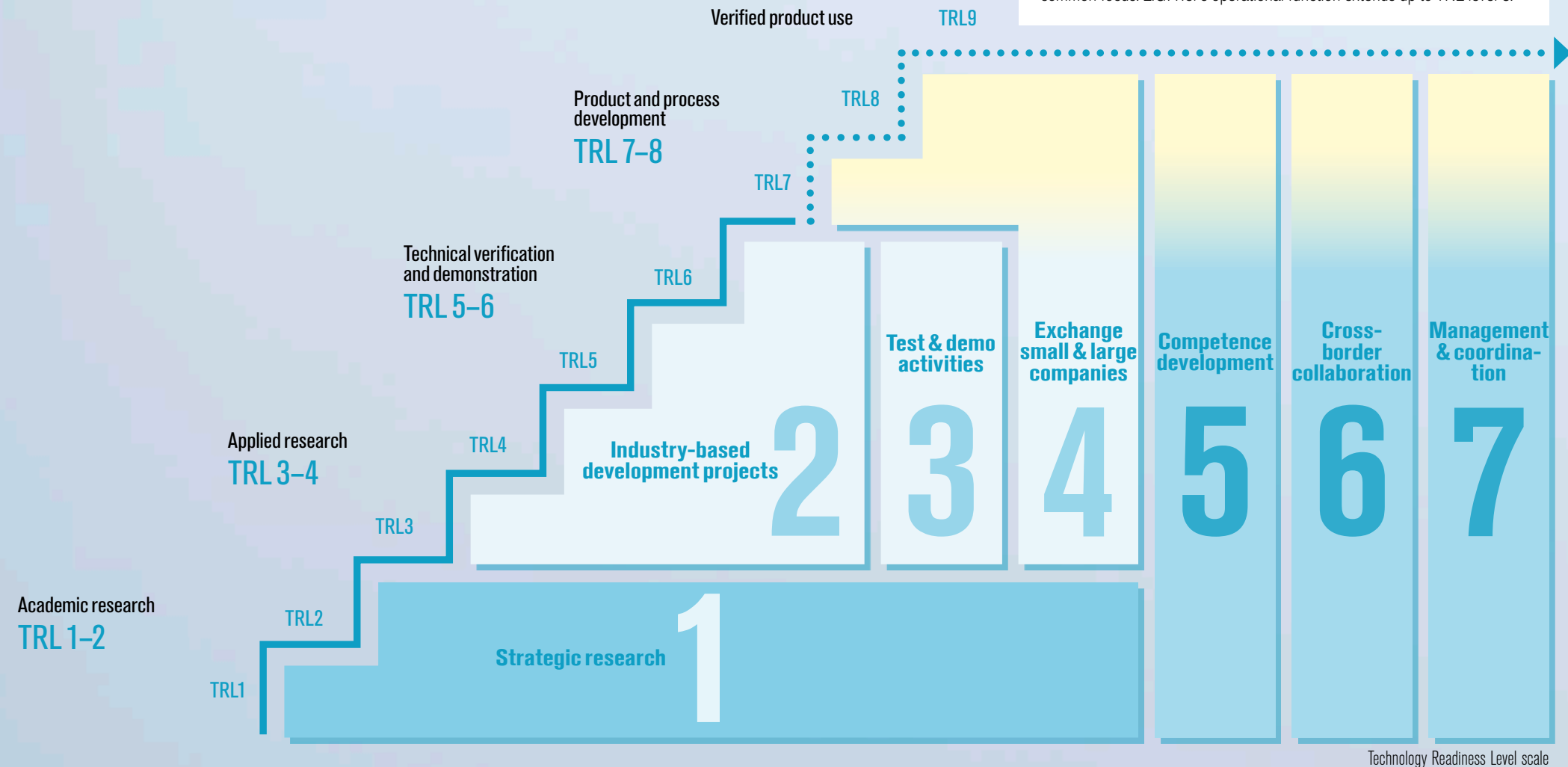
In order to succeed on a global market, Sweden must now increase the tempo of the work to strengthen the entire TRL scale, starting from our seven innovation mechanisms.

An enhanced Technology Readiness Level (TRL) scale, which demonstrates, based on the maturity of technology, how we take the processes further, creates the prerequisites for new technology to be fully tested in order to be industrialised and launched on the market. This is still the biggest challenge, but with the help of our two previous Lightweight Agendas released in 2013 and 2016, we have taken important steps forward.

