

# FiveClusters

FIVE CLUSTERS IN WEST SWEDEN WITH STRENGTH AND POTENTIAL FOR THE FUTURE



**Urban Future**

**The Marine Environment and the Maritime Sector**

**Transport Solutions**

**Green Chemistry and Bio Based Products**

**Life Science**

**FIVE CLUSTERS** is a collaboration between Chalmers University of Technology, The City of Gothenburg, University of Gothenburg, Region Västra Götaland and West Sweden Chamber of Commerce.

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## Urban Future *page 6-9*



**SWEDEN IS ONE** of the leading countries within sustainable urban development and is therefore a role model internationally. For a long time, West Sweden has been one of the most attractive regions of the country to live and work in, and few areas in Europe have grown more population-wise in the last 20 years.



## The Marine Environment and the Maritime Sector *page 10-13*



**THE SEA IS** one of West Sweden's core assets and entrepreneurship linked to the marine environment goes way back. Herring fishing, shipbuilding, ocean trade, and port operations are some examples. The maritime cluster as a whole is well rooted in academia and the public and private sectors of the region.



## Transport Solutions *page 14-17*



**THE TRANSPORTATION SECTOR** is facing enormous challenges in a global perspective. Climate researchers estimate that for the so-called two-degree target to be achieved, CO2 emissions from road transports must be reduced by 90% by 2050. West Sweden's ability to recruit and focus resources and to work across boundaries will make a difference.



## Green Chemistry and Bio Based Products *page 18-21*



**A SUSTAINABLE DEVELOPMENT** of the world we live in will require substantial changes in its flows of materials and energy. Such a major process of change will be impossible without hard work and a team effort involving the academia and the public and private sectors. West Sweden is uniquely suited to lead the development within bio-based products and so-called green chemistry.



## Life Science *page 22-25*



**THE FIELD OF** life science covers a large number of challenges from the regional to the global level, including possible solutions. There is a focus on health and healthcare, and problems for example related to an aging population, antibiotic resistance, and pandemics. West Sweden's public actors have expressed a clear emphasis on life science for example by commissioning former Prime Minister Ingvar Carlsson to assess what needs to and can be done to develop the life science sector.





# We live in an exciting era!

**THE MAJOR CHALLENGES** ahead are telling us that many of the things we do in life need to be reconsidered and changed. Since the world is growing, in 2050 the planet is expected to host nine billion people, we need to get serious about finding new and more resource-efficient ways of living.

This insight presents many challenges. Yet it also signals many opportunities, especially for a country and a region that have proven to be forerunners when it comes to this very type of problem solving.

The first important realization is that the challenges are so complex that they for certain will require cross-boundary collaboration. Different regions can contribute different things depending on their specific strengths and resources. Thus, Gothenburg and West Sweden must identify their strengths and figure out how they can best contribute to growth and welfare, not only regionally and nationally but also globally.

**THIS TEXT DESCRIBES** five strong clusters in West Sweden that have been identified jointly by leading representatives from the academia and the public and private sectors. The clusters each have a long tradition, and they are all facing some exciting challenges.

## **THE FIVE CLUSTERS ARE**

- Urban future
- The marine environment and the maritime sector
- Transport solutions
- Green chemistry and bio based products
- Life science

**THE INTENTION IS** for these clusters to develop cross-boundary collaborations, something Gothenburg and West Sweden have always done over the years. The region is characterized by openness to the surrounding world, both nationally and internationally. It is also known for the closeness between the academia and the public and private sectors, not to mention the openness among people in general.

However, in order to be successful we also have to be brave enough to try new approaches. In addition to our renowned cooperative spirit, we must reinforce the sense of trust that effective cooperation is built upon. Then Gothenburg and West Sweden will clearly have what it takes to become even more attractive, both nationally and globally.

**EVERYBODY IS INVITED** to join the exciting ride that will take Gothenburg and West Sweden into the future.

Welcome onboard!

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# Urban Future

**Sweden is one of the leading countries within sustainable urban development and is therefore a role model internationally. For a long time, West Sweden has been one of the most attractive regions of the country to live and work in, and few areas in Europe have grown more population-wise in the last 20 years.**

**IN ORDER TO** take advantage of the possibilities that come with urbanization, and at the same time meet our local and global challenges, many actors in the region are working innovatively and across conventional boundaries in order to jointly create new knowledge about sustainable urban development. The amount of actors involved in shaping urban futures is nearly impossible to define. However, it is clear that the key to being able to implement visions about sustainable urban futures lies in the ability to integrate a wide range of actors and make them collaborate. It is important to find joint solutions to various problems and secure that they are long-lasting.

**FOR THE FIRST** time ever, a majority of the world's population live in urban environments. The strong trend of urbanization implies that we will build urban environments for three billion more individuals within only a few decades. Cities are important drivers of development and welfare, yet the ecological, social, and financial systems that are supposed to support the development are already under great pressure. It is a great challenge to create sustainable cities where all people are able to satisfy their needs at the same time as we have to deal with the climate threat and our overutilization of the world's resources.

**WEST SWEDEN IS** a forerunner in cross-sector collaborations concerning sustainable urban development. Several established processes and arenas for cooperation, capacity building, and knowledge creation are in place. West Sweden is also a seedbed and a base for a large number of innovative companies that in one way or another are engaged in sustainable urban development. The region offers these companies ample opportunities to develop and test tomorrow's products and services in collaboration with other actors.

## THE REGION'S STRENGTH IN TACKLING GLOBAL CHALLENGES

### Mistra Urban Futures

**IS A NEW** center for sustainable urban development with an ambition to become a world leader in the field within a few years. The center, which is managed from Gothenburg, was formed to find out more about the difficulties and opportunities the world's cities are facing. It consists of five local platforms for cooperation located around the world: Gothenburg (Sweden), Cape Town (South Africa), Kisumu (Kenya), Manchester (U.K.), and Shanghai (China).

**CLOSE COOPERATION BETWEEN** practitioners and researchers will yield first-class knowledge. The center will contribute to making a real difference for the environment and for people's lives in the cities of the world. The primary strength of Mistra Urban Futures is the close cooperation between

*» West Sweden is a forerunner in cross-sector collaborations concerning sustainable urban development.«*

**MISTRA URBAN FUTURES** started in January 2010 and is funded by Mistra – the Foundation for Strategic Environmental Research, SIDA – Swedish International Development Cooperation Agency, and a consortium comprising Chalmers University of Technology, The Göteborg Region Association of Local Authorities, the City of Gothenburg, the University of Gothenburg, the IVL Swedish Environmental Research Institute, the County Administrative Board of Västra Götaland, and Region Västra Götaland. Chalmers University of Technology hosts the center.

research and practical application. The center offers an arena for development and transmission of knowledge, where cooperation with the private sector, interest groups, and the public will be developed. It is a forum for knowledge and will develop at pace with the flow of ideas and experiences that the involved actors contribute.

### RiverCity Gothenburg

**REFERS TO THE** areas in central Gothenburg (Centrala Älvstaden) that are located on both sides of the river that flows through the city. A unique feature of the area is that there are empty lots in the city center that can be developed. One of the challenges will be to tie the city together across the river.

**THERE IS BROAD** agreement regarding how Gothenburg and the Gothenburg region should be developed: The central parts of Gothenburg, the regional core, should be strengthened in order to strengthen West Sweden in general. A vision and a strategy for the large central areas that are going to make up the regional core in the future are currently being developed. The areas; former harbor, terminal, and industrial areas on both sides of the Göta Älv river, all have good potential to be turned into good examples of sustainable urban development and serve as a testing ground for new innovative ideas.

**ACADEMIA AND THE** public and private sectors are collaborating broadly to build RiverCity Gothenburg. The purpose is to ensure that RiverCity Gothenburg is given sustainable urban development of high quality by developing work models for collaboration, dialogue, and information. The intention is to collect experiences gained elsewhere, test them on RiverCity Gothenburg, and then document the experiences so that they can be shared both nationally and internationally. It is a matter of creating urban development that is including, that contributes to a complex and robust economy, and that can

handle the effects of climate change. Children are the future, and all urban development in Gothenburg should be based on their needs. The City of Gothenburg has, in broad collaboration with other actors, successfully developed models aimed to promote the social sustainability dimension. The tools that have been developed for child and social impact assessments are implemented in all development efforts related to the city's physical environment.

**NEW CROSS-BOUNDARY PROCESSES** are created and tested in the RiverCity Gothenburg project. For example, nearly 80 international experts met for a five-day workshop in June 2011 to develop joint suggestions regarding the future of central Gothenburg. The project is also focusing on different forms of citizen participation. Knowledge is created in meetings between different professions, between research and practice, and between professionals and citizens through new dialogue forms.

## Gårdsten

**IN GÅRDSTEN, NORTHEAST** of Gothenburg, there is a project for the sustainable reconstruction of a rather worn down residential area. The project, which started in 1997, is characterized by dialogue and close cooperation with the residents. The good partnership between residents, experts, and academia has resulted in unconventional and innovative



energy solutions. The Solhusen project has been recognized in particular, for example through the World Habitat Award, and the property owner Gårdstensbostäder received the Stora Samhällsbyggarpriset award in 2006. The company produces wind-generated electricity outside the buildings, and has in fact been self-sufficient since 2009. In order to further increase the residents' participation in the management and development of the area, Gårdstensbostäder runs an employment office, called Gårdstensbyrån, which helps the building companies recruit residents to assist with renovations and reconstructions.

## 3K – Kvillebäcken, Nya Krokslätt, and Kongahälla

**THE GOTHENBURG REGION** is hosting three of the country's main demonstration projects within sustainable urban development: Kvillebäcken in Gothenburg, Nya Krokslätt in Mölndal and Kongahälla in Kungälv. These projects have received support from for example the Delegation for Sustainable Cities to create attractive and ecologically, socially, and economically sustainable urban environments that contribute to reducing greenhouse gas emissions, and also to serve as a display window to the world. The projects offer an opportunity to study full-scale systems and technical solutions, at the same time as additional sustainability aspects are brought to the surface. They are good examples of urban development with integrated city planning and applied environmental technology. Cutting edge technology related to transports, energy efficiency, and waste management is developed and implemented jointly by property owners, building companies, engineers/subcontractors and researchers following consultation with the residents. «

## 3K - Sustainable urban development in West Sweden

### KVILLEBÄCKEN



Kvillebäcken, which is centrally located five minutes by public transit from the Gothenburg Central Station, is part of the development of RiverCity Gothenburg.

Today the area is very diverse, and parts of it give a rough and run-down impression with several empty lots, of which some are badly damaged by pollution.

The conversion of Kvillebäcken fills a gap in the city grid and thus links the surrounding areas together. The main challenge has been to create an attractive and sustainable city environment within the framework of high exploitation and limited financial resources. For the purpose of the project, the City of Gothenburg and six other actors have formed a consortium (BF Veidekke, Derome Hus, HSB Gothenburg, Ivar Kjellberg Fastigheter, NCC, Wallenstam, and Älvstranden Utveckling AB).

The transformation of Kvillebäcken offers unique possibilities to demonstrate applied environmental technology in a real city environment as well as show how environmental technology can be integrated into the city development process.

### NYA KROKSLÄTT



The vision for Nya Krokslätt is to show the world an example of a historic industrial site that supports a climate-smart lifestyle among the residents and those working in the area.

At Nya Krokslätt, sustainability is a matter of coordinating and optimizing solutions related to energy, mobility, services, and participation of residents through the active involvement of the property owner, the City of Mölndal, academia, the private sector and other stakeholders. Sustainable urban development involves many different actors and areas of competence, and the property owner Husvärden AB has signed a cooperation agreement with actors from academia, the public and private sectors.

Collaborations with for example Mistra Urban Future, Chalmers University of Technology, and the Swedish University of Agricultural Sciences give the property owner an important platform for introduction of expert knowledge into the project and for spreading of knowledge nationally and internationally.

In addition, the project offers an opportunity to test different research ideas full scale as well as an arena where the ideas can reach businesses in the community development sector.

### KONGAHÄLLA



Kongahälla is a new district of Kungälv where 900 homes and services are scheduled to be developed by 2019. There is an explicit vision for the district that sustainable living should be easy.

The project was started by the Municipality of Kungälv and Kungälv Energi together with Riksbyggen, Förbo, Kungälvsbostäder, and KF Fastigheter. The goal is to make Kongahälla an active part of the city, socially, economically, and environmentally.

Kongahälla will, throughout the year, produce more electricity than is consumed, which will require that the consumption is kept at a low level. The Municipality of Kungälv has initiated the project "From low-energy to passive buildings – the next generation of energy-efficient buildings", where the SP Technical Research Institute of Sweden has been commissioned to assess what is required in terms of building technology, energy systems and planning in order to complete the Kongahälla project.

The project will benefit from broad-based collaboration and will be followed-up in cooperation with the SP Technical Research Institute of Sweden, the University of Gothenburg, and Mistra Urban Futures.



# The Marine Environment and the Maritime Sector

The sea is one of West Sweden's core assets and entrepreneurship linked to the marine environment goes way back. Herring fishing, shipbuilding, ocean trade, and port operations are some examples. The maritime cluster as a whole is well rooted in academia and the public and private sectors of the region.

**DESPITE THE REMARKABLY** large number of local companies that have proven to be internationally competitive in the maritime sector, there is generally a shortage of maritime knowledge. Thus, there is an urgent need for research and the creation of knowledge in order to take full advantage of the diversity of the marine environment. Marine research therefore has a strong position at both the University of Gothenburg and Chalmers University of Technology.

*»The sea knows no boundaries. Thus, all problems and possibilities are shared.«*

**THERE ARE NUMEROUS GLOBAL** challenges in the maritime sector. In a nutshell, it is a matter of the essential conditions for life, for example that the sea must be able to remain the most important global source of protein, that we must figure out how to use the sea as a renewable source of energy, and that the sea should be used for sustainable transportation without harming the environment. The University of Gothenburg and Chalmers University of Technology are involved in all of these areas, as well as in more basic research aimed to facilitate sustainable

use of marine resources, for example research on the genetics of marine organisms.

**THE SEA KNOWS NO BOUNDARIES.** Thus, all problems and possibilities are shared. Countries and regions bordering the same seas and oceans must cooperate. Yet there are also some global challenges that must be solved jointly by all countries in the world. The maritime cluster in West Sweden is therefore characterized by both partnerships with competence centers around the Baltic and North Seas and collaborations on a larger European or global scale.