Recommendations Lightweight Agenda 2020–2022

- An even clearer **lifecycle perspective** that permeates the lightweight development. By continuing to refine and use our sustainability tools along the entire TRL scale we ensure that the developed solutions also meet the UN's sustainability goals.
- More **multidisciplinary research and development projects** to produce solutions that give radically lower weight. This requires more and more sustained funding that creates the conditions for larger and broader research groups.
- A **coordinated national approach** to create a stronger test and demo infrastructure with more facilities in the interplay between several Strategic Innovation Programmes (SIP) and other key stakeholders.
- To strengthen the entire value chain by **improving the conditions for small and medium-sized companies** to collaborate with large stakeholders. Opportunities to finance work in later parts of development projects are a key.

LIGHTer creates an effective structure for the development of technologies, test environments and individuals. By linking the Lightweight Agenda's seven innovation mechanisms to the different stages of the TRL scale, we want to clarify the need for interaction at all levels and create a common focus. LIGHTer's operational function extends up to TRL level 6.



Technology Readiness Level scale

VISION OF THE LIGHTWEIGHT AGENDA

Lightweight strengthens Swedish competitiveness and growth for a more sustainable world.

Based on the vision, the Lightweight Agenda should result in tangible results and strengthen the competitiveness of the Swedish manufacturing industry on an international market. The agenda's impact goals in Sustainability, Growth and Efficiency indicate a clear direction. The goals are to be followed up through key indicators, which help us to measure the effects of LIGHTer as cross-industry arena.

THE IMPACT GOALS OF THE LIGHTWEIGHT AGENDA

Sustainability

Swedish lightweight products and services reach end customers.

- Swedish industry meets or exceeds national and international environmental targets linked to lightweight solutions.
- Thanks to world-class expertise within lightweight solutions, Sweden has a strong international profile when it comes to energy and the environment.

Growth

Swedish lightweight solutions create growth in the economy.

- Swedish exports, which are the result of lightweight development, are increasing annually.
- The number of Swedish small and medium-sized companies in lightweight technology that are being developed to export on a global market is increasing.
- The number of engineers and researchers with degrees in lightweight technologies is increasing annually.

Efficiency

Creative structures for research give a greater return per krona invested.

- The percentage of Sweden's lightweight innovations, based on cross-industry technological development, is increasing annually.
- The collaboration within lightweight is increasing annually, both between industry and academia/institutes as well as between different research partners.

- More than 75% of the lightweight materials and technologies included in LIGHTer's industrial development projects are industrialised.

The world meets major societal challenges

The UN's global goals are the most ambitious agenda for sustainable development that the world's countries have ever adopted – and something we all have to relate to. Solving the climate crisis is one of the goals, where lightweight plays an obvious role. Both national and international guidelines are increasing.

Following on from the sustainability goals, Sweden is working on 16 environmental quality goals which give structure to the country's environmental work. Lightweight development directly affects several of these goals and in recent years Swedish industry has focused on digitalisation, sustainable production, provision of skills and test environments.

At the end of 2016, the Paris Agreement, UN's framework convention on climate change, also came into force. The increase in global temperature must be kept well below 2°C and we must work for it to stop at 1.5°C.

The Juncker Commission has also positioned both energy efficiency and circular economy as key areas within its ten political priorities for the European Union. For industries such as automotive and aerospace, the EU has set high environmental goals.



For example, the average emissions for new cars may not exceed 95g CO₂/km from 2021.

Flightpath 2050 is Europe's vision for the aerospace industry and includes goals which seek to achieve a 75% reduction in carbon dioxide emissions per passenger-kilometre and 90% reductions in nitrogen oxide emissions.

The European Road Transport Research Advisory (ERTRAC) has established goals that aim to achieve a 40% reduction of carbon dioxide emissions per tonne of load per kilometre by 2030 compared with levels in 2010.

In the Swedish Maritime's climate roadmap, the goal is to reduce carbon dioxide emissions per transport work by 30% until 2030, compared to 2010. The aim is to achieve zero emissions of carbon-dioxide and other harmful substances in 2050.