*ONE EXAMPLE OF West Sweden's strong international position is that the European Maritime Day will be held in Gothenburg in May 2012. The event will attract politicians, researchers, entrepreneurs, and organizations from all over Europe, and they will come to Gothenburg to discuss the possibilities of the sea as part of the theme: Sustainable growth from the oceans, seas, and coasts.*

**THE MARITIME STRATEGY** for West Sweden emphasizes the importance of cooperation for the creation of innovative environments. Academia and the public and private sectors collaborate in several strategic maritime projects aimed both to strengthen the competitiveness of the maritime sector and to meet society's challenges in a global perspective.

## THE REGION'S STRENGTH IN TACKLING GLOBAL CHALLENGES

**THE AMPLE ACCESS** to broad competence that includes the perspectives of academia and the public and private sectors on local, regional, and state levels implies good prospects for cooperation in the maritime sector. One interesting example concerns fishing in the northern parts of Bohuslän, where fishermen and researchers, with the support of authorities, are cooperating with a shared vision to make the fishing interfere less with the unique marine environment in the Koster Sea. In the cooperation, fishermen are studying

marine biology, and researchers are joining fishing crews in their work in order to learn more about it. As a result, they have figured out how to make shrimp fishing harmless to the marine environment. The Koster Sea is full of corals and other species that cannot be found anywhere else in the country. When the marine national park Kosterhavet opened in 2009, the coastal fishing could continue thanks to the creative collaboration between the fishing community and researchers.

**THE COASTAL ENVIRONMENT** with its productive shallow areas is particularly sensitive to emissions of, for example, sewage and fertilizers from farming. Researchers and entrepreneurs within land and sea management were pioneers within mussel farming to reduce the effects of over-fertilization and to produce high-quality food products. Shellfish and mussels from the coast of Bohuslän are exported in large quantities to continental Europe. Today the marine aquaculture along the west coast is largely based on mussel farming.

The west coast also has a potential for ecological fish farming. Marine research, high environmental standards in food production, and access to clean water imply unique conditions for experimental marine aquaculture. Researchers at the Centre for Aquaculture at the University of Gothenburg, together with representatives of the private sector, are exploring the potential for fish farming in the marine environment.

**MODERN AQUACULTURE IS** characterized by sustainable utilization of biological resources from the sea. Norwegian and Swedish researchers are collaborating on the sustainable use of biomarine resources in a joint project on Skagerrak's unknown flora and fauna. The aim of the study is to utilize features of marine organisms that may be beneficial in the production of materials, medicines, and nutritious food additives.

*THE PLACEMENT OF the new Swedish Agency for Marine and Water Management in Gothenburg gave the region a new, strong public actor with an explicit focus on knowledge-based maritime development. In a similar vein, the Swedish Maritime Administration has decided to place the unit for the development of future traffic control, the so-called VTS system, in Gothenburg as well.*



**THE MARINE ENVIRONMENT** is quite demanding, and a sustainable use of marine resources requires equipment and tools that are not yet available. EU requirements communicated through various directives and the introduction of for example marine spatial planning are pushing the development of marine measurement technology forward. In this context it should be noted that West Sweden has the possibility to offer a testing ground for international companies thanks to its marine field stations and technical expertise.

**ONE EXAMPLE OF HOW** cooperation between academia and the public and private sectors, and between research areas as well, can yield creative solutions to complex problems concerns fouling, which is the growth of microorganisms, plants, algae, and even animals on the hull of a boat or ship. The heavy metals and chemicals that have been used in the past to prevent fouling have led to emissions of toxins into the sea and severe damage to the fauna. Joint efforts by the University of Gothenburg and Chalmers University of Technology have resulted in anti-fouling methods that do not harm the environment. The Gothenburg-based company I-Tech has developed an anti-fouling biocide, Selektope, that does not interfere with the surrounding environment. As a result of cooperation with for example Volvo Penta, the new anti-fouling substance is ready to enter the global market. I-Tech's innovation may make the company a key actor in the anti-fouling market, which totals some 2.5 billion SEK per year.

## Benefiting from a windy coastal location

**IT IS AN** explicit goal of West Sweden to become fossil independent by 2030. This will require a transformation of large parts of the energy supply. Fossil fuels must be replaced by renewable energy on a large scale. The sea is an enormous source of energy, and researchers are working intensively to figure out how to control and use it. There are plans to generate 10% of Europe's total power supply by means of offshore wind power by the beginning of the 2020s. West Sweden is perfectly located in a wind power perspective. General Electric (GE), a world leading hi-tech company, will place an offshore wind power prototype in Gothenburg in the

**WAVE POWER HAS** great potential and the technology to utilize it is currently being developed for example at the Ocean Energy Centre, where several companies in the industry are working together with academia and the public sector to come up with effective solutions. Fortum and the Swedish Energy Agency have decided to build the largest wave power park in the world in Lysekil. The company Sea Based has developed the technology and a total of 420 wave power generators will be placed in the sea. The total effect will equal 10 MW and the park is expected to yield 25 GWh per year.



winter of 2011/12. The project is a collaboration involving GE, Göteborg Energi, Chalmers, and the Swedish Energy Agency.

**THE TECHNICAL AND** financial challenges linked to offshore energy extraction are considerable. Large-scale development of wind and wave power parks requires a number of test sites. Both established suppliers of wind power equipment, such as SKF and ABB, and research centers can attract more subcontractors that can contribute to pilot plants for a new generation of offshore wind power able to deliver renewable energy to Europe. There are significant synergies between wind and wave power. Connection to the main power grid, equipment maintenance in a demanding marine environment, and materials for and sustainability of marine energy extraction are some areas where knowledge in the wind power sector can be used at the Ocean Energy Centre in Gothenburg.

**IN ORDER FOR** ports to be located near business and industry and large cities, the emissions from sea transportation must be reduced. One of the most important methods to accomplish this is to connect the ships to the main power grid. The Port of Gothenburg is one of the world leaders when it comes to onshore power supply connection and was first in the world to provide high voltage onshore power supply for cargo ships. Another step towards greener sea transport in Gothenburg was taken when Stena Line opened a new onshore power supply facility for its ferries operating between Sweden and Germany. In total, one in three vessels that enter the Port of Gothenburg can now turn off their diesel engines

at the quayside and instead use renewable power from land-based wind power. The Port of Gothenburg's successful investments in transportation to and from the port via rail is another example of a sustainable logistics solution.

**WEST SWEDEN IS** the natural Swedish base for the industry that deals with transportation and logistics to Sweden as a whole and to large parts of the rest of Northern Europe. The region is home to all the actors that in the future may help develop new sustainable and innovative solutions that require cooperation and a holistic approach. This makes it possible to test solutions that require cooperation, such as energy efficiency measures, new fuels, and security and logistics systems, before they are implemented on a larger scale. Research centers, transportation companies, and subcontractors can come together and test and further develop new solutions at their shared testing ground Lighthouse, a cross-disciplinary competence center situated at Lindholmen Science Park. The center is based at Chalmers University of Technology and the University of Gothenburg, but is strongly supported by the public and private sectors. «

**THE WEST SWEDEN** based project *Clean Shipping Index, CSI*, has developed a new environmental index that helps large transportation customers assess ship owners and cargo ships. According to a recent review by WWF International, *CSI* is the most comprehensive environmental index there is. *CSI* is based in Gothenburg but is active all over the world with more than 1,500 registered vessels and about 30 customers.

## Some of the organizations that strengthen this cluster

### The Swedish Agency for Marine and Water Management

Has been commissioned by the Government to implement a coherent policy for all Swedish waters. Located in Gothenburg since 2011.

### Centre for Marine Research, University of Gothenburg

A center for marine and maritime research with an aim to strengthen cross-disciplinary cooperation within research and doctoral programs.

### The Arendal Project

Home for one of the most advanced prototypes for offshore wind power in the world.

### Lighthouse

Competence center that focuses on cross-disciplinary maritime research related to economics and business aspects, the environment, safety and logistics, work environment issues, and shipbuilding.

### N-research

Lysekil-based company specializing in transferring research-based knowledge to commercial customers in areas such as analysis of plastic residue in the sea and the potential for using marine organisms to produce biogas.

### The Koster Sea

Sweden's first marine national park.

### Clean Shipping Index

Helps customers choose environmentally sound transportation providers.

### Mare Novum

Innovation platform for marine research at the University of Gothenburg with an aim to use marine organisms for medicines, energy, cleantech, and biotechnology.

### Port of Gothenburg

Scandinavia's largest port and world leader in onshore power supply connections and conversion to sustainable transport solutions.

### Marin Mätteknik

High-resolution hydrographic surveying for industrial projects. Located in Gothenburg.

### I-Tech

Developer of anti-fouling ship hull paints that do not harm the environment.

### SSPA Sweden

Organisation that functions as the bridge between research and industry implementation. Focus on energy efficiency, sustainable development through proper risk management.

### Ocean Energy Centre, Chalmers

The centre focuses on R&D in the area of wave power. The center is administered by Chalmers University of Technology, Shipping and Marine Technology.

### Sea Based

In charge of the world's largest wave power park outside Lysekil. The park is scheduled to open in 2012.





# » Transport Solutions

**The transportation sector is facing enormous challenges in a global perspective. Climate researchers estimate that for the so-called two-degree target to be achieved, CO2 emissions from road transports must be reduced by 90% by 2050.**

**EVERY YEAR 1.3 MILLION** people die and 50 million are injured in traffic accidents, making it a serious global problem. New transport solutions must address these problems and at the same time contribute to increased efficiency in the transportation systems in order to secure a satisfactory growth rate. All in all, this means that both automotives and the transportation systems in general must be developed very rapidly in the near future.

**WEST SWEDEN'S SHARE** of the problems may seem small in a global perspective. However, our potential to lead the

development of solutions is much larger, thanks to the strong cluster comprising a few leading automotive manufacturers and their subcontractors, a strong and growing transport and logistics industry, multidisciplinary environments for research and education with a strong interest in the challenges facing the transportation sector, and not least societal actors that are strongly committed to developing green, effective and safe transportation alternatives. West Sweden's ability to recruit and focus resources and to work across boundaries will make a difference.

# THE REGION'S STRENGTH IN TACKLING GLOBAL CHALLENGES

## Safe transports

**THE REGION IS** already a leader when it comes to traffic safety. In 2010, Sweden was recognized for having the highest level of traffic safety in the world, and Gothenburg is one of the safest cities in the country. And the goals for the future are high: to reduce the yearly number of individuals injured in the Gothenburg traffic from 300 to 75 in ten years. Traffic safety is assigned high priority in the city's traffic development plans, and so-called unprotected road users are emphasized in particular. The vision of zero traffic casualties that was passed by the Swedish Government in 1997, Sweden was the first country ever to announce such a vision, implies that zero traffic casualties also must be an obvious goal in urban planning.

**THE AUTOMOTIVE INDUSTRY** is also pushing traffic safety forward. For example, Volvo Car Corporation and Autoliv have been forerunners in vehicle safety for a long time. Volvo Cars' high goals to develop cars that do not crash and, in the short term, that nobody should die or get injured in a Volvo by 2020, are driving the development of entirely new safety solutions.

**AN IMPORTANT SHARE** of the research in the area is conducted jointly by the 24 members of the competence center SAFER, a partnership formed in 2006 comprising automotive producers and subcontractors, telecom companies, academia and the public and private sectors.

**SAFER'S VISION IS** to serve as a hub for research on vehicle and traffic safety in a real environment. SAFER is a broad platform for multidisciplinary research, where actors from different parts of society can meet and collaborate.

**THE GOAL IS** to contribute with new safety systems and solutions that will minimize traffic-related accidents and injuries. Chalmers University of Technology is hosting the center, and the involved actors come from academia and the public and private sectors. It is funded primarily by VINNOVA.

*»West Sweden's ability to recruit and focus resources and to work across boundaries will make a difference.«*

## Efficient transports

**THE GOTHENBURG REGION** has been named the best logistics location in Sweden for the 10th straight year. There are several reasons for this. Well-functioning cooperation between the region's academia and the public and private sectors is emphasized by Intelligent Logistik, the Swedish trade journal that gives out the award:

*"The fact that the largest import and export port in Scandinavia, with direct, ocean-going lines and a well-developed system of rail shuttles, is located in Gothenburg is clearly a strong factor behind the award. Yet the Gothenburg region has additional advantages. The trade journal Intelligent Logistik mentions the short distance from port to warehouse, which implies low logistics costs. This is obviously important to businesses planning to relocate or expand. Moreover, Gothenburg's transportation infrastructure is generally considered to be very effective, and the specialized programs in logistics at Chalmers University of Technology and the University of Gothenburg give the region outstanding access to logistics competence."*

**CITY LOGISTICS IS** an area that is expected to develop significantly in the near future. Improved coordination of urban transports will require businesses to organize their work in new ways and will imply new demands on the actors involved and on the infrastructure. Gothenburg has, as the first city in the country, appointed a person to be in charge of city logistics.

**THE IMPORTANCE OF EFFICIENT** urban transportation systems is expected to increase since the functionality of cities is becoming more and more central to economic growth. Sustainable Urban Transport (SUT) is a project launched in 2010 where the City of Gothenburg, the private sector and academia cooperate to develop broad solutions to present and expected problems related to city transports. Lindholmen Science Park is coordinating the members of the

project: Volvo Technology, the City of Gothenburg Traffic and Public Transport Authority, Älvstrandens Utveckling, and Chalmers University of Technology.

**ISSUES RELATED TO** long-distance transports, such as "green corridors" and "high capacity transports" are being addressed as well, and Closer is used as a platform for cooperation regarding transport efficiency.

*CLOSER IS A national arena for transportation research, a meeting place for collaboration among academia and the public and private sectors in the field of transport. The goal is to provide a powerful demonstration and innovation environment with expertise in transportation efficiency.*

*CLOSER WILL BE a national resource that serves as a hub for Sweden's collective competence and promote a Swedish vision for increased transportation efficiency. It will also have the resources to lead larger demonstration projects within the EU.*

*CLOSER IS RUN as a project within the Lindholmen Science Park on behalf of VINNOVA and the Swedish Transport Administration since 2011.*

## Green transports

**GREAT EFFORTS ARE** being made to reduce emissions from motor vehicles and ships. This is partly a result of new legislation, which has led to advanced collaboration among automotive manufacturers, energy companies, academia and the public sector. The efforts to attain the low emission levels that are needed to achieve sustainable road transport solutions have sparked a rapid development of electric drive systems. Electrification of cars has come a long way, and new solutions for larger vehicles are emerging. Electrified roads, with continuous transfer of energy, imply a paradigm shift in the development of electric vehicles. Volvo Powertrain is heading a large project where they, the Swedish Transport Administration, and seven other companies are assessing methods for transferring electrical energy between road and vehicle.