1.5°C TEMPERATURE GOAL
The Paris agreement

40% LOWER CARBON EMISSIONS
European Road Transport Research Advisory Council

95g CO₂/KM MAXIMUM LIMIT
EC 2009 European Parliament



Therefore, Swedish exports depend on lightweight

Within several industries, companies are fast approaching deadlines for global environmental requirements, which means that lighter products will very soon become imperative in order to remain on the market.

For the transport industry, the benefits of lower weight and energy savings have long been evident. Today, this also concerns a number of other industries, such as the energy sector with its wind turbines and insulators; the construction and infrastructure sectors with their pre-designed building elements and reinforcement materials; the manufacturing industry with its tools and robots; and the medical industry with its prosthetics and other aids.

LIGHTer estimates that at least half of Sweden's exports¹⁾ depend on the development of lightweight solutions as sectors such as transport, electronics, machinery, iron and steel, metal, forestry, wheel chairs and furniture already use lightweight technologies to gain a competitive edge or have niches with growth potential. In the same way, we can look at Sweden's largest companies according to turnover²⁾ and determine that six of the ten largest companies have a lightweight connection.

1) SCB: Exports for important goods areas according to SITC
2) largestcompanies.se: The largest companies according to turnover in Sweden
3) The Swedish Welding Commission (Svetskommissionen), Roadmap 2015
4) largestcompanies.se: The largest employers in total in Sweden

Sweden's GDP is also dependent on high levels of specialisation within the country's manufacturing industry. A whole 30% of the country's GDP relates to welding or products that are in some way joined together³⁾ – a domain that is directly influenced by new advanced lightweight technologies.

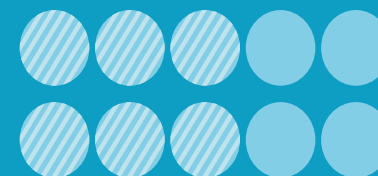
The value of lightweight is also high when viewed from an employment perspective. Of the twenty largest industrial employers, 40% include lightweight⁴⁾ as one of their key focus areas. In other words, Sweden's investments in lightweight technology are absolutely crucial if the country is to reach its sustainability goals, strengthen its competitiveness and create jobs on home turf.

The value of lightweight is also high when viewed from an employment perspective.

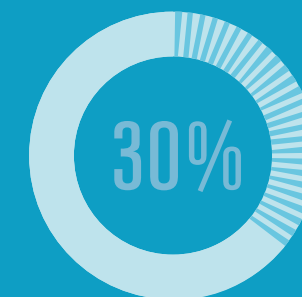
The industrial lightweight business



50% of Sweden's exports are estimated to be dependent on lightweight according to LIGHTer's assessment




6 of Sweden's 10 largest companies according to turnover have a lightweight connection



30% of Sweden's GDP stems from welding and welded products



4 out of Sweden's 10 largest employers have lightweight as one of their key focus areas



The automotive industry is facing a huge technological change and electromobility is making the saving of weight more significant. Swedish suppliers are very good at finding solutions and this will be a competitive advantage in the future.



PETER BRYNTESSON
Research Programme and Senior Project Leader
FKG – Scandinavian Automotive Supplier Association

MEGA TREND electromobility

The first electric car was designed and manufactured as early as 1835 by Professor Stratingh of Groningen and his assistant Christopher Becker. Today, development has advanced significantly and the starting point for electromobility is that it will play a decisive role in reducing the sustainability impact of transport. Today, more than 10% of the market in the Nordic region consists of rechargeable cars.

Lightweight further strengthens the potential benefit of electromobility for sustainable development, as lighter solutions, in addition to increased range, also reduce material consumption. The fact that the battery in some models today represents a quarter of the car's weight, really emphasises the need of an expanded lightweight perspective.

Research is underway on completely new solutions with multifunctional materials. In the long term, this should be possible

to implement in the aerospace industry as well. Norway has already ruled that all domestic flights should be electrified by 2040.

However, in a shorter perspective the development of lighter battery solutions is a priority. Today, battery boxes are mainly made of steel and aluminium, but should be possible to partly replace by other mouldable and lighter composite materials that drastically reduce weight. In a longer-term perspective, completely new battery systems should be a reasonable aim. One challenge for the automotive industry is to ensure that existing platforms can withstand the weight of the batteries.

At the same time, electromobility assumes that we develop systems to recycle the batteries. By the same token, cost-effective manufacturing processes with a lightweight focus on large volumes are of course a central element, and LIGHTer's cross-industry arena has a crucial role to play.