**THE PORT OF GOTHENBURG**, which is the most important node in the Scandinavian transport system, received international recognition by receiving the Sustainable Shipping Award in 2011 for its innovative methods and overall contributions to green shipping. The port for example compensates ships for investments in cleaner fuels and gives discounts to "green ships."

**THE R&D ON ALTERNATIVE FUELS** is also centered in West Sweden, and a new national competence center for renewable fuels has just opened at Chalmers University of Technology. The Swedish Energy Agency and Region Västra Götaland (VGR) are funding the initiative.

**FUTURE SOLUTIONS CONCERNING** electrification and alternative fuels will require increased collaboration among many different actors. Technical solutions developed by individual companies must be made to work in larger systems, where new types of vehicles need new infrastructures for recharging and refueling, new knowledge is needed to develop and operate the systems, and rules and regulations need to be adapted to function across organizational and geographical boundaries. Göteborg Energi is an important and leading actor in these efforts, where West Sweden has a good potential to lead the way.

*SWEDISH KNOWLEDGE CENTRE for renewable transportation fuels (f3) is a nationwide center, which through cooperation and a systems approach will contribute to the development of sustainable fossil-free fuels for transportation.*

*THE CENTER WILL, through joint efforts by the center partners, perform syntheses of current research about the production of renewable fuels as well as supplementing research, such as comparative systems analyses of fuels, processes, raw materials, and plant design.*

**AS A PLANNER OF THE** regional infrastructure and a strong consultative body for the national infrastructure plan, Region Västra Götaland (VGR) has the potential to contribute to a sustainable transport system. The cooperation between VGR as a political actor, academia and private sector is a great advantage in the work to implement a modern and sustainable transportation system. Great efforts are being made across the region to increase travel by public transportation. The cooperative project K2020 presents a vision where one goal is to double this type of travel, which implies that 40% of all travel should be made by public transportation by 2025.

**THE SWEDISH HYBRID** vehicle centre (shc) is a distributed Center of Excellence with the objective to develop and optimize existing and coming technologies for propulsion and energy storage to find the most fuel effective and cost effective hybrid vehicle concept.

**ONE AREA WHERE** West Sweden really can take the lead globally is the combination of safe and green traffic solutions. The construction of a leading research, test, and demonstration infrastructure for continued cooperative efforts to

develop tomorrow's vehicle and traffic safety solutions is currently in progress, and the company ASTA Zero has been formed jointly by SP and Chalmers University of Technology. ASTA Zero is also supported by Test Site Sweden, AB Volvo, Volvo Car Corporation, Autoliv, Saab Automobile, Scania, the Swedish Transport Administration, Region Västra Götaland, Vinnova, and the Swedish Agency for Economic and Regional Growth.

**CLIMATE NEUTRAL FREIGHT** transportation (kneg) is a national collaboration project focusing on making freight transports on Swedish roads climate neutral. The goal is to reduce the environmental impact of a typical Swedish freight transport by 50% by 2020. Twelve companies, including Volvo, Schenker, ICA, and Stora Enso, are collaborating with the Swedish Transport Administration and the Centre for Environment and Sustainability.

**THE SO-CALLED WEST** Swedish package encompasses a series of infrastructure investments in public transport, railways and roads worth a total of 34 billion SEK. The purpose is to create a larger labor market, which will promote employment and growth but also reduce the environmental effects of traffic. «

## Some of the organizations that strengthen this cluster

### SAFER

A broad platform for multidisciplinary research on vehicle and traffic safety in a real environment. The center is hosted by Chalmers University of Technology, is funded primarily by VINNOVA and involves actors from academia and the public and private sectors.

### Closer

A project run within the Lindholmen Science Park on behalf of VINNOVA and the Swedish Transport Administration. Closer is a national arena for transportation research, a meeting place for collaboration among academia and the public and private sectors in the field of transport.

### The Port of Gothenburg

The most important node in the Scandinavian transport system. The port has been recognized internationally for its innovative methods and overall contributions to green shipping.

### Swedish Knowledge Centre for Renewable Transportation Fuels (f3)

A nationwide center which contributes to the development of sustainable fossil-free fuels for transportation through cooperation and a systems approach.

### The Swedish Hybrid Vehicle Centre (SHC)

A Center of Excellence hosted by Chalmers University of Technology which aims to develop the most fuel and cost effective hybrid vehicle concept.

### Climate Neutral Freight Transportation (KNEG)

A national collaboration project focusing on making freight transports on Swedish roads climate neutral. Twelve companies collaborate with the Swedish Transport Administration and the Centre for Environment and Sustainability in Gothenburg.



# Green Chemistry and Bio Based Products

A sustainable development of the world we live in will require substantial changes in its flows of materials and energy. Such a major process of change will be impossible without hard work and a team effort involving the academia and the public and private sectors.

**THE OBSERVATION THAT** our planet is entering a new development phase, called the Anthropocene, where its future development is determined by humans and where the warning bells are ringing for the consequences of carbon and nitrogen imbalances, resource scarcity, and reduced biological diversity, makes the urgency of this requirement even more evident.

**WEST SWEDEN IS** home to several of the country's most important industries, with a potential for increased production or utilization of bio-based, sustainable chemical and

material products and for production of renewable energy. In addition, the region offers an excellent environment for research and innovation through the universities and several research centers that are well recognized within innovation and knowledge creation related to sustainable development.

**ALL IN ALL,** West Sweden is uniquely suited to lead the development within bio-based products and so-called green chemistry. Academia and the public and private sectors see West Sweden as a potential "test bed" that can be used to demonstrate new, unique, and large-scale sustainable

technologies, materials, and products. Joint efforts to show off the region can be seen as a way to increase its attractiveness to investors and relocating businesses, and to improve its economic competitiveness. The private sector within the green chemical cluster enjoy growing opportunities in the home market and thus also increased credibility in the global market.

**THE REGION HOSTS** *most of the nation's production of automotive fuels; the chemical industry in Stenungsund; most of the country's automobile industry; forest and pulp companies that are going for new material products; Sweden's only gas grid with a growing proportion of biogas, which is going to be connected with one of the world's first large-scale plants for thermal gasification of biomass (GoBiGas); the larger industrial ports; a well-developed district heating system, etc.*

## THE REGION'S STRENGTH IN TACKLING GLOBAL CHALLENGES

**THE ACADEMIA AND** the public and private sectors cooperate in an already established chemical industry cluster through the participation of Region Västra Götaland (VGR), Business Region Göteborg (BRG), the cities of Stenungsund and Lysekil, Invest Sweden, AkzoNobel, Borealis, Ineos, Göteborg Energi, Hogia, Perstorp, Preem, Swedegas, Chalmers University of Technology, and SP Technical Research Institute of Sweden.