MEGA TREND multifunctionality

Multifunctionality is a broad concept that includes, among other things, materials, components and systems that can perform several different tasks. The research area is growing steadily, and more and more organisations are interested.

An example is material that can carry load but at the same time act as a sensor, store energy, or be able to change shape. Other multifunctional materials can even self-heal if they would be damaged. A very interesting material in this context is graphene. Graphene can be added to composites for increased fatigue properties, but also to different types of surface layers giving the composite for example defrosting properties or allow the surface to act as lightning conductor.

An effective way to reduce the weight of a system is to reduce the number of components by having each component perform more tasks. For example, a car roof has several tasks. It should

protect the occupants from weather and wind, take some load and at the same time dampen vibrations in the car body and be sound insulating. Traditionally, different materials and components have been used to achieve this. However, it has been shown that it is possible to make a car roof with a multifunctional sandwich construction that solves all tasks but to a significantly lower weight.

Through collaboration between KTH and Chalmers¹⁾, we have also already been able to establish that the batteries for future electric cars can be integrated into the body structure itself, so-called structural batteries. That is, the material in the body, here carbon fibre reinforced composite, carries both load and stores energy. In the long term, structural batteries should also be applicable in the aerospace industry. The research on carbon fibres that can store energy has been made possible by LIGHTer Academy, and is considered by Physics World to be one of the ten most important scientific contributions in 2018.

1) KTH Royal Institute of Technology and Chalmers University of Technology



If you can integrate the battery and make it part of the structure, it offers completely new opportunities to reduce weight in the aerospace and automotive industries. Here continued interdisciplinary collaboration is of central importance for development.



DAN ZENKERT
LIGHTer Academy
Professor at KTH Royal Institute
of Technology



Image: Chalmers University of Technology



Through AI and automation, we can have an opportunity to live up to the exacting demands of citizens on how a modern welfare society should work.



FREDRIK HEINTZ
Chairman of the Swedish AI Society

MEGA TREND artificial intelligence

The great interest in AI is the result of a long series of advances in sensor technology, data communications, large data management platforms and, not least, sufficient computing power to run really advanced algorithms for machine learning within a reasonable time. This means that we can now supplement traditional knowledge-based systems using data-driven technology, where knowledge is obtained directly from the data.

AI influences all areas in ways that are difficult to predict. The development will change the world, as data and applications are everywhere. This is not about a single technology, but AI is highly integrated with, for example, automation and control systems, systems for planning and optimisation, quality control through image analysis and predictive maintenance. Machine learning also provides access to new approaches in simulation and data analysis for the design and development of new materials, products and processes. AI already surpasses human experts in image and video analysis. This also applies in natural language,

where data-driven systems are used to review tenders and contracts, find patterns in warranty issues, or help customers with questions.

Swedish industry needs to get acquainted with what AI can accomplish and learn from what others have already done. And in the lightweight area there are many applications. Some examples are:

- More efficient product development through new methods for simulating material properties
- Data-driven maintenance of connected machines to anticipate calibration needs
- Automatic quality control through intelligent image and video management

The development with the help of AI is not in the future. It has already started.

MEGA TREND sustainability

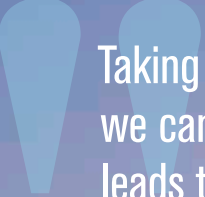
Making components and products lighter gives direct gains in the form of reduced fuel consumption, reduced use of materials and reduced workload to name but a few. We must also include the entire product chain; from manufacturing to residual processing through a pronounced lifecycle perspective in all lightweight projects.

The consumption of resources in the form of raw materials, energy, transport and the possibilities of reuse of material plays a major role in whether a lighter product is sustainable throughout. This applies not least to composites and other multimaterials, where the lifecycle perspective requires not only to identify strength and weight loss, but also how the materials can be separated for reuse or recycling.

In the same way, society must be able to solve the handling of all the car batteries that will drive the world's millions of electric vehicles. At the same time it plays a significant role how the electricity is produced that the cars run on. Charging with coal-based electricity means indirectly that you drive with a fossil fuel, unlike a car driven on electricity from wind or hydro power.