**THE ACTORS IN** the chemical industry cluster have focused on issues linked to infrastructure, technological development, and knowledge creation. Some examples are expansion and secured supply to the regional gas grid, expansion of the district heating system with waste heat from industry, and the creation of the Swedish knowledge center for renewable transportation fuels, f3, which is coordinated by Chalmers Industriteknik.

**ONE INTERESTING AND** important initiative within the chemical and materials sector, originating in the chemical industry cluster, is the vision "Hållbar Kemi 2030" (Sustainable Chemistry 2030), where the chemical companies in the city of Stenungsund, Sweden's largest chemistry and materials cluster, have developed a joint ambition to work toward a fossil-independent West Sweden by 2030. Their vision is to have Stenungsund be the center of production of sustainable products in the chemical industry, with all processes being based on renewable resources and energy, and thus contribute to a sustainable world.

**THE VISION HAS** led to an action plan supported by five chemical companies: Aga, AkzoNobel, Borealis, Ineos, and Perstorp. The action plan lists four focus areas:

- Renewable resources to be introduced into the system
- Production of renewable chemical and material products
- Production of renewable automotive fuels
- Resource and energy efficiency including recycling of waste heat

**SEVERAL SMALL STEPS** have already been taken in the direction of the vision, yet the major steps will rely on the development of two production processes: gasification and fermentation. Both can be based on waste, forest products, and crops as resources, in order to produce biogas/green syngas, or bioethanol. Once these products become available "at the plant fence," the chemical companies in Stenungsund will be able to utilize their industrial structure and comple-

**UNIQUE INITIATIVES CONCERNING** *sustainable development have been taken within the framework of the cluster. Perstorp and Preem, together with partners, have invested a total of 1.3 billion SEK in the production of biodiesel. Borealis has invested 4 billion SEK in polyethylene as high-voltage cable insulation. GoBiGas project, production of biomethane for the gas grid, where Göteborg Energi and E.ON are jointly investing up to over 1 billion SEK to complete the project by 2013. AkzoNobel and Perstorp have developed and introduced several new bio-based chemical products with a wide range of applications that affect people in their everyday life, such as environmentally-friendly hygiene products, softeners, paint products, and cleaners and detergents.*



menting investments to produce renewable chemical and material products for sustainable applications.

**THE PROCESS OF** making gasification and fermentation of bioresources commercially viable in the production of renewable products is going to require substantial research and technological development. A large research project carried out jointly by Göteborg Energi and Chalmers University of Technology is exploring technical designs of indirect gasification for green syngas production as well as integration aspects concerning the new plant GoBiGas and the existing systems. This includes, not least, resource logistics and energy integration. The project is also addressing issues related to regional infrastructure, where the societal actors are very important in the long-term planning of a sustainable energy system.

**WITH AN EXPANDED** gasification capacity and an increased production of biogas, the chemical companies in Stenungsund will be ready to make the transition to bio-based chemical and material products today. With better developed processes for fermentation of cellulose to ethanol, the chemical companies in Stenungsund will be able to produce bioethylene. The bioethylene can be refined into biopolyethylene and bio-PVC, for which there is already a demand in the global biomaterials market, such as in the packaging industry, in the building sector, and in healthcare.

## The west coast cluster – part of a network without boundaries

**THE CHEMICAL COMPANIES** are ready to invest in developing bio-based materials such as softeners and additives to be used in for example paints and plastic products. They also have their minds set on refining bioethanol and biogas into biopolyethylene, biobutanol, and bio-jet fuel. Preem and Chalmers University of Technology are currently studying how to produce green hydrogen gas from biomass for the

*»...a joint ambition to work toward a fossil-independent West Sweden by 2030.«*

dehydration of automotive fuels. The alternative is to produce entirely green fuel from biomass. Various possibilities to produce renewable materials and products based on biomass are also studied. Commercially viable results will require extensive cooperation between not only the chemical companies and academia, but also with customers in the automotive, textile, pharmaceutical, and packaging industries and with engineering companies, resource suppliers, and public and political actors. The latter group is included since a number of policy considerations and technological development issues have to be addressed in order to create a potential in the home market and hence become the important reference that the companies need in order to grow in the long term.

**AN INTERESTING DEVELOPMENT** toward green chemical and material products can be found in the Swedish forest and paper industry as well. Synergies between the chemical industry's experiences and knowledge concerning chemical products on the one hand and the forest industry's resources and material products on the other may become crucial to the development of the sustainable materials and products of tomorrow.

**RECYCLING IS AN** area with a large impact on the flows of materials. There are many good examples in West Sweden where the waste management companies Renova and Stena Recycling are leading the development. Waste can be used as a bioresource in gasification and fermentation and in the recycling of polymeric materials.

**THE COOPERATION BETWEEN** academia and the public and private sectors is an important part of the knowledge cluster in West Sweden. In addition to the already mentioned collaborations between Chalmers University of Technology and the private sector, joint efforts are currently in progress,

for example within the framework of Chalmers' strategic program Chalmers Energy Initiative (new processes linked to biomass-based resources and products) and at the Wallenberg Wood Science Centre (a research center for new materials from forest resources, jointly operated with the Royal Institute of Technology in Stockholm).

**WEST SWEDEN IS** also home to a strong research institute sector through the Technical Research Institute of Sweden (SP) and the Swedish Environmental Research Institute (IVL). SP is for example running a competence center that deals with the production of biofuels and the prospects for industrial use of bioresources, and the Swedish Institute for Food and Biotechnology (SIK) has a competence center for the development of protective coatings used to make food products more durable.

**THE OTHER CLUSTERS** in West Sweden are dependent on the products of the green chemistry in order to successfully

respond to the challenges ahead. Renewable automotive fuels and components for sustainable transportation, waste heat for district heating/cooling, building materials in sustainable cities and renewable products for sustainable hospitals are some of the products that tie the clusters in West Sweden together.

**ONE IMPORTANT AND** very demanding task will be to develop the cooperation within and between the involved companies, and with academia and society at large, based on already existing cluster collaborations and the defined visions. This task will be crucial for a successful transition to a more sustainable production of chemical and material products, automotive fuels, and power/heating and for more efficient resource management. A sustainable transition is vitally important for both West Sweden and the country as a whole, and it is also expected to be an important factor in the efforts to attract further innovation and investments. «

## Some of the organizations that strengthen this cluster

### Business and industry actors

Borealis - Polyethylene products.  
Ineos - PVC for, for example, construction applications.  
Aga - Industrial gases in the chemical industry.  
Perstorp - Renewable specialized chemical products and biodiesel (RME).  
Akzo Nobel - Renewable specialized chemical products.  
Preem - Manufacturer of automotive fuels such as biodiesel.  
Swedegas - Owns and operates the country's only gas grid with a growing proportion of biogas.  
Hogja - IT services for sustainable trucking logistics.  
Södra - Refines forest resources into advanced chemical and material products.  
SCA - Advanced products within hygiene, care and medicine.  
Holmen - High marginal products based on forest resources.  
AstraZeneca - Pharmaceuticals.  
Stora Enso - Product applications for printing and packaging.  
Stena Recycling - Develops, recycles, and refines waste to maximize profits and benefits.  
Renova - Recycles and refines waste.  
Göteborg Energi - Distributes waste heat and is building a commercial plant for gasification of biomass.  
Svensk Fordonsindustri - Energy efficient and sustainable transportation solutions.