Wood and other bio-based materials could help Sweden achieve our growth and sustainability objectives. Even here, LIGHTer can play a crucial role in taking renewable and carbon-neutral materials onto the market, from a lightweight perspective. Today we have forest producers and end users. The question is what will the chain in between look like? Several research and development projects with participants from the forest industry and end users can be one way. Construction of hybrid materials could be a way to increased skills and the use of bio-based materials.

The global sustainability goals mean that LIGHTer will continue to develop methodologies and clarify the research directives from a lifecycle perspective. Pushing over potential environmental problems on someone else is just not sustainable. LIGHTer's sustainability analysis is based on the UN's 17 global goals. Having sustainability as a starting point is the basis for us to succeed and our sustainability experts are pursuing a constant dialogue on these issues.



Taking a holistic approach means that we can ensure what we develop really leads to sustainable improvements.



JENNY SANDAHL
Sustainability Manager, Association
of Swedish Engineering Industries



LIGHTer joins the international stage

In recent years, the work with lightweight has both deepened and internationalised, in line with the priorities of the lightweight agenda. LIGHTer will continue to strengthen our international networks.

A strategic initiative is our international conference, which is arranged and gathers researchers from academia and industry primarily from Europe but also the rest of the world. Leading lecturers in lightweight are combined with seminars based on LIGHTer's five innovation themes: lower costs, more efficient development methods, mixed materials, improved qualities and innovative functions.

LIGHTer also continuously seeks new international collaborations. The participation in the formulation of a bilateral Swiss-Swedish call within the European EUREKA Initiative, linked to a Swiss-Swedish network conference for Research and Development, is one example. We are committed to the European Lightweight Cluster Alliance (ELCA) and the Smart Eureka Cluster. In addition, continuous calls are being made to deepen international collaboration between ELCA's member companies and LIGHTer's networks.

The investment in the LIGHTer PhD Network is another growing concept with an international character. Many international students are included in the network, as they are enrolled at one of Sweden's universities.

LIGHTer Academy is another unique academic network that started in 2014 and has funding for at least 12 years. The frame currently consists of 13 part-time funded senior university researchers. In addition to their own lightweight focus, they also have the opportunity to invite international researchers to Sweden or participate in international contexts within the framework of the LIGHTer Academy. The researchers come from different disciplines and universities. This gives a holistic perspective to lightweight that inspires and builds collaboration that leads to greater technological leaps.

The LIGHTer International Conference has evolved into an important meeting place for researchers and strengthens Swedish lightweight technology in the world.



CECILIA RAMBERG
Director of LIGHTer

International initiatives

- LIGHTer International Conference
- LIGHTer Academy
- LIGHTer PhD Network
- International seminars and study visits
- European Lightweight Cluster Alliance
- Smart Eureka Cluster

Lightweight technology helps us at IKEA to reach our climate targets and affects two aspects of our Democratic Design guidelines in particular. We get smarter transport and drive fewer miles. In addition, we get lower prices, by buying fewer tonnes and save materials and costs throughout the whole value chain.



ÅSA LIDÉN
Material and Innovation
Area Manager IKEA

Image: IKEA



A broad-rooted agenda

The first national Lightweight Agenda was unveiled in 2013. It was the result of more than 100 organisations' involvement, where a majority also expressed their formal support for the direction that was mapped out.

Since then, collaborations have been strengthened, developed and grown. In 2019, we can see that more than 400 unique organisations in the form of companies, research institutes and universities are, in different ways, engaged in LIGHTer. They share and study the lightweight experience by participating in LIGHTer's conferences, workshops, training courses and projects.



Lightweight Agenda #1: 2013–2016

Light must be light

The first Lightweight Agenda gathered Lightweight Sweden and the work to anchor the importance of collaboration to achieve international competitiveness was established in earnest. It also led to Lightweight being chosen as one of Sweden's 17 Strategic Innovation Programmes, with responsibility to run lightweight development and allocate research resources.



Lightweight Agenda #2: 2016–2019

Give Lightweight Sweden a boost

In the second edition, the reasoning and direction were refined based on three years of experience. We were already able to present several successful projects, where cross-industry collaboration had led to tangible results. Continued focus on closing the gap between strategic research and industrial development was pronounced, where the key is to strengthen the entire value chain: from small businesses to global industries.



Lightweight Agenda #3: 2019–2022

Lightweight is more important than ever

In this third edition, the direction has been further specified. At the same time, we see how several mega trends both affect working methods, but above all, strengthen the chances of having even more positive effects from strategically lightweight work. Internationalisation is tangible, and with the help of LIGHTer's new structures for skills development and exchange, new opportunities for national coordination are being opened up.