### Centers of expertise and research

f3 - National research center for renewable transportation fuels.  
Wallenberg Wood Science Center - A research center with a focus on new materials from trees.  
SOFT - Research on soft materials.  
SuMo Biomaterials - Competence center for the development of new knowledge on biomaterials.

### Public actors in West Sweden

Region Västra Götaland (VGR)  
Business Region Göteborg (BRG)  
Invest Sweden

### Research and development

Chalmers University of Technology - Profile areas Energy, Materials Science, Transportation)  
SP - The Technical Research Institute of Sweden (Biofuels, Systems Analysis)  
University of Borås  
SIK - The Swedish Institute for Food and Biotechnology  
IVL - The Swedish Environmental Research Institute



# Life Science

**The field of life science covers a large number of challenges from the regional to the global level, including possible solutions. There is a focus on health and healthcare, and problems for example related to an aging population, antibiotic resistance, and pandemics.**

**NEW CHALLENGES SUCH** as new diseases that may arise due to climate change are addressed as well. The sustainability perspective is a great challenge within life science. Sustainable growth is not possible without a healthy population. Tomorrow's health care sector will have to respond to increased demands for quality, accessibility, cost-efficiency, and personalized care. There will also be a need for new treatments in order to deal with major diseases such as heart attack, stroke, cancer, obesity and diabetes.

**WEST SWEDEN IS HOME** to one of Europe's largest university hospitals, to cutting-edge research in biomedicine and the natural sciences, to a strong research-based biomaterials industry, to a "mega-site" within global pharmaceutical development, and the list goes on. The close link between the Sahlgrenska University Hospital, the University of Gothenburg through the Sahlgrenska Academy, and Chalmers University of Technology is another strength of the region. Professor Arvid Carlsson at the University of Gothenburg won the Nobel Prize in 2000 for his discoveries concerning

neurotransmitters such as dopamine and serotonin. His findings for example led to the realization that Parkinson's disease is caused by a lack of dopamine in some parts of the brain.

**THE CHALLENGES IN** life science can be successfully met when these resources come together. The region's public actors have expressed a clear emphasis on life science for example by commissioning former Prime Minister Ingvar Carlsson to assess what needs to and can be done to develop the life science sector.

*»The challenges in life science can be successfully met when these resources come together.«*

## THE REGION'S STRENGTH IN TACKLING GLOBAL CHALLENGES

**WEST SWEDEN'S EFFECTIVE** cooperation between academia and the public and private sectors makes it possible to respond to the global challenges facing the field of life science.

### Pharmaceutical development

**HAS HISTORICALLY BEEN** a successful part of life science in the Gothenburg region. The heart medicine Seloken and the ulcer best-seller Losec were developed in Gothenburg by the pharmaceutical company AstraZeneca (Hässle at the time) and researchers at the Sahlgrenska University Hospital. AstraZeneca's plant in Mölndal outside Gothenburg is one of the company's three "mega-sites" with the whole chain from early research to clinical development. There are only about 40 pharmaceutical centers of this caliber in the world. There are several smaller companies in the region as well, for example Abigo and Albireo. Then there are spin-off companies that focus on new pharmaceutical candidates, for example from the marine environment. Regardless of size, all of these companies depend on close contacts with clinical research.

### Medical technology

**SAVES LIVES AND** gives people a higher quality of life. The field covers a wide range of products, for example X-ray technology, minimally invasive surgery, surgery simulators, medication management, dialysis, functional aids and disposable products such as latex gloves. The role of medical technology in healthcare is immensely important, and there are currently more than 500,000 different technologies available. West Sweden is strong in the medical technology sector. There are several world-leading companies in the region, especially in the field of implants and biomaterials, including Astra Tech, Nobel Biocare, and Candlear. Other successful companies in the sector include Mölnlycke Healthcare, the Getinge Group and SCA. There are also companies that work in the area that combines medical technology and biotechnology, such as Vitrolife and Cellartis. Some of the companies' manufacturing is also located in the region.

*THE UNIQUE COOPERATIVE environment in the region is based on a close partnership between Chalmers University of Technology and the University of Gothenburg regarding for example signal processing, mathematical modeling, and IT, important areas when designing tomorrow's healthcare. It is also crucial for major initiatives in the field, such as the new ultramodern imaging and intervention center that is being built in Gothenburg.*

**CARMEL PHARMA IS A** medical technology company that has received a great deal of attention lately. In 2011 the company received the Swedish Trade Council's Grand Export Award (Stora Exportpriset) for its export success with a closed-system drug transfer device for safe handling of hazardous drugs.



*MILLIONS OF PEOPLE suffer from loosening, or even loss, of teeth as a result of diseases such as dental caries and periodontitis. Thanks to Professor Per-Ingvar Brånemark from the University of Gothenburg and his discovery in the 1950s that titanium interacts with bone, dentists around the world are now able to offer patients well-documented, permanent replacement of lost teeth. Brånemark's discovery is the reason why world-leading companies such as Astra Tech and Nobel Biocare can be found in the region. The method has spread around the world and has increased the quality of life for millions.*

**THE SECTOR IS FULL** of other promising innovations and companies as well. One example is Medfield Diagnostics, which develops and markets an instrument for quick diagnosis of stroke victims. The innovation is based on microwave technology and is a result of a cross-disciplinary project at Chalmers University of Technology. Medfield is one of the so-called incubator companies at the Sahlgrenska Science Park.

**THE COLLABORATION BETWEEN** academia and the private sector has continued, and today the region is also a world-leader when it comes to bone-anchored hearing aids through the company Candlear and the anchoring of arm and leg prostheses through the company Integrum. The research on cell therapy at the University of Gothenburg formed the foundation of the company Cellartis, which has become world-leading in the development products and technologies for pharmaceutical development and regenerative medicine based on stem cells.

*HEALTHCARE PROFESSIONALS MAY possess all kinds of specialized knowledge and skills, yet in the end only the patient truly knows what it feels like to be ill. The University of Gothenburg Centre for Person-Centred Care emphasizes the importance of viewing the patient as a fellow human being who should actively participate in his or her own care.*

**THE CENTER IS** a national center of excellence within care science, although researchers from several other disciplines work there as well. The center's research shows that personalized care can, in some cases, reduce the number of hospital days by 50%, and is thus not just something you do to make the patient feel good.

## Diseases linked to metabolism

**SUCH AS OBESITY** and diabetes, are a growing problem. Besides the complex connection between genetics and lifestyle, it has been found that a person's intestinal flora is an important factor as well. The partnership between the Sahlgrenska Academy and Chalmers University of Technology has yielded revolutionary research where test material from clinical research is combined with mathematical modeling and experimental verification.

## The clinical research

**WHICH IS THE** step from idea to practical application, is the most critical phase when developing new medicines and treatments. Doing it in a way that benefits both patients, healthcare, research, and industry is a success factor.