The cross-industry work continues

When this third Lightweight Agenda is now setting out the direction for the years to come, more than 70 organisations are included in the LIGHTer Membership Programme. It gives them access to a unique network and the ability to take joint national responsibility for the development of world-leading lightweight technology.

Since its inception in 2013, more than 400 organisations have participated in LIGHTer's various activities and our newsletter LIGHTer News has over 1 000 subscribers. The strategic decisions are taken by a board anchored in a broad spectrum of companies, research institutes, academia and other stakeholders in Lightweight Sweden, which further strengthens us as a hub. We have built up a multidisciplinary academic network of 32 senior researchers through the cross-industry collaborations. Our national doctoral network currently accommodates more than 80 PhD students and alumni.

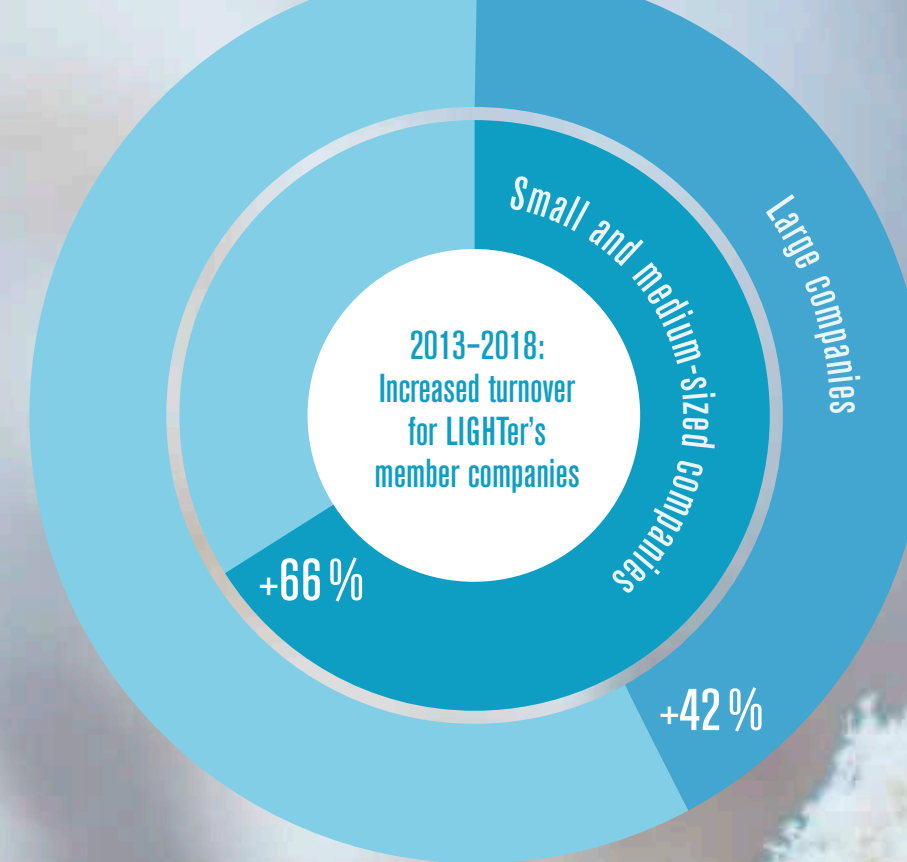
MEMBERS

3M Svenska AB
 AB Volvo
 Altair Engineering AB
 Andr nplast AB
 AP&T Sweden AB
 Biteam AB
 Br derna Bourghardt
 C Lindhe Xtend AB
 CAE Values AB
 Chalmers University of Technology
 Devex Mekatronik AB
 DIAB International AB
 DYNAMore Nordic AB
 EDR & Medeso AB
 Elmia
 Engel Sverige AB
 Envirotainer Engineering AB
 ESI -Scandinavia / Efield AB
 Element Materials Technology AB
 FS Dynamics Sweden AB

Gestamp HardTech AB
 GKN Aerospace Engine Systems Sweden
 Gleitmo Technik AB
 Grafren
 Halmstad University
 Husqvarna AB
 Hydroforming Design Light
 Hydro Extrusions
 H gan s AB
 IMA – Innovative Material Arena
 Innolite Design AB
 Innovatum AB
 Ionbond Sweden AB
 Juteborg
 Kenpo Sandwich AB
 KTH Royal Institute of Technology
 Lamera AB
 Lightness by Design AB
 Ljungby Komposit
 Lule  University of Technology

Lund University Faculty of Engineering
 Macromould Modell & Form AB
 Marstrom Composite AB
 Modul-System HH AB
 Nordic Aircraft AB
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 RISE Research Institutes of Sweden
 RISE IVF
 RISE KIMAB
 RISE SICOMP
 RISE SWECAST
 Saab Aeronautics
 Safeman
 Scania CV AB
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 SSAB AB

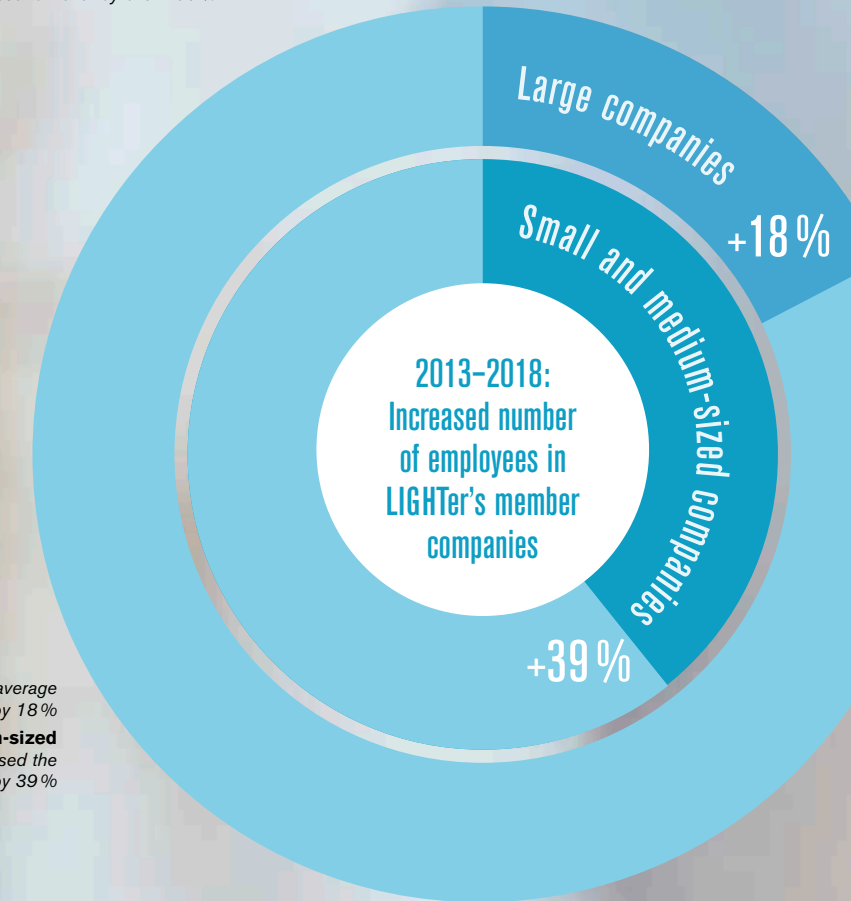
SwedFoam Development AB
 Swedish Waterjet Lab
 Svenska Tanso AB
 SWERIM
 Svero Lifting AB
 The Scandinavian Automotive Supplier's Association (Fordonskomponentgruppen)
 The School of Engineering, J nk ping University
 Triple Steelix/The Swedish Steel Producers' Association (Jernkontroet)
 University of Bor s
 University of Sk vde
 University West
 Wematter
 Winfoor AB
 Volvo Cars Group
  rebro University



The large member companies have increased their turnover by 42%

The small and medium-sized member companies have increased their turnover by 66%

! 7 of the small and medium-sized member companies have increased their turnover by over 100% in the last four years. A further 3 have increased turnover by over 200%.



The large member companies have on average increased the number of employees by 18%

The small and medium-sized member companies have on average increased the number of employees by 39%

LIGHTer

A national Lightweight Arena for companies, research institutes, academia, industry associations, municipalities and authorities. HOSTED BY RISE

Industry, institutes and academia have all participated via LIGHTer in the production of this Strategic Research and Innovation Agenda for Lightweight. Version 3

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