**IN WEST SWEDEN**, a coordinated effort in clinical research is being made through Gothia Forum, which has received both national and international attention as a successful model for cooperation. Gothia Forum serves as a meeting place for researchers and businesses, regardless of size, in the life science sector. They can contact the Forum regarding information about, and access to, all of the region's available research resources. Gothia Forum can help with anything from large clinical studies to testing, research projects and quality trainings, and was formed through a unique collaboration among the pharmaceutical industry, Chalmers University of Technology, the Sahlgrenska Academy, the Sahlgrenska University Hospital, and Region Västra Götaland (VGR). The region also has a special registry competence center, Registercentrum, which can help create new quality



registries for quality assessments and improvements of healthcare.

## The regional innovation systems

**WITHIN BIOMEDICINE AND** health in West Sweden focuses on increasing the flow of ideas and improving the chances of attracting funding in the early phases. This is accomplished for example through training in entrepreneurship, incubators, seed funding and strong environments for research and innovation. The system includes collaboration between actors of the public sector, such as Region Västra Götaland (VGR) and Business Region Göteborg (BRG), and academia and the private sector.

**THE FUTURE DEVELOPMENTS** in life science will concern so much more than biomedicine. For example the companies

**PHARMACEUTICAL DEVELOPMENT, BIOMATERIALS, biotechnology and medical technology are R&D-intensive and expansive. The region's life science industry comprises around 170 companies with more than 5,600 employees. The latest report from VINNOVA shows that life science companies in West Sweden employ about 17 % of all employees in the sector nationally, and they contribute nearly 24% of the total income.**

in the chemical and chemical engineering industry that are located along the Lysekil-Stenungsund-Gothenburg route are of particular interest. The food industry is also moving in the direction of more complex products and a stronger link to life science research. «

## Some of the organizations that strengthen this cluster

### Gothia Forum

A meeting place for researchers and companies in the life science sector. Offers support in connection with for example large clinical studies, testing, research projects, and quality trainings.

### Chalmers University of Technology

Has several strong areas within life science.

### Sahlgrenska Science Park

The region's business incubator. Helps innovators and new companies launch new business ideas within life science. In addition, the park offers laboratories and offices to businesses in the sector.

### Gothenburg BIO

A joint project between academia, business and industry, and public actors aimed to facilitate growth in the life science sector.

### Region Västra Götaland

In charge of health care, culture, growth and sustainable development in West Sweden. Cooperates with academia and the public and private sectors.

### University of Gothenburg

The Sahlgrenska Academy, which is the faculty of health sciences at the University of Gothenburg, comprises several strong areas in life science as well as a holding company that manages life science innovations.

### GIBBS

Gothenburg International Bioscience Business School is an entrepreneurship school at the master's level for tomorrow's entrepreneurs and business leaders in life science.

### Business and industry

Companies established in the region, such as AstraZeneca, Astra Tech, Nobel Biocare, Mölnlycke Healthcare, Getinge, Cellartis, Vitrolife, and SCA.

### SP

SP Technical Research Institute of Sweden with expertise in medical technology and innovation development.

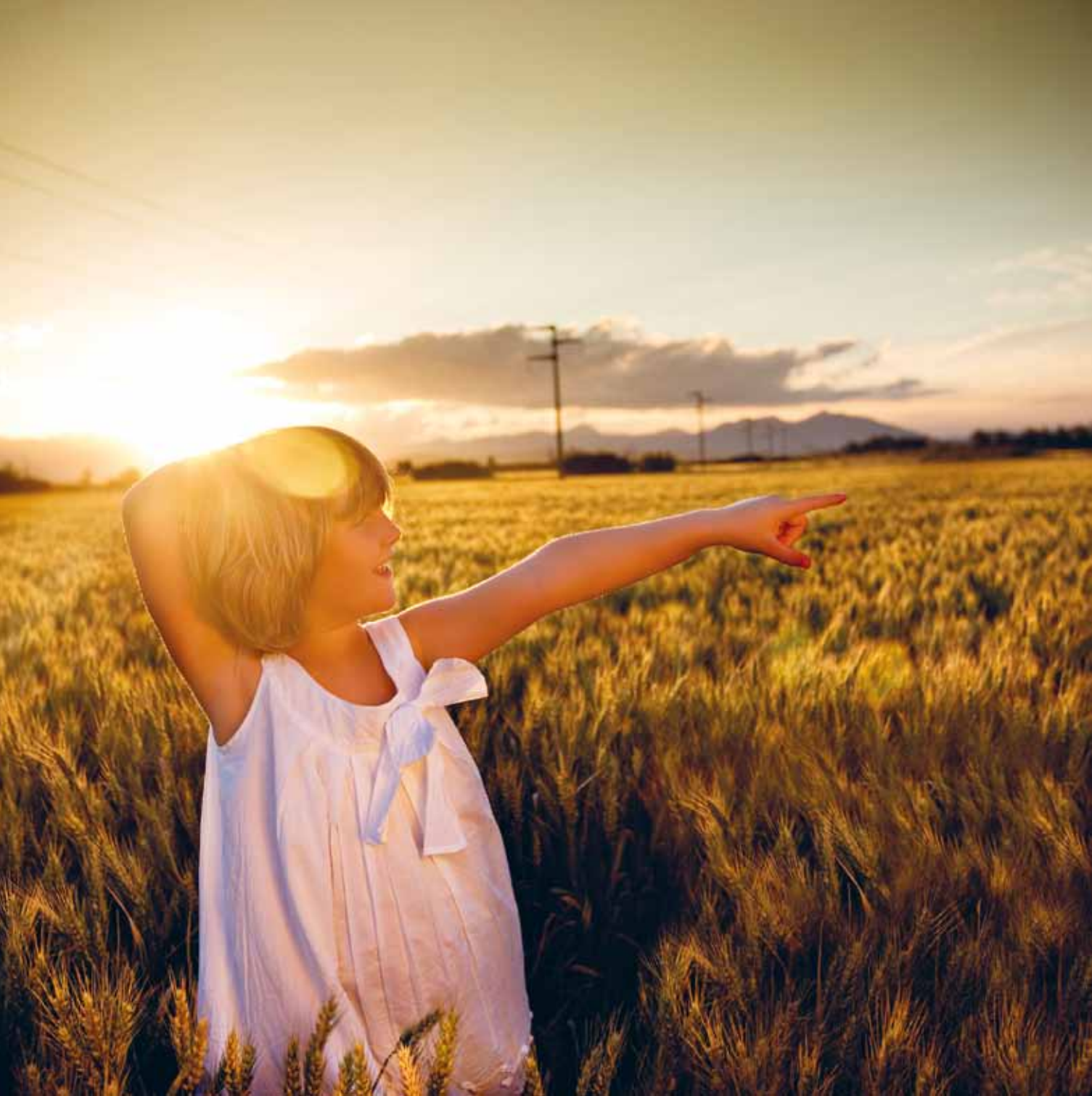
### Sahlgrenska University Hospital

One of the largest hospitals in northern Europe. It is nationally commissioned in certain areas and is widely recognized for its outstanding clinical research.

### Business Region Göteborg

Promotes growth and employment opportunities in the Gothenburg Region. Helps both existing and new companies with their ambitions to grow.





Everybody is invited to join the exciting ride that will take Gothenburg and West Sweden into the future. Welcome onboard!



**CHALMERS**



**Göteborgs  
Stad**



**GÖTEBORGS UNIVERSITET**



**VÄSTRA  
GÖTALANDSREGIONEN**



**VÄSTSVENSKA  
HANDELSKAMMAREN